

Quick Bread Chemistry

Estimated Time: 90 minutes

SUMMARY

In this activity, kids investigate how chemical leavening agents work by examining a quick bread recipe and experimenting with the quick bread leavening ingredients. The use of chemical leavening agents in quick breads demonstrates how the reaction between a base and an acid will cause bread to rise without yeast. Quick breads provide a very relevant application of acid-base chemistry to the production of food, and this is demonstrated by “baking” a quick bread using a lidded, nonstick skillet, and a hotplate or stove.

WHAT YOU’LL LEARN

- How acid-base reactions create gas
- How humans have used acid-base reactions to bake for centuries

<p>Materials Used</p> <ul style="list-style-type: none"> • At least 4 tsp of any of the following liquids you have available: <ul style="list-style-type: none"> ○ Water ○ Milk ○ Buttermilk ○ White vinegar ○ Baking soda solution (1 tsp for every 3 tsp of water) ○ Cream of tartar solution (1 tsp for every 3 tsp of water) ○ Lemon juice ○ Any other edible liquids • Additional 4 tsp of baking powder for each liquid you are using. 	<ul style="list-style-type: none"> • A small cup or glass for each liquid • A small, clear disposable water or soda bottle that can hold approximately 20 oz. • A balloon • One piece of yarn or string • A ruler <p>Resources Used</p> <ul style="list-style-type: none"> • Biscuit Recipe (a substitute like bacon fat can be used instead of butter) - https://www.serious-eats.com/recipes/2018/03/light-and-fluffy-biscuit-recipe.html • Banana Bread Recipe - https://www.thekitchn.com/how-to-make-banana-bread-the-simplest-easiest-recipe-139900
--	---

WHAT TO DO

Predicting What Will Happen with Baking Soda

1. Place 4 tsp. of each of the following liquids (if available) into the small cups or glass: water, milk, buttermilk, white vinegar, baking soda solution, cream of tartar solution, and lemon juice. Make a data table of initial observations of each liquid to record. Describe the color of the liquid, the acidity or alkalinity (see below), or any other characteristics of the liquid you think might be important. The first rows of a data table might look like this:

Liquid	pH (acid/base)	Initial Observations	Prediction	Final Observations
Lemon Juice	~2 (acid)	Yellow and cloudy	Lots of gas	

2. One column in the table above lists pH, how acidic or basic something is. You can measure this with pH strips if they are available or use red cabbage (you can find instructions for that on our STEM at Home site). If something like this is available, test each liquid and record results in your data table.
 - a. Based on the results of the pH tests, write your predictions for what will happen when baking soda is mixed with each of the following substances: water, milk, buttermilk, white vinegar, cream of tartar solution, and lemon juice. Which ones will react and form a gas? Which reactions will produce the most gas? Which will produce the least gas?
 - b. If pH paper isn't available, help your students' predictions by noting that buttermilk, vinegar, cream of tartar solution and lemon juice are acidic and milk and baking soda solution are basic.

Testing Baking Powder

3. Pour 4 teaspoons of each liquid into the small cups, one liquid per cup. Use masking tape and permanent marker to label the cups with the names of the liquids.
4. Pour one of the cups into the clean bottle to test. Use a funnel or a piece of paper made into a funnel, to add 4 tsp of baking soda to the balloon, and attach the baking soda-filled balloon to the water bottle that contains a liquid.
5. When you're ready, securely hold where the balloon is attached to the neck of the water bottle. Lift up the other end of the balloon so that all the baking soda in the balloon empties into the water bottle. Continue to hold where the balloon attaches to the bottle. Carefully swirl the bottle to mix in the baking soda.
6. Make some observations about the chemical reaction in progress. Does the balloon inflate? How much and how quickly? Wait until the balloon appears to have stopped inflating, then use string and ruler to measure the circumference of the balloon by wrapping a string around the widest part of the balloon, then straighten the string and measure it with a ruler. Record the results on your table to allow you to compare the amount of gas produced by each mixture (reaction).

Keep Testing!

7. Rinse the liquids and baking soda out of the bottle, then repeat steps 4-7 for each liquid. Remember to keep cleaning the bottle between tests and record your predictions and observations!
8. Have a discussion with the student about what is going on. If they're interested, keep testing more things to see what will react!

SCIENCE BACKGROUND

- Substances like baking soda and baking powder are called chemical leavening agents and they work because they produce a chemical reaction that releases carbon dioxide gas into the dough. Bases (alkaloids) and acids react when combined with each other. Many of us are familiar with the reaction of vinegar (an acid) with baking soda (a base). Whether an item is alkaline (basic) or acidic depends on its chemical structure which will result in varying levels of pH. Baking quick breads shows that an acid-base reaction can be used to produce gas to makes bread rise without the use of yeast.

- Do we know what the difference is between baking powder and baking soda? What do you think the difference is? (Baking soda is only the base part and needs an acid. Baking powder has both an acid and a base, so it can create the reaction without an additional acid)

TIPS

- If you have more bottles and balloons available, the timing of the activity can be sped up by performing more tests at once.
- A great extension is to repeat all tests with baking powder instead of baking soda.
- The skillet quick bread is... not exceptional tasting. It's definitely better with honey butter, but a few of my favorite quick bread recipes are included in the resources section. I prefer them because I never know what to do with leftover bacon grease or old bananas, so learning some science seems to be the best solution.
- The recipe below uses what we learned in the first activity to bake a quick bread in a skillet.

Skillet Biscuit Bread (Recipe from Jane Maynard)

Equipment and Supplies

1 hot plate

1 mixing bowl

Ingredients

1½ cup flour

1 teaspoon baking powder

½ teaspoon salt

Instructions

Mix the dry ingredients, then add water, and mix.

Pour about 1 tablespoon of olive oil, or butter, in a 9-inch non-stick skillet over medium heat.

Immediately pour the batter into the pan, spreading evenly and letting some of the oil come on top as you press the dough down. Add a few tablespoons of water around the edge of the bread then cover with a lid.

Cook for about 7 minutes (until browned), flip and then cook covered about another 7 minutes. Bread should be browned on both sides.

Serve. (It is delicious with a butter and honey spread!)