FRESH ROOTS

Activity Guide

Uplifting Leavening

What makes bread, cookies, cakes, and more light and fluffy and not flat like a cracker? Leavening! In this activity, you will see how yeast and baking soda compare as leaveners.

Things You'll Need

- Two (or more) bottles with narrow mouths (500mL pop bottles, milk bottles, small jugs, or the like. Glass works best, but plastic is fine.)
- Two (or more) balloons
- 1 TBSP baking soda
- 150 mL white vinegar
- 1 packet (about 2 tsp) Active Dry yeast
- 1 tsp sugar
- 150mL very warm (not hot) water
- a funnel (you can make one by cutting the top 1/3 off a plastic 500mL bottle)
- Permanent marker
- Measuring tape (flexible)
- Timer

Suggested Grades

Grades K-7

Time

30-45 minutes

Subjects

Science
- Biology
- Chemistry
- Experimental Design

Food

Background: What is Leavening?

Leavening is what makes doughs and batters rise, giving cakes, breads, cookies, and more their fluffy or airy texture. It's what makes those tiny holes in your sandwich bread, or the big ones in your English muffin.

Leavening is generally either biological (using yeast) or chemical (using baking soda) and that's what we're going to explore in this activity. In both biological and chemical leavening, the goal is to create tiny bubbles of carbon dioxide (CO_2) in the batter or dough.

In biological leavening, yeast, which are a type of fungus, eat sugars and create carbon dioxide as a waste product (just like we do!). As long as there's enough food, yeast will grow and multiply, creating more and more carbon dioxide. Yeasts will eat simple sugars quickly, and break down complex carbohydrates more slowly. Yeast also need water and a cozily warm place to grow. When baking with yeast, we're generally relying on the strong protein structures in the flour (the gluten) to trap the bubbles. Along with making our dough rise, yeast adds extra flavor to our breads.

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Background: What is Leavening? continued

In chemical leavening, a base mixes with an acid and the chemical reaction creates carbon dioxide. Generally, the base is baking soda or baking powder. Baking soda, also know by its chemical name sodium bicarbonate, needs an acidic ingredient in the batter, like brown sugar, applesauce, honey, or cocoa. Baking powder is a combination of baking soda and an acid so it doesn't need acidic ingredients. The baking soda or powder dissolves in the liquid in the batter or dough and as soon as the acidic and basic components find each other, they start making carbon dioxide bubbles. Once the batter runs out of either the acid or the base, it will stop bubbling. Double-Acting baking powder has another trick. It has a a quick-dissolving acid that starts to work right away, and another needs heat to dissolve, which means it releases even more carbon dioxide once the batter is cooked.

Mechanical leavening is another way to make baked goods fluffy, by whipping tiny bubbles of air into either a mixture of fat and sugar (like when you make chocolate chip cookies, which also use chemical leavening), or into a protein like egg whites (like when making an angel food cake).

Leavening in Action

But why do we use different leaveners for different foods? Let's see how a chemical and a biological leavener compare by using them to blow up balloons!

1. Pre-stretch. Balloons are much tougher than bread dough or cake batter, so give them a little help by blowing them up and letting them deflate.
2. Prepare your balloons.
   a. Using your funnel, add 1 TBSP of baking soda to one balloon.
   b. Using your funnel, add 2 TBSP/one packet of yeast to another balloon.
   c. Label which balloon is which (You can decorate them, too!)
3. Prepare your bottles.
   a. In one bottle, put 150mL of vinegar.
   b. In another bottle, put 150 mL of very warm (not hot!) water and 1 tsp sugar.
   c. Label your bottles, and mark the top of the liquid.
4. Stretch the Yeast balloon over the mouth of the Water/Sugar bottle. Stretch the Baking Soda balloon over the Vinegar bottle.

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Leavening in Action, continued

5. Flip! Hold the balloons up so their contents fall into the bottle. Give the the yeast bottle a little swirl to combine everything.
6. Observe! Record your observations in the table below. Measure your balloons as they grow! You may want to keep observing longer than 30 minutes. Just keep recording on a separate piece of paper.

	Chemical Leavening	Biological Leavening
What I observed immediately was:		
What I observed after 5 minutes was:		
What I observed after 15 minutes was:		
What I observed after 30 minutes was:		

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Reflection

Here are some questions to write about or discuss with someone else:

1. What was similar about what happened in the two bottles? What was different?
2. What qualities do you like in a cake? How about in bread? Think about texture and use as well as taste.
   a. What qualities to they have in common? Which are different? (Why do we use one to make sandwiches with and not the other?)
   b. How does the type of leavening affect the texture? How does the texture affect the leavening?

Experimental Design Extension

Using your knowledge from this activity, list the variables that affect leavening. Think chemsitry for chemical leaveners, or biology for biological leaveners, and don't forget things like time and temperature!

	Chemical Leavening	Biological Leavening
What variables affect leavening?		

Then choose ONE of those variables to ask a question about, and design a bottle experiment to answer your question. For example, you might ask "How much vinegar does 1 TBSP of baking soda need to blow up a balloon?" In your experiment, you could have three bottles, one with 150mL of vinegar like we had the first time (your control), one with 100mL of vinegar, and one with 50mL of vinegar.

Be sure to record your hypothesis (what you think will happen) before you start, your observations during your experiment, and your conclusion based on the evidence of your observations. You can always try your experiment again if it doesn't answer your question, but remember to only change ONE variable!

Still want more? Design a baking experiment based on the results of your bottle experiment!