

Sugar versus Salt

Sugar and salt look almost alike. However, we all know that they taste very different. They are different in other ways, too. In this activity you will discover one of these ways.

Materials

- 1 $\frac{1}{2}$ teaspoons red food color
- water
- measuring cup
- measuring spoons
- 3 tablespoons vinegar
- timer or clock
- several plastic spoons
- 2 teaspoons table salt
- 2 teaspoons sugar
- bowl
- masking tape
- pencil
- paper towels
- 3 plastic cups
- 3 eggs, hard-boiled or raw (raw eggs can be blown out and the shells kept indefinitely)
- (optional) rubber gloves to protect hands from dye

Safety

Do not eat any of the eggs used in this experiment.

Exploration

- Step 1 Place 1/2 teaspoon red food color into each of the 3 cups. Add 1 tablespoon vinegar and 1/2 cup water to each cup and stir.
- Step 2 Add 2 teaspoons table salt to one of the cups and stir. Label the cup “salt.”
- Step 3 Add 2 teaspoons sugar to one of the other cups and stir. Label the cup “sugar.”
- Step 4 Label the third cup “control.”
- Step 5 With the pencil, label one eggshell “salt,” another eggshell “sugar,” and the third eggshell “control.”
- Step 6 Place each eggshell into the appropriate cup. Leave the eggshells in the cups for exactly ten minutes. (Use a clock or timer.)
- Step 7 Remove the eggshells, dip each one in a bowl of clear water 5 times to rinse, and place on a paper towel (or in an egg carton) to dry. What effect does the table salt or sugar seem to have on the intensity of the color?

Challenge

Does either table salt or sugar affect the dyeing of eggshells; if so, why?

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Concepts

ionic and covalent compounds

Expected Student Responses to Exploration

Step 7 (a) The intensity of the color decreases when table salt is added.

(b) The intensity of the color is not affected by the addition of sugar.

Expected Student Answer to Challenge

Table salt affects the dyeing of eggs; table sugar does not.

Table salt is an ionic compound and dissociates into sodium ions and chloride ions in solution. Clearly, one or both of the ions interfere with the dye particles attaching to the egg shell. (The negative chloride ions are attracted to the positively-charged protonated amine groups in the protein of the eggshell cuticle. Therefore, there are fewer of these positively-charged groups to be attracted to the negatively-charged dye particles and the eggs are less intensely colored.)

Sugar is a covalent compound and does not form ions in solution. Therefore, there are no ions to interfere with the dye particles attaching to the egg shell.

Reference

A.M. Sarquis, J. Sarquis, *Fun with Chemistry: A Guidebook of K-12 Chemistry Activities*, Institute for Chemical Education, University of Wisconsin, 1993, Volume 2.

Acknowledgment

This activity was developed as a part of the NSF-funded “General Chemistry: Discovery-Based Advances for the Two-Year College Chemistry Curriculum” project, grant #DUE-9354378.