

Activity 5.1

Powder particulars

How can you use the characteristic ways substances react to tell similar-looking substances apart?

In the introductory activity and demonstration, students will be introduced to the concept that different substances react chemically in characteristic ways. First they will compare the way baking soda and baking powder react with vinegar. Then they will see dramatic color changes when red cabbage indicator is added to cream of tartar and laundry detergent. Seeing some of the ways similar-looking powders react with different test liquids will lay the foundation for *Activity 5.2*.

Materials needed for each group

Baking soda
Baking powder
Vinegar
4 Small cups

Materials needed for the demonstration

Red cabbage leaves
Cream of tartar
Powdered laundry detergent
Water
Zip-closing plastic bag (quart-size, storage-grade)
3 Clear plastic cups
 $\frac{1}{8}$ Teaspoon

Notes about the materials

- **Be sure you and the students wear properly fitting goggles.**
- Purchase one fresh head of red cabbage; pre-shredded red cabbage will not work. This red cabbage will be used to make indicator solution for *Activities 5.1, 5.2, 5.7, 5.8, and 5.9*. Refrigerate the cabbage so that it will stay fresh.

Preparing materials for the activity

- Label 2 small cups **vinegar**, 1 small cup **baking soda** and 1 other small cup **baking powder** for each group.
- Pour 1 teaspoon of vinegar into each of its labeled cups.
- Place $\frac{1}{2}$ teaspoon of baking soda and $\frac{1}{2}$ teaspoon of baking powder in their labeled cups.

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Preparing materials for the demonstration

- Tear 2 red cabbage leaves into small pieces and place them in a storage-grade zip-closing plastic bag.
- Add about 1 cup of room-temperature water. Get as much air out of the bag as possible and seal the bag securely.
- While holding the bag, repeatedly squeeze the water and cabbage leaves until the water turns a medium to dark blue.
- Open a corner of the bag and carefully pour the red cabbage indicator into an empty clear plastic cup, leaving the cabbage pieces behind in the bag.
- Place about $\frac{1}{8}$ teaspoon of cream of tartar in one empty clear plastic cup and about $\frac{1}{8}$ teaspoon of laundry detergent in another. Do not reveal the identity of these powders to your students until the end of the activity.



Activity sheet



Copy *Activity sheet 5.1—Powder particulars*, pp. 258–259, 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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Question to investigate

How can you use the characteristic ways substances react to tell similar-looking substances apart?

Take a closer look

1. Have students read the introductory story on *Activity sheet 5.1* and compare the way baking soda and baking powder react with vinegar.



Distribute *Activity sheet 5.1—Powder particulars*. As students read the introductory story, distribute the baking soda, baking powder, and cups of vinegar. Then, have students follow the procedure to see if they can figure out which clues the student in the story used to correctly identify baking powder and baking soda.

Can you use vinegar to tell baking soda and baking powder apart?

Procedure

1. Look closely at the samples of baking soda and baking powder that your teacher gave you. How are these powders similar and different?
2. With the help of your lab partner, pour all of the vinegar from each cup directly onto the baking soda and baking powder at the same time.
3. Observe until you think both reactions are over.
4. Record your observations on the activity sheet.

Expected results: Both powders bubble when vinegar is added. Baking soda bubbles more vigorously at first, but baking powder bubbles for a longer period of time.



2. Discuss students' observations.

Ask students questions such as the following:

- Could you tell baking soda and baking powder apart just by looking at them?
- What differences did you observe when baking soda and baking powder were reacting with vinegar?
- Do you think you could tell baking soda and baking powder apart by comparing the way each reacts with vinegar?

Students may notice slight differences in the appearance of baking soda and baking powder. Baking powder may seem whiter, while baking powder may seem slightly yellow. Students should agree that adding vinegar reveals a more obvious difference between the two powders.

Tell students that the bubbles they observed in each cup were made of carbon dioxide gas. This new substance was created during the reactions. When two or more substances combine and make new a substance, it is called a *chemical reaction*. The difference in the way each powder reacted with vinegar shows that there is a chemical difference between the two powders. Bubbling, or *production of a gas*, is evidence that a chemical reaction has occurred.

Watch this!

3. Do a demonstration with red cabbage indicator to show students that the similar-looking powders are different.

Before beginning this demonstration you will need to have prepared red cabbage indicator along with two clear plastic cups containing cream of tartar and powdered laundry detergent. Instructions are on p. 254. Do not reveal the identity of these powders yet.

Hold up both cups of powders and tell students that the powders in the cups may look alike, but this does not necessarily mean that they are the same. Explain that you will use red cabbage indicator to see if the powders are the same or different.

Procedure

1. While students are watching, pour about $\frac{1}{3}$ of the cabbage juice indicator into the cup with the cream of tartar and swirl.
2. Pour about $\frac{1}{3}$ of the indicator into the cup with the laundry detergent and swirl. Leave about $\frac{1}{3}$ of the indicator in the cup as a control.
3. Have students write how they know that these similar-looking powders are different on the activity sheet.



Expected results: The cream of tartar turns the blue cabbage juice pink and the laundry detergent turns it green.

4. Discuss the results of the demonstration.

Ask students:

- How do you know that the two white powders in the bottom of each cup at the start of the demonstration were different?

Reveal the identities of the two powders to students. Explain to students that the blue liquid you used in the demonstration comes from a red cabbage. Red cabbage has a special chemical in it which gives the leaves a purple color. This chemical changes color when it reacts with certain types of substances. A change in color, like the production of a gas, is evidence that a chemical reaction has occurred. Tell students that they will experiment with the amazing color-changing property of red cabbage juice in future activities in this investigation (*Activities 5.2, 5.7, 5.8, and 5.9*).

What's next?

5. Review the definition of a chemical reaction and introduce the signs that a chemical reaction has occurred.

Tell students that test liquids like vinegar and red cabbage indicator can be used to tell similar-looking powders apart. The differences they saw in each reaction were evidence that the powders were made of different chemicals.

Explain that in the following activity, students will compare the way baking soda, baking powder, and other similar-looking powders react with vinegar, red cabbage indicator, water, and iodine solution. Since each powder has a characteristic set of reactions with the test liquids, the reactions can be used to correctly identify an *unknown* powder.