Leavener Lineup

Year levels 4–5

Curriculum Links

Science

- Science knowledge helps people to understand the effect of their actions (Yr 4, ACSHE062).
- Solids, liquids and gases have different observable properties and behave in different ways (Yr 5, ACSSU077).
- Scientific knowledge is used to inform personal and community decisions (Yr 5, ACSHE217).
- With guidance, select appropriate investigation methods to answer questions or solve problems (Yr 5, ACSIS086).

Resources

- Bicarbonate of soda, baking powder and (optional) cream of tartar for students to look at
- Resources for the experiment are listed with the experiment instructions on p 16
- After the experiment, students will need the recipes they examined in Lesson 1

Location

The classroom

Duration:
45 minutes – 1 hour

Getting started

- Revisit the term 'leavening agent'. Leavening agents are substances that react with other ingredients to create gases.
- Those gases get trapped in the batter and, in the right circumstances, leavening agents make baked goods rise. The heat of an oven bakes the batter or dough so that it stays risen.
- Humans have developed recipes over hundreds or thousands of years to take advantage of the reactions they have observed in certain circumstances.
- A recipe is a sequence of ingredients and actions that create the circumstances in which the reaction will occur.

How do we use chemical reactions in the kitchen?

Write this question on the board and show students the leavening agents again as you discuss the next few points.

- **Chemical leavening agents** are **chemical compounds** that typically react with acidity, moisture and heat to produce carbon dioxide.
- **Bicarbonate of soda** is a very common chemical leavening agent. Its scientific name is sodium bicarbonate, but it is also called baking soda in some recipes.
- **Baking powder** is another chemical leavening agent you may have used. It is a mixture of chemicals (including sodium bicarbonate) that has a slightly different effect.

(It's possible that students may have come across one or two other chemical leavening agents, such as **potassium bitartrate** which is commonly called **cream of tartar**.)

Biological leaveners such as yeast have been in use for thousands of years, whereas **chemical leaveners** have only been used for hundreds of years. They have been developed intensely since the 1830s, as industrial processes began to be applied to food production. Before this time, the earliest chemical leaveners included potash, a by-product of burning organic material that can be extracted through mixing ash with water and allowing the water to evaporate. Potash was observed to create a reaction in a batter and to cause small, flat cakes to rise and cook quickly into crisp rounds. This resulted in the invention of cookies!

Hands-on experiment

- Before doing the hands-on experiment on the next pages, discuss the experiment with students and ask for their predicitons about what will happen.
- Students discuss, set up and complete the experiment on the following pages, noting their observations in their journals and on the worksheets provided.

Vocabulary

acid
alkaline
chemical reaction
compound
leaven/leavened
leavening agent
unleavened

After the experiment

- Revisit the recipes students used in Lesson 1, or provide a recipe for a chemically leavened quick bread such as a basic scone.
- Ask students to examine the list of ingredients. Can they identify the primary raising agent in the recipe?

Extension/Variation

- Some students may also look for clues to other ingredients in these recipes that are acting in conjunction with the primary raising agent. These might be acids, such as fruit juice, brown sugar, molasses, vinegar, buttermilk, soured milk or yoghurt. Can they find recipes that use a combination of baking powder or bicarbonate of soda plus one of these acids?

Assessment

Students' achievement of the objectives will be evident through:

- the way they work as a group in the experiment, including reading instructions and preparing before starting the experiment
- the accuracy of students' observations
- evidence, through observation or in their responses to the questions on the student worksheet, that indicates understanding about the process of experimentation, including using a control.

Leavener Lineup – Teachers' Notes

Arranging the experiment

If time is short, you can do this Leavener Lineup in small groups, one experiment per group. You might even get a kitchen team to do one or two of these tests in the kitchen class if they have finished their recipe. They could present their findings to the rest of the class.

Tip

Make sure students read all the instructions first. It works best when everyone has a job to do at the critical moment when the balloons go on the bottles. A few spare balloons might come in handy.

What happens?

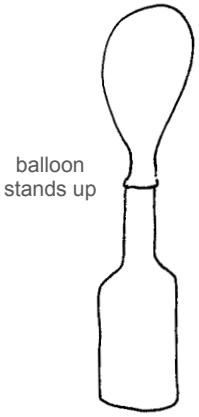
Bottle 1 – Baking powder

Baking powder contains chemicals that react with each other when in contact with the water. The balloon should start to stand up but it will deflate fairly quickly. Conclusion: the reaction doesn't last very long.

Implications for baking:
Baking powder only needs liquid to activate it. It already contains chemicals that will react with each other. It releases a quick burst of gas, and double-acting baking powders are formulated to release a second burst of gas when larger acid crystals are dissolved later in the process by the action of heat and water over time. It also contains corn flour to absorb atmospheric moisture and keep it dry (stable) in storage.

Bottle 2 – Bicarbonate of soda

Bicarbonate of soda, or baking soda, is alkaline. It reacts with the acid in the lemon juice, prompting a very quick release of gases. The reaction is the quickest of the substances tested in this experiment.



Implications for baking:
Baked goods using soda bicarbonate need an acidic ingredient (fruit juice, brown sugar, molasses, vinegar, soured milk, buttermilk, yoghurt etc.) to make them work.

Bottle 3 – Water

The balloon stays deflated. No chemical or biological reaction is taking place and so no gases are being released.

Implications for baking:
Water alone will not make a batter rise, even though it will dissolve other substances and help chemical chains of gluten to form.

Later in this unit, students test yeast in a similar way.

Hands-on Experiment: Leavener Lineup

You will need (per group):

3 empty bottles of the same size (clean bottles, 375–500mL work best)

Sticky labels or tape to label each bottle

3 clean, dry funnels that will fit into the tops of the bottles

3 sets of measuring cups

2 sets of measuring spoons

3 stopwatches (optional)

1 large jug (1–2L) for pouring water

3 balloons, one per bottle

1 tablespoon baking powder

1 tablespoon bicarbonate of soda

1 teaspoon lemon juice

A camera to record results

What to do:

- First, make the balloons more flexible. Blow up each balloon three times, letting the air out every time.
- Label the three bottles:
  - Bottle 1: Chemical leavener – baking powder
  - Bottle 2: Chemical leavener – bicarbonate of soda
  - Bottle 3: Control – plain water
- Place the funnel in Bottle 1: Chemical leavener – baking powder.
- Carefully measure 1 tablespoon of baking powder into the bottle through the funnel. Tap the funnel to make sure all the powder shakes through.
- Place a clean funnel into Bottle 2: Chemical leavener – bicarbonate of soda.
- Carefully measure 1 tablespoon of bicarbonate of soda into the funnel and tap it down into the bottle.
- Place a clean funnel in Bottle 3: Control – plain water.
- Now fill a jug of water from the tap and bring it over to your experiment station.

Scientist's Tip:

You want all the balloons to be stretched (blown up) the same amount. Have a friend watch and count to be sure that you blow them up three times, then count for them.

Continued ...

- Working quickly, one bottle at a time, starting with bottle 1:
  - Carefully measure exactly 125mL (½ cup) of water and tip it down the funnel into the bottle.
  - Have one member of the class start the stopwatch the moment the water is all in the bottle.
  - Have someone else quickly and carefully remove the funnel and stretch the balloon over the opening of the bottle.
  - Have a third person take a photo of the bottle and balloon. Without stopping the timer, write down the time on the stopwatch when you take the photo.
  - Take a photo when the stopwatch reads 5 minutes.
  - Take a photo when the stopwatch reads 10 minutes.
  - Take a photo when the stopwatch reads 15 minutes.
  - Take a photo when the stopwatch reads 20 minutes.

- Now follow the same process with Bottle 2 – **but** after the bicarbonate is in the bottle, rinse the funnel and use it to pour 1 tablespoon of lemon juice **into the balloon**. Hold the balloon carefully so the lemon juice stays inside, and when you place the balloon over the neck of the bottle, tip the balloon up so that the lemon juice runs down into the bicarbonate of soda and water. (The reaction will be instantaneous and you want to catch all of it.)

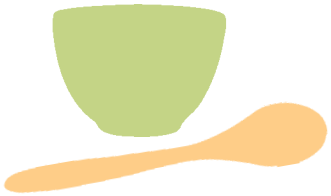
Scientist's Tip:

Before you measure the water, get everyone ready to do their job quickly and without getting in each other's way. The faster you get the balloon on the bottle, the more of the reaction you capture inside it.

- Using the third clean funnel, add 125mL water to Bottle 3 and put a balloon over the top.
- Take photos and write down the time of each photo from the stopwatch. Aim for 5 minutes, 10 minutes, 15 minutes and 20 minutes. Write down the actual times when you take your photos.

Leavener Lineup

Predictions



- What do you think will happen? Why?

Observations

- Draw or photograph the results at 5 minutes, 10 minutes, 15 minutes and 20 minutes.

5 minutes

10 minutes

15 minutes

20 minutes

After the experiment:

- Compare each of the timed photographs. What do you see?
- What does this make you wonder?
- Was the result what you expected? Why or why not?
- If you were to repeat this experiment, what would you do differently?