

5th Grade - Lesson 3.2

Exploring Baking Powder

Objective

Students will be able to plan and carry out an investigation to identify which two of the three ingredients in baking powder react to produce a gas when water is added. Students will be able to explain that mixing substances can cause a chemical reaction that results in the formation of a new substance. Students will also be able to explain that substances react in characteristic ways and that the way a substance reacts can be used to identify the substance.

Key Concepts

- Mixing substances can result in a chemical reaction that produces new substances.
- Substances have characteristic chemical reactions that can be used to identify them.
- Designing a fair test to study chemical reactions requires keeping all variables the same except for the one you want to know about.

NGSS Alignment

- **NGSS 5-PS1-3**
Make observations and measurements to identify materials based on their properties.
- **NGSS 5-PS1-4**
Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Summary

- In a demonstration, students see that baking powder reacts with water to produce a gas but baking soda does not.
- Students are told that baking powder is a mixture of three ingredients (baking soda, cream of tartar, and cornstarch) and that two of these ingredients react to produce a gas when water is added.
- Students are guided to design a test to determine which two of the three ingredients in baking powder react to make it bubble when water is added. (The answer is baking soda and cream of tartar.)
- Finally, students will watch a demonstration of an effervescent tablet, such as Alka-Seltzer, which fizzes when it dissolves in water. The reaction that causes this fizzing is similar to the reaction that occurs when baking powder and water are combined.

There are three main ideas in this activity:

- 1) How to design a valid experiment
- 2) Mixing substances can result in a new substance (carbon dioxide gas)
- 3) The way different substances react is a characteristic property that can be used to identify a substance

Evaluation

Download the student activity sheet and distribute one per student when specified in the activity. The activity sheet will serve as the Evaluate component of the 5-E lesson plan.

Safety

Make sure you and your students wear properly fitting safety goggles.

Clean-up and Disposal

Remind students to wash their hands after completing the activity. All common household or classroom materials can be saved or disposed of in the usual manner.

Materials for the ENGAGE demonstration:

- Baking soda
- Baking powder
- Cream of tartar
- Measuring spoon, ½-teaspoon size
- Graduated cylinder or tablespoon
- 2 clear plastic cups
- Warm water
- Liquid soap or detergent
- Popsicle stick or plastic spoon

Teacher preparation for the demonstration

Note: This demonstration works best if you make your own baking powder by mixing cream of tartar, baking soda, and cornstarch.

1. Make a baking powder mixture by placing 1/4 teaspoon of cream of tartar, 1/4 teaspoon of baking soda, and 1/4 teaspoon of cornstarch and in a cup. Use a popsicle stick or plastic spoon to thoroughly mix the powders.
2. Place ½ teaspoon of the baking powder mixture into a cup and label it **Baking Powder**.
3. Label another cup **Baking Soda** and place 1/2 teaspoon of baking soda into this cup.

Materials for each group

- Baking soda in cup
- Cream of tartar in cup
- Cornstarch in cup
- [Testing sheet](#)
- Water
- Popsicle stick or plastic spoon
- Dropper

Teacher preparation for the student activity:

Each group will need a source of baking soda, cream of tartar, and cornstarch.

- For each group, label three plastic cups **Baking Soda**, **Cream of Tartar**, and **Cornstarch**. Students will use the cups to get their ingredients.
- Place 1 teaspoon of baking soda, cream of tartar, and cornstarch into their labeled cups.
- Add about 15 milliliters (1 tablespoon) of water to a cup for each group.

Materials for the EXTEND demonstration:

- Clear plastic cup or graduated cylinder
- Warm water
- Effervescent tablet like Alka-Seltzer
- Detergent solution: Prepare a detergent solution by adding ½ teaspoon of dishwashing liquid to 15 milliliters (1 tablespoon) of water in a small cup.

ENGAGE

1. Do a demonstration to see whether baking soda or baking powder reacts with water.

Remind students that both baking soda and baking powder reacted with vinegar. Ask students if they think both powders will react with water.

Note: The reaction between the water and baking powder is not very vigorous, so students may need to be close to the demonstration to see the bubbles produced. Depending on the number of students in the classroom, invite students to gather around the demonstration table to view the reaction. Alternatively, for large class sizes, it may be better to scale up the demonstration by increasing the amounts of powder and water. Don't forget to increase the size of the container as well!

Procedure

Show students the two labeled cups, one containing 1/2 teaspoon of baking soda, and the other with 1/2 teaspoon of baking powder.

1. Pour about 15 mL (1 tablespoon) of warm water into two empty cups.
2. Add 1 drop of detergent solution to the water in each cup and gently swirl to mix.
3. At the same time, add all of the water from each cup to the baking soda and baking powder cups.



Expected results:

The baking powder reacts with water to produce bubbles, while baking soda does not react with water.

Give each student an Activity Sheet.

Students will record their observations and answer questions about the activity on the activity sheet.

EXPLORE

2. Introduce the idea of “active ingredients” in baking powder.

Question to investigate:

What two ingredients in baking powder react together to produce bubbles when water is added?

Remind students that three ingredients make up baking powder. The three substances are baking soda, cornstarch, and cream of tartar. Explain that two of these three substances in baking powder are the “active ingredients” that react to produce bubbles when water is added. When the two active ingredients are combined with water, a chemical reaction occurs and a gas is produced. We observe the gas in the form of bubbles.

3. Identify all of the possible pairs that can be formed from the three different substances that make up baking powder.

Tell students that in order to identify the two active ingredients in baking powder, they must figure out and test all of the possible combinations of two powders that can be formed from the three different substances that make up baking powder.

Ask students to figure out all the different two-powder combinations using baking soda, cornstarch, and cream of tartar. Have students list these combinations on their activity sheets. The possible combinations are:

Baking soda + Cornstarch

Baking soda + Cream of tartar

Cornstarch + Cream of tartar

Distribute the Testing sheets. Students should recognize that the combinations of powders on their testing sheets are the same as the ones they figured out. Have students test the different combinations with water to identify the active ingredients in baking powder.

Ask students to suggest how they could test each set of powders. As a whole class, agree on a procedure. The following procedure is given as an example.

Materials for each group

- Baking soda in cup
- Cream of tartar in cup
- Cornstarch in cup
- Testing sheet
- Water
- Popsicle sticks, 3
- Dropper

Procedure

1. Use a separate popsicle stick to place a small amount of each solid into its labeled area on the testing sheet.
2. Use a popsicle stick or plastic spoon to combine the powders in each area to form three separate combinations of solids.
3. Use a dropper to add about 5–10 drops of water to each pile.



Expected results

Only the combination of baking soda and cream of tartar produces bubbles when water is added.

4. Discuss the results with the class and ask students to identify the two active ingredients in baking powder.

Ask students:

- **Which combination of solids produced bubbles when water was added?**
The combination of baking soda and cream of tartar bubbled.
- **Which powders are the active ingredients in baking powder?**
Baking soda and cream of tartar.

Explain that cornstarch is also an ingredient in baking powder, but it is not involved in the reaction with water. The purpose of cornstarch is to absorb moisture from the air so that the baking soda and cream of tartar don't react while in a container.

EXPLAIN

5. Show an animation reviewing and explaining that the active ingredients in baking powder are baking soda and cream of tartar.

Show the animation [Exploring Baking Powder](#).



Explain that testing each combination of two powders showed that only the baking soda and cream of tartar pair reacted when combined with water. Those two powders must, therefore, be the active ingredients in baking powder.

Tell students that cream of tartar is a dry acid and that, when mixed with water, it reacts with baking soda to produce carbon dioxide gas. This is very similar to the way vinegar (a solution of acetic acid) reacts with baking soda to produce a gas.

EXTEND

6. Do a demonstration showing that an Alka-Seltzer tablet "fizzes," or produces bubbles, when it is added to water because the tablet is made up of baking soda and an acid.

Materials

- Clear plastic cup or graduated cylinder
- Warm water
- Effervescent tablet like Alka-Seltzer
- Detergent solution

Demonstration

Show students an effervescent tablet, like Alka-Seltzer. Explain that the tablet is composed mostly of baking soda but that it also contains another ingredient.

Procedure

1. Fill a clear plastic cup about 2/3 full with warm water.
2. Add 1 drop of detergent solution to the water.
3. Drop the tablet into the cup of warm water.

Tell students that you put 1 drop of detergent in the water to make it easier to see the bubbles that are produced.



Expected results:

There should be lots of bubbling.

Ask students:

- **What other ingredient do you think is in the tablet that causes the baking soda to produce bubbles when the tablet is added to water?**

Some kind of acid.

Tell students that the tablet contains citric acid along with baking soda. Explain that the fizzing reaction is like the baking soda and vinegar reaction because the tablet has baking soda and another solid substance that is also an acid (citric acid), just like vinegar is an acid. The tablet is also similar to baking powder because baking powder contains baking soda and cream of tartar, and cream of tartar is another example of a solid acid.