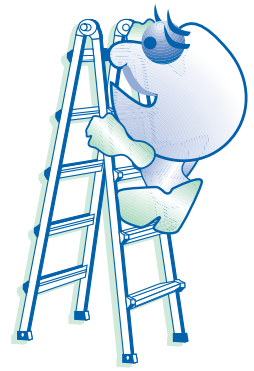


YEAST ON THE RISE



All breads are not created equal. Why are some flat and others fluffy? What is the difference between tortillas and sandwich bread? Are all breads made of the same ingredients? What happens if you change the ingredients in bread dough?

Goal

To investigate variables that affect the energy and carbon dioxide production of yeast in bread dough.

Activity Time

60 minutes

Time to Get Ready

15 minutes

What You Need

Have the following for each team of 3:

- 2 cups of flour
- 3 paper or plastic cups
- 2 packages of rapid-rise yeast
- 2 cups of warm water
- 6 teaspoons of sugar
- alternate sweeteners such as honey, jelly, artificial sweeteners
- 24 clear straws
- 24 clothespins or 9-inch piece of modeling clay
- 1 measuring teaspoon
- 1 tray or cookie sheet
- 1 metric ruler
- 1 permanent marking pen
- 1 loaf of bread (demonstration only)

Getting Ready

- Mix 1 cup of flour, 2 teaspoons of sugar, and 1/3 package of yeast. Very slowly add warm water a tablespoon at a time and knead the mixture to produce a stiff dough. The dough should not stick to your hands or work surface. If it is too sticky, add more flour.
- If using a bulk supply of yeast, measure out 1 teaspoon per group.
- Measure a second cup of flour, 1 cup of warm water (40 to 45°C), and 6 teaspoons of sugar into paper or plastic cups for each group.
- If clothespins are not available, modeling clay can be used to hold the straws upright. Make half-inch balls of clay for each straw. Push the end of the straw into the clay. Push the clay down on the table to flatten the bottom side.
- Mark straws at 3-cm intervals ahead of time (optional).

Useful Information

Yeast are living organisms that require food, water, and a warm place to grow. They break down sugars as a food source for their energy needs and produce carbon dioxide gas and ethanol as waste products. This process is called fermentation.

Fermentation is important in the production of many food products such as bread, yogurt, cheese, pickles, and sauerkraut. When flour is mixed with water, sugar, and yeast, the yeast feed on the sugar. As the yeast release carbon dioxide and alcohol, the gas becomes trapped as bubbles in the dough, causing it to rise. When the bread is baked, the gas is vaporized, leaving a honeycomb texture.



Suggestions to Modify the Activity for Those Who Are Exceptional

Specific modifications for this activity are found here. For common considerations when modifying activities for exceptional participants, see page V of the **Introduction**.

Blind or Visually Impaired

- Allow the participants to touch and smell different types of bread. Discuss the distinct characteristics of bread, such as texture and density. Allow participants to taste the different sweeteners. Sensory stimulation is beneficial to participants, as it helps achieve a better understanding of the activity.
- Have the participants mark the 3-cm intervals on the straws with small pieces of tape. This will benefit the participants if they do not have access to a braille ruler. Mark the final measurement of the dough in the straw with tape also.

Deaf or Hard-of-Hearing

- See the **General Modifications** for *Blind or Visually Impaired* listed in the **Introduction**, page V.

Mobility Impaired

- See the **General Modifications** for *Mobility Impaired* listed in the **Introduction**, page V.

Physically Impaired

- Attach a ruler to lengthen instruments with short handles to make them easier to manipulate.
- Wrap an elastic band around the measuring devices to provide the participant with a better grasp.

Cognitively Impaired

- See the **General Modifications** for *Cognitively Impaired* listed in the **Introduction**, page V.

For More Information

Collins, K. (1993). The fungi feast. *Favorite Labs from Outstanding Teachers, Volume II*. Reston, VA: NABT Publications, 100-101.

Kolata, G. (1996). Genetic blueprint of baker's yeast is deciphered. *The New York Times*, CXLV(50,409).

Wade, N. (1997). New gene research aims at lowly yeast. *The New York Times*, CXLVI(50,735).

How to Start the Activity

- Show the participants the dough mixture prepared earlier and a loaf of bread. Have them discuss the similarities and differences between the two.
- Impress upon the participants that yeast are living organisms with needs similar to other living things. Discuss the needs of living things.
- Explain that yeast, like humans, make waste products. Yeast and humans produce waste carbon dioxide.

Let's Make a Hypothesis

Discuss the following questions to help guide the participants to make hypotheses.

- What do the bread and dough have in common?
- What makes bread rise?
- What is the living component in bread?
- What feeds the living component in bread?
- What makes sandwich bread different from flat breads such as matzoh, tortillas, or taco shells?

What the Data Mean

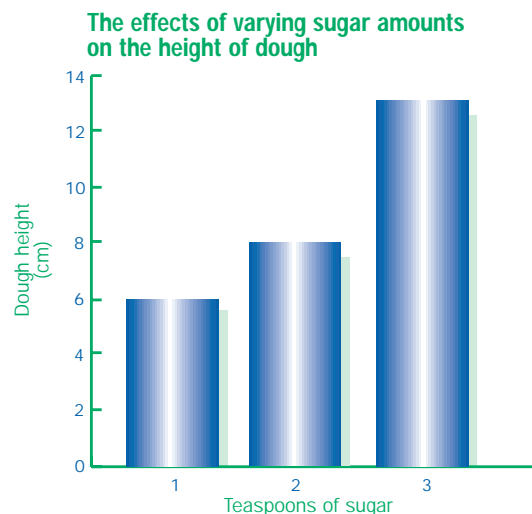


Figure 1. Graph of the effects of different sugar amounts on the height of dough. Increasing the amount of sugar increases the production of carbon dioxide, which in turn increases the height of the dough in the straw.

YEAST ON THE RISE



Questions to Think About

Bread is one of the most basic foods in our diet. How many different kinds can you name? What makes them different? How are they similar? What ingredients are needed to make bread? What role does each ingredient play? What makes dough rise? Yeast are living organisms. What do they eat? At what temperature do they live best? How can you find answers to these questions?

Safety Notes

- Wash hands before and after the activity.
- Do not eat the dough.
- Food, drinks, and gum are not allowed.

What to Do

1. Consider the bread ingredients before you begin. Which one makes the bread rise? What limits the bread's ability to rise?
2. Dust your tray and hands with flour. Divide your portion of flour into 4 equal mounds of 1/4 cup each. Designate the mounds as Control 1, 2, and 3. Measure 1 teaspoon of sugar and add it to Mound 1. Measure 2 teaspoons of sugar and add to Mound 2. Measure 3 teaspoons of sugar and add to Mound 3. Add no sugar to the Control Mound. Pour 1/4 package, or 1/4 teaspoon, of yeast over each mound. See Figure 1. While continuing to keep each mound separate, very slowly add warm water a teaspoon at a time to moisten the mixtures. Continue to add water and knead by hand until the mounds have doughy consistencies. The dough should not stick to the tray or your hands. If it is too sticky, add more flour. Form each mound into a ball. See Figure 2.

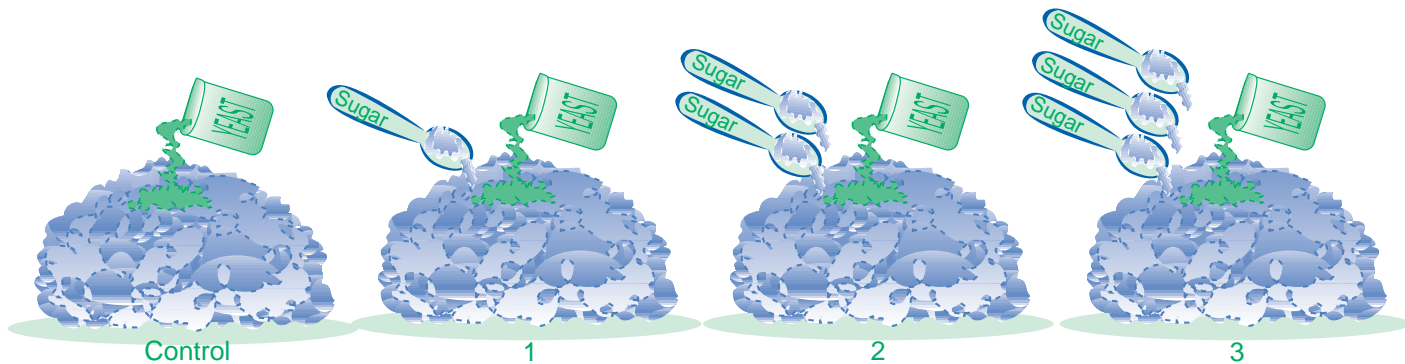


Figure 1. How to set up the flour, yeast, and sugar.

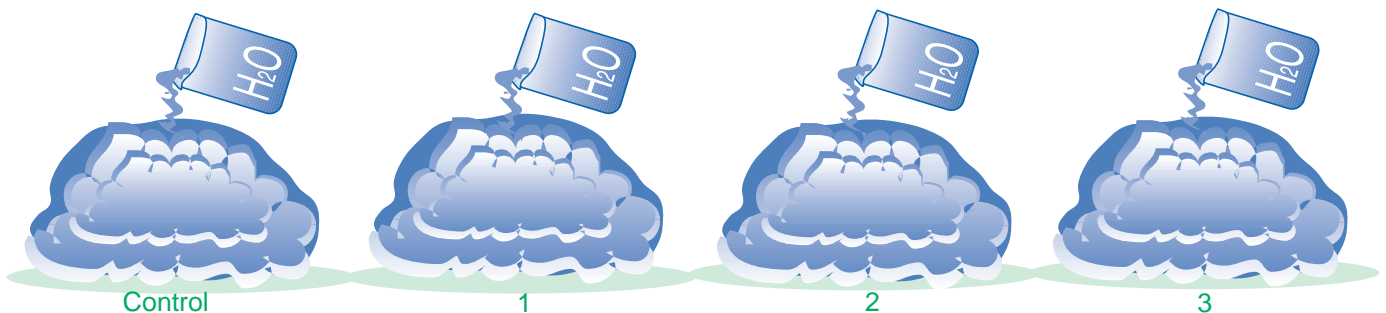


Figure 2. Add water and form into 4 balls of dough.

3. Measure 3 cm from the end of a straw and mark it. Repeat the process with 11 more straws.
4. Working quickly, push 3 straws into the Control Mound, filling each with dough to the 3-cm mark. Label the straws as Control. Repeat the process for Mounds 1, 2, and 3 and label accordingly. See Figure 3.

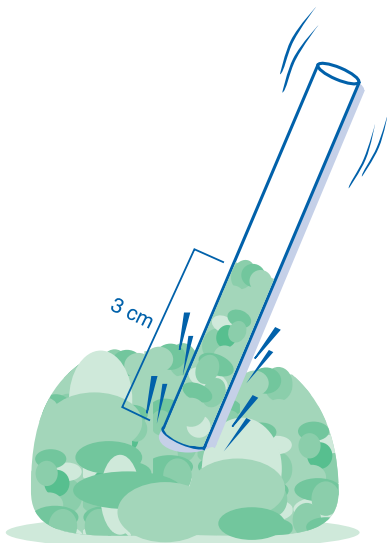


Figure 3. How to use a straw to remove dough from the dough ball.

5. Remove the straws from the dough and pinch the ends of the straws to push the dough away from the ends. Place a clothespin perpendicular to the dough end of each straw. The clothespins should function as stands, holding the straws upright. Mark the new height of the dough on each straw. See Figure 4.

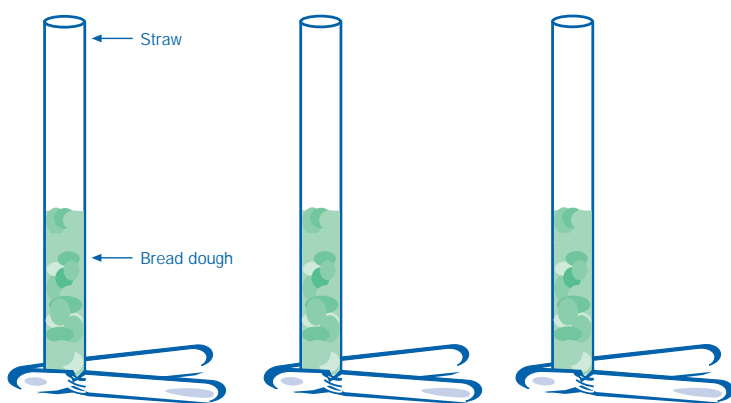


Figure 4. Clothespin straw holder assembly.

6. What is the variable or factor that changes in this activity? Why did you create 3 straws from each mound? Which dough will rise the most? As the dough begins to rise, it will push up into the straws. Predict how far the dough will rise in each straw in 10, 20, and 30 minutes. Write down your predictions.
7. After 10 minutes, measure and mark the heights of the dough in the straws. Calculate an average height for each mound. Repeat the process after 20 and 30 minutes. Graph your results.
8. While you are waiting for the dough to rise in your straws, repeat the procedure. This time instead of using sugar, use other sweeteners. Measure and mark the heights of the dough in the straws. Graph your results. Are they similar to the results you got using sugar?
9. What other questions come from your results? To what other topics is this activity related? How does this activity relate to your life? What did your graph show?
10. How can you learn more about the metabolic activity of yeast? What procedures would you use? What would you measure? What if you changed the kind of flour? What if you left some ingredients out? Design an experiment with one independent variable, a control, and at least three replicates per treatment group.
11. Design a new experiment based on data you gathered or questions you asked during this investigation. Develop a hypothesis that can be tested in a controlled experiment that gathers quantitative data. Write a procedure in a numbered list to test your hypothesis. What is your control? What variables are important? How many trials have you included? What will you measure? How can you show your results in a graph?

What Did You Find Out By Doing the Activity?

Before doing "Yeast on the Rise," did you know:

- how bread is made?
- why you use yeast to make bread?
- why bread has bubbles in it?

From this activity, did you discover:

- the factors that affect how quickly yeast grow?
- how yeast produce the bubbles you see in baked bread?
- how the different ingredients in bread affect the growth of yeast?
- if breads that contain more sugar have a more bubbly texture than those that don't contain as much sugar?