Super Science Connections: Fizzy or Not Fizzy?

What happens when solid materials and water are mixed?

This activity is intended for children entering grades K-4 in the next school year. To carry it out safely there must be a responsible older person to prepare materials, read directions aloud, and supervise the activity. This could be a parent, guardian, or older sibling. The supervisor should do the preparation steps and consult the science background information that is located on Page 4. Page 3 provides prompts and a place to write predictions and observations from the activity.

Materials

- As many as possible of these solid materials including at least one of the first two:
  - 1 seltzer antacid tablet (a brand name is Alka-Seltzer™, but there are other brands that behave similarly).
  - ½ teaspoon baking powder.
  - ½ teaspoon sugar.
  - ½ teaspoon salt.
  - ½ teaspoon baking soda
- Clear containers (a clear plastic cup is ideal), one for each solid material available.
- ¼ cup (60 mL) water for each container; hot tap water works better than cold.
- Spoon or something else to use as a stirrer.

Preparation

- For each of the solid materials you have available, you need to prepare one clear container with ¼ cup hot tap water in it.

This activity is courtesy of ICE, the Institute for Chemical Education at UW-Madison's Chemistry Department. It is adapted for use at home from Fizzing I in the Super Science Connections Section 3: Pressure activities offered by ICE at this link:
http://ice.chem.wisc.edu/sites/ice.chem.wisc.edu/files/images/Publications/SSC/SSC_Pressure.pdf

- Before beginning, make a copy of the worksheet on page 3.
- Tell participants the goal is to observe what happens when solids (whichever of the five solid materials you have available) are mixed with water. Observations include whether the solid eventually disappears, whether there is any bubbling (effervescence), and anything else they notice.

Directions

1. On the worksheet from page 3, write the name of each solid material that will be mixed with water.
2. Add each of the solid materials to a separate clear container of hot water. You can do this with all containers at nearly the same time or you can do it one container at a time. Think about which procedure would allow better observations.

3. Observe what happens when each solid is added to water. Write observations on the worksheet next to the name of the solid material.
4. After about a minute, stir each mixture with a spoon or other stirrer. Repeat at one-minute intervals until nothing further appears to happen. Record all observations.
5. Here are some questions to prompt observations:
    a. What do you see?
    b. What happened to the pieces of the solid?
    c. Is the water different from before you added the solid? How can you tell?
    d. What does the mixture look like after nothing further is happening?
    e. Can you think of other things that fizz when mixed?

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This is what we mixed.

This is what happened...

This is what we learned...

Names of the scientists:

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Science Background

Here are observations related to the suggested questions for each solid.

- **Salt** consists of tiny grains or crystals. When mixed with water, salt crystals disappear after a short time. A scientist would say that salt dissolves in the water. You can tell that the salt is still in the water by tasting a tiny bit of the mixture. It should be salty.
- **Sugar** consists of tiny grains or a fine powder. When mixed with water, sugar disappears after a short time. A scientist would say that sugar dissolves in water. You can tell that the sugar is still in the water because the water tastes sweet.
- **Seltzer** consists of a solid tablet that sinks to the bottom of the water. Seltzer produces bubbles that rise to the surface of the water. The tablet disappears after a while but takes longer to dissolve than the sugar or salt.
- **Baking powder** is a powdered solid—very finely divided. When added to water, some of it stays on the surface. Bubbles form around the solid powder. Not all of the baking powder dissolves. Some solid remains on the bottom of the container for a long time.
- **Baking soda** is a powdered solid—not quite as finely divided as baking powder. When added to water baking soda does not form bubbles but eventually it all dissolves.

Some other things that fizz when mixed are baking soda added to citrus juice or vinegar, and Mentos added to diet Coke. Baking soda is sodium bicarbonate, an ingredient of both seltzer tablets and baking powder. If baking soda is available, children can try mixing it with citrus juice (which contains citric acid) or vinegar (which contains acetic acid). Acid mixed with a bicarbonate produces carbon dioxide gas (CO_2).

Many solid substances can be ground to form powders or small grains. Because the powders or grains have more surface area than a single block or tablet of the same material, powders usually dissolve or react faster than the same quantity of material in a single block.

The solid seltzer tablet has two ingredients. They do not react with each other when they are solids. However, both ingredients dissolve in water and when they do, there is a chemical reaction between them that produces a gas. One of the ingredients is sodium bicarbonate and the other is citric acid. From the reaction the gas carbon

dioxide (CO_2) is produced. The gas is what causes the fizzing. Another substance that is formed in the reaction is sodium citrate, which reacts with acid in the stomach and is the reason the seltzer tablet soothes indigestion.

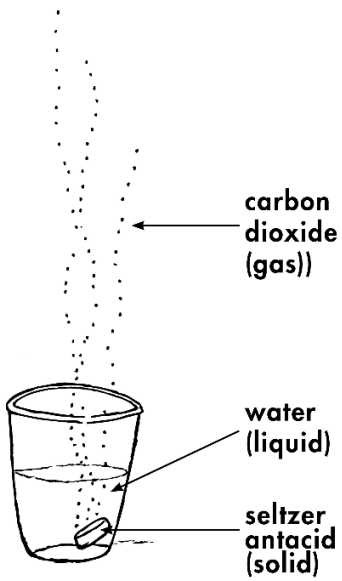
Baking powder is similar to the seltzer tablet in having two ingredients: one is sodium bicarbonate and the other is an acidic phosphate. Some of the acidic phosphate dissolves in water, but not all of it. The ingredients react chemically when both dissolve in water, but in the solid they do not react. The gas produced by the reaction is carbon dioxide (CO_2). Baking powder is used to make baked goods expand. The carbon dioxide gas that you saw escaping from the water is trapped within the dough or batter, making bubbles that expand the dough. When bread or cake is baked the dough or batter solidifies, trapping the carbon dioxide permanently and making the cake or bread light.

There is no pressure build-up in this experiment because the gas is not trapped. The gas escapes from the liquid into the air, but you can see by the bubbles that gas is produced by the reaction. If the gas were trapped, could not expand, and could not escape, producing more gas would increase gas pressure.

Two of the solid materials in this activity illustrate chemical reactions. In the activity, the reaction can be recognized because a new substance, the gas, is produced from two other substances, the solid and liquid that were present initially. Other ways to tell that a chemical reaction has occurred include formation of two new substances from a single initial substance, a significant change in temperature, and changes of color.

Dissolving salt or sugar does not involve a chemical reaction because the salt and sugar are still there (which you can verify by taste) but are now mixed with the water. If you let all the water evaporate, the salt and sugar will remain behind as solids.

You can also use this activity to discuss the *solid*, *liquid*, and *gas* states of matter. The solid materials dissolve in liquid water. Some of them react chemically to produce the gas carbon dioxide (CO_2). In the case of the seltzer tablet, the **solid seltzer tablet** reacts with **liquid water** to produce the **gas carbon dioxide**.



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