

Bubbles and Bread

Subject Area: Chemistry

Grade Level: Middle School Chemistry

Lesson Title: Bubbles and Bread

National Science Education Standards:

- Science as Inquiry: 5–8
- Properties and Changes of Properties: 5–8

Physical Science Standards:

- Physical Science: 5–8
- Science in Personal & Social Perspectives: 5–8

Suggested Prior Knowledge: concepts of states of matter, chemical reactions/changes, gas formation

Purpose: To investigate the chemical reactions that form gases and cause bread to rise.

Key Vocabulary:

carbohydrate—Any of a group of organic compounds that includes sugars, starches, celluloses, and gums and serves as a major energy source in our diet. These compounds are produced by photosynthetic plants and contain only carbon, hydrogen, and oxygen, usually in the ratio 1:2:1

fermentation—a chemical reaction in which sugar is broken down and carbon dioxide gas is released, among other products

gas—matter with no fixed volume or definite shape; consist of particles that are very small and very far apart

knead—to work (dough, clay, etc.) into a uniform mixture by pressing, folding, and stretching

variable—factor that can cause a change in the results of an experiment (in this case, students will alter the ingredients combined)

yeast—any of various unicellular fungi capable of fermenting carbohydrates to form carbon dioxide gas

Objectives:

1. Students will be able to describe gas formation reactions.
2. Students will be able to investigate which bread ingredients react to form the gas that makes bread rise.
3. Students will design and conduct an experiment that produces a gas.

Materials:

- Safety Goggles
- Basic Bread Recipe
- Flour
- Water (warm)
- Sugar
- Yeast
- Salt
- Oil
- Test Tubes (or small cups)
- Stirring rods (or spoons)

Procedure:

1. Begin with a discussion of bread and its consistency. Discuss what makes the holes in the bread and what makes the bread rise (expand).
2. Discuss with students how to design an experiment to investigate the ingredients in bread and explore which ingredients cause the bread to rise. Lead students to a technically correct experiment that allows them to examine the ingredients in a basic bread recipe and explore chemical and physical reactions between these ingredients. As students progress and develop their procedure, the teacher should validate and prioritize their answers to create a valid procedure similar to that in this lesson plan. Guide students as they develop their investigation procedures to limit variables so that they are able to easily identify which ingredients give them which results.
3. A brief review of physical and chemical changes may be helpful.
 - **physical change**—change of matter that does not change the identity of the substance
 - **chemical change**—change of matter that converts the matter into one or more new substances with different identities and compositions
4. Begin with a leading question and follow up:
 - *What are the ingredients in bread?(basic recipe is provided below)*
 - *Why are some breads so light and fluffy?*
 - *What causes the holes in bread?*
 - *What kind of experiment can we do to find out which of these ingredients makes the bread rise?*
 - *What variables (ingredients) can we change?*
 - *What variables should be kept the same?*

5. Basic Bread Recipe: (also included on the Student Worksheet) This is provided for reference only. Use it to illustrate what ingredients are typically used to make bread.

<p>Grandma's Basic Bread Recipe</p> <p>Ingredients:</p> <p>3 cups warm water</p> <p>3 tablespoons active dry yeast</p> <p>3 teaspoons salt</p>	<p>Makes 3 loaves</p> <p>4 tablespoons vegetable oil</p> <p>½ cup sugar</p> <p>8 cups bread flour</p>
<p>Directions:</p> <ol style="list-style-type: none"> 1. In a large bowl, combine warm water, yeast, salt, oil, sugar and 4 cups of flour. Mix thoroughly and let dough rise until doubled in size. 2. Gradually add about 4 cups flour, kneading until smooth. Place dough in a greased bowl and turn several times to coat. Cover with a damp cloth and let rise until doubled in size. 3. Punch down the dough and let it rest a few minutes. Divide into 3 equal parts, shape each into a loaf and place in a bread pan. Let rise until doubled in size. 4. Bake at 350° for 35-45 minutes. 	

6. Lab safety equipment and protocols should be followed.

7. A basic procedure for this investigation is as follows:

- Obtain samples of each bread recipe ingredient
- In test tubes or small cups, combine small quantities of the combinations of ingredients listed in the table below. Use enough warm water to dissolve solids (if they will dissolve). I suggest filling test tube half full with liquids and adding small scoops of the solids and stirring.
- For each combination, stir to mix ingredients and observe to see if bubbling (gas formation) occurs.

Combination of Ingredients
1. Warm water and flour
2. Warm water and sugar
3. Warm water and yeast
4. Warm water and salt
5. Oil and flour
6. Oil and sugar
7. Oil and yeast
8. Oil and salt
9. Warm water, Oil and Yeast
10. Warm water, yeast and sugar
11. Warm water, yeast and salt
12. Warm water, yeast and flour

8. Have the students record the data and observations from this experiment. Encourage them to try all listed combinations of two or three ingredients.

9. Have students draw a conclusion about which combination of ingredients created the most gas (more bubbles).

10. After students have drawn conclusions regarding the cause of gas formation in bread making, guide a discussion of how yeast uses sugar as food and produces carbon dioxide gas when it undergoes fermentation.

Additional Resources:

- <http://www.newton.dep.anl.gov/askasci/mole00/mole00195.htm>
- <http://www.answers.com/topic/yeast>
- http://wiki.answers.com/Q/How_does_yeast_give_off_gas
- http://www.flinnsci.com/resources_display.asp?catID=8
- <http://allrecipes.com/recipes/Bread/Main.aspx>
- <http://www.harpercollege.edu/tm-ps/chm/100/dgodambe/thedisk/chemrxn/signs3.htm>

Student Worksheet for Bubbles and Bread

Experiment Title: _____ Date: _____ Name: _____

Student Hypothesis: _____

Materials Available:

- Safety Goggles
- Basic Bread Recipe
- Flour
- Water (warm)
- Sugar
- Yeast packets
- Salt
- Oil
- Test Tubes (or small cups)
- Stirring rods (or spoons)

Procedure: _____

Data and Observations:

Ingredient Combination	Observations

Observations: _____

Conclusion: _____

What causes bread to rise?

Grandma's Basic Bread Recipe Ingredients: 3 cups warm water 3 tablespoons active dry yeast 3 teaspoons salt	Makes 3 loaves 4 tablespoons vegetable oil ½ cup sugar 8 cups bread flour
Directions: 5. In a large bowl, combine warm water, yeast, salt, oil, sugar and 4 cups of flour. Mix thoroughly and let sponge rise until doubled in size. 6. Gradually add about 4 cups flour, kneading until smooth. Place dough in a greased bowl and turn several times to coat. Cover with a damp cloth and let rise until doubled in size. 7. Punch down the dough and let it rest a few minutes. Divide into 3 equal parts, shape each into a loaf and place in a bread pan. Let rise until doubled in size. 8. Bake at 350° for 35–45 minutes.	