

Flour and Yeast Do WHAT?

Objective:

The purpose of this lesson is to recognize that starch, proteins and cellulose are natural polymers found in the grains we use and the food we eat; understand the role of polymers in bread; & understand the role of yeast and fermentation in the baking of bread.

Keywords:

- Flour
- Natural polymers
- Leavened bread
- Unleavened bread
- Fermentation
- Yeast

21st Century Skills Represented:

- Health Literacy
- Problem Solving
- Critical Thinking

National Science Education Standards:

- Physical Science: Matter & its Interactions
- Earth & Space Sciences: Earth & Human Activity
- Engineering Technology & Applications of Science: Engineering Design; Links Among Engineering, Technology, Science & Society

feedstocks

Crops - grains (wheat, barley, rye) and soy

processes

Mechanical
Biological - fermentation

uses

Food - bread, leavened and unleavened

Background

Bread baking is really a science experiment at work: flour, yeast, liquid and salt mixed into dough that rises and bakes in a hot oven.

Flour is made by grinding grains; the seeds are crushed, releasing starches and proteins. Starch molecules are long polymer chains of simple sugars linked head to tail by chemical bonds. Proteins are more complex; a single protein contains amino acids strung together.

When water is added to flour and kneaded, the proteins form a tough elastic substance call gluten. Gluten can stretch and trap the bubbles of gas that make dough rise. The gas is formed when enzymes from the yeast transform the glucose in the sugar into carbon dioxide, which bubbles up through the mixture causing the dough to rise! These basic properties serve as a foundation to understand the formation of more complex polymers, such as plastics, rubber and lubricants.

In the oven, these pockets of gas expand, the proteins harden and the bread becomes toasty brown. What would happen if there is no yeast?

Materials

Per group of 2-3 students:

- Samples of different kinds of bread (e.g. leavened and unleavened)
- Samples of varying types of flour, specifically corresponding to the flour used in the bread samples above (e.g. all-purpose, bread, soy, cake, etc.)
- 1 tablespoon of sugar
- 1 tablespoon baker's yeast
- 1 cup lukewarm water
- Medium-sized mixing bowl
- Measuring cups and spoons
- 1 mixing spoon
- 1 paper plate
- 2 resealable gallon-sized plastic zip lock bags
- 3 cups all-purpose flour

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Pre-Lab Preparation

1. Have students brainstorm a list of all the kinds of bread they can think of.
2. Divide students into groups of 2-3 people.
3. Have each group gather a small sample of each kind of flour.
4. Hand each group a different slice of bread (leavened and unleavened).
5. Instruct students to record their observations about the slices of bread: texture, smell, flexibility, taste etc.
6. Tell students to determine which flours were used to make the type of bread they have. How did they come to that decision?
7. Exchange types of bread and repeat steps 5 and 6.
8. Discuss the students' observations.
9. Answer the following questions:
 - a. What is a polymer?
 - b. What types of polymers can you find in bread?
 - c. What do you think those polymers do?
 - d. What are the differences between leavened and unleavened bread?
 - e. How do different flours affect the characteristics of bread?

Lab Procedures

1. Before class mix the yeast, sugar and lukewarm water so that there is enough for each group to have 1 cup of solution. Use the following ratios as a guide for mixing the solution:
 - a. 1 cup of water, 1 tablespoon of yeast, and 1 tablespoon of sugar
 - b. Solution should sit for at least 10 minutes prior to use.
2. Divide students into groups of 2-3.
3. Explain the ingredients in the solution: yeast, lukewarm water, and sugar.
4. Ask, "Why is the timing of putting these ingredients together important?" *Answer:* to ensure that the yeast is fresh and active.
5. Instruct each group to follow these steps:
 - a. Gather $\frac{1}{2}$ cup of yeast solution, 1.5 cups of all-purpose flour, a mixing bowl, a mixing spoon, a paper plate and a resealable plastic bag.
 - b. Mix the yeast solution and flour so that it forms dough.
 - c. Remove the dough from the mixing bowl and knead it on a paper plate.
 - d. Place the dough in a resealable plastic bag; seal the bag and label it.
 - e. Clean off paper plate, spoon and mixing bowl.
 - f. Gather $\frac{1}{2}$ cup lukewarm water, 1.5 cups of all-purpose flour and a resealable plastic bag.
 - g. Mix the flour and water so that it forms dough.
 - h. Remove the dough from the mixing bowl and knead it on a paper plate.
 - i. Place the dough in a resealable plastic bag; seal the bag and label it.
 - j. Wait, and then observe both of the dough mixtures and record observations.

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Post-Lab Discussion/Questions

1. Have the students answer the following questions.
 - a. What differences did you observe between the two different types of dough?
 - b. Why are there differences between the dough with yeast and the dough without yeast?
 - c. What processes do you think caused those differences? How does the process work?
 - d. How did the products of that process interact with the polymers in the flour?
 - e. What else could this process be used for?
 - f. What else could yeast be used for?
 - g. What other organisms perform the same process or a similar process?
 - h. How does yeast affect nutrition and taste? How do different flours affect nutrition and taste?
2. Hold a class discussion about the questions and their answers.
 - a. Explain that adding soy flour to the dough mix can help bread rise even better. Ask: "Why do you think soy flour helps bread to rise?" *Answer:* soy flour improves the binding of the proteins in the dough and allows for more efficient and effective CO₂ capture.

Expansion Ideas

- Discuss polymers that occur in other foods.
- Create a kinesthetic model and/or paper model of the polymers in flour.
- Share the polymers of bread and the role of yeast with younger students.
- Discuss the similarities and differences between natural and synthetic polymers.

Evaluation of Learning

- Turn in all observations, questions and answers.
- Draw polymers to show the different connections of flour types.
- Describe the reactants and products of fermentation.
- Describe why yeast allows bread to rise.
- Describe the connection between yeast and/or flour and nutrition.

Resources

- Websites and Articles
 - [All About Polymers](#) by Akron Global Polymer Academy at The University of Akron
 - ["What are polymers"](#) video
 - [Breads of the Harvest Curriculum](#) by Ohio 4-H
 - [Elementary Bread Science](#) by Newton's Apple
 - [Science of Cooking and Gluten](#) by the Accidental Scientist Science of Cooking

Contacts

- Local Community College Culinary Programs