

Activity 5.4

Change in temperature—Endothermic reaction

Aside from bubbling, what else happens during a reaction between baking soda and vinegar?

In each of the previous activities, students observed bubbling and learned that this was evidence that a chemical change occurred. In this activity, students will observe another aspect of the reaction between baking soda and vinegar. Along with bubbling, students will see that the temperature decreases. A change in temperature is another clue that a chemical reaction has occurred. A reaction that results in a decrease in temperature is called an *endothermic* reaction.

Materials needed for each group

Baking soda	½ Teaspoon
Vinegar	1 Clear plastic cup
Thermometer	2 Small cups

Notes about the materials

- Be sure you and the students wear properly fitting goggles.
- The bulb of the thermometer needs to be completely submerged in the vinegar in order to get an accurate reading. Due to the small amount of vinegar suggested in the procedure, you may need to have students tilt their cups of vinegar so that the bulb of the thermometer is completely submerged. If your thermometers have a plastic backing, you may be able to “lower the bulb” by clipping the plastic backing so that it is even with the bottom of the bulb.

Preparing materials

- Label 2 small cups **vinegar** and **baking soda**.
- Place about 1 tablespoon of vinegar and about 1 teaspoon of baking soda in their labeled cups.
Note: If you plan to do *Activity 5.5* immediately after *Activity 5.4*, increase the amounts to 4 tablespoons (¼ cup) vinegar and 1 tablespoon baking soda. These source cups can then be used for both activities.

Activity sheet



Copy *Activity sheet 5.4—Change in temperature: Endothermic reaction*, p. 276, and distribute one per student when specified in the activity.

Assessment

An assessment rubric for evaluating student progress during this activity is on pp. 305–307. For this formative assessment, check a box beside each aspect of the activity to indicate the level of student progress. Evaluate overall progress for the activity by circling either “Good”, “Satisfactory”, or “Needs Improvement”.

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Change in temperature—Endothermic reaction

Question to investigate

Aside from bubbling, what else happens during a reaction between baking soda and vinegar?

1. Have students measure the change in temperature in the reaction between baking soda and vinegar.

Decide in advance whether you will have students use the Fahrenheit or Celsius scale. Review with students how to read a thermometer. Explain that the bulb of the thermometer should be submerged during the reaction and when students are reading the thermometer.



Distribute *Activity sheet 5.4—Change in temperature—Endothermic reaction*.

Use the activity sheet to help explain how to use a graduated cylinder to measure liquids before students begin the activity.

Procedure

1. Use a graduated cylinder to measure 10 ml of vinegar and pour it into a clear plastic cup.



2. Place a thermometer in the vinegar. Read the thermometer and record the temperature on the activity sheet.
3. While the thermometer is in the cup, add $\frac{1}{2}$ teaspoon of baking soda.
4. Watch the thermometer to observe any change in temperature. Record the lowest temperature reached.



Expected results: If you begin with room-temperature vinegar, the temperature will drop about 12°F or about 7°C . There is also a gas produced.

2. Have students share their observations.

Ask student groups whether the temperature increased, decreased, or stayed the same during this reaction. Then have them share the lowest temperature reached during the reaction. There will likely be some variation.

Explain to students that a change in temperature is a sign that a chemical reaction has occurred. Introduce the term *endothermic* to describe a reaction in which the temperature decreases.

Remind students that in chemical reactions, new substances are formed. Ask students if they observed anything that might be considered a new substance. Students should recognize the bubbles of carbon dioxide gas (introduced in *Activity 5.1*) as a new substance.