

# Investigation Two – Microorganism Multiplication

<b>Standard 05:</b> Students will understand that microorganisms range from simple to complex, are found almost everywhere, and are both helpful and harmful.
<b>Objective 1:</b> Observe and summarize information about microorganisms.
<b>Objective 2:</b> Demonstrate the skills needed to plan and conduct an experiment to determine a microorganism's requirements in a specific environment.
<b>Intended Learning Outcomes</b> 1 – Use science process and thinking skills 3 – Understand science concepts and principles 4 – Communicate effectively using science language and reasoning

**Standard**  
**V**

**Objectives**  
1,2

## Background Information

Yeast are small, single-cell organisms. They are members of the kingdom *fungi* (singular, fungus), that also include mushrooms. Fungi differ from plants in that they have no chlorophyll. They have been useful to humans for centuries in the production of certain foods and beverages. They are responsible for the rising of bread dough and the fermentation of fruits and grains to produce alcoholic beverages. They also play the initial role in the production of vinegar. Most yeast can live only on sugars and starches. From these they produce carbon dioxide gas and alcohol. Yeast usually reproduce by a method called *budding*. A small knob or bud forms on the parent cell, grows and finally separates to become a new yeast cell. Although this is the most common method of reproduction, yeast also multiply by the formation of spores.

Yeast used in bread production is an example of fungi that causes fermentation. Yeast consumes the sugars present in bread dough to use the energy from the sugar for growth and reproduction. When the yeast consumes sugar, it is broken down into carbon dioxide gas and alcohol. Little bubbles of carbon dioxide released from the yeast fill the dough and cause it to expand or “rise.” A slice of bread can be examined with the naked eye or with a magnifying glass to see the many small spaces made by the carbon dioxide. Some yeast are able to grow at relatively low temperatures. In fact, the fermentation of wines and beer is often carried out at temperatures near 4°C (40°F). This can create a spoilage problem in meat coolers and other refrigerated storage areas.

Because yeast can grow under conditions of high salt or sugar content, they can spoil certain foods in which bacteria would not grow. Examples are honey, jellies, maple syrup, and sweetened, condensed milk. Foods produced by the bacterial fermentation process, such as pickles and sauerkraut, can also be spoiled by yeast which interfere with the normal fermentative process.

## Pre-Assessment/Invitation to Learn

Ask students what makes bread rise and under what conditions bread rises best. Explain to them that they will be using yeast and design an experiment to see what conditions are best for yeast to grow and thrive.

### *Activity One – Growing Yeast*

#### Instructional Procedures

##### Materials

- 125 ml Erlenmeyer Flasks
- Water
- Hot plate or thermos
- Flour
- Sugar
- Teaspoon yeast (rapid rise)
- Balloons
- Salt

1. Explain to students we can measure the activity of yeast by collecting the gas they give off. More gas means more yeast are eating, reproducing and performing the functions of life.
2. To trap the gas, a balloon will be placed over the mouth of a narrow-necked beaker (a 125 ml Erlenmeyer flask works best) or a test tube.
3. Show students the “control” flask. Add 100 ml of warm water. Add ½ tsp yeast and a tsp of sugar. Place a balloon over the flask and swirl it.
4. Assign students to as many groups as possible and give them time to design an experiment on the yeast. Show them the materials that are available. They can change ONE variable in the experiment. For example, they could change the amount of sugar or use flour, honey, salt or powdered milk instead. Some students should try hot water (over 130°F) or cold water. They may put in more or less yeast. Have them record in a journal or lab paper what they will change.
5. Give students time to set up their flasks and time for the yeast to grow and the balloons to expand. This may take 30 minutes or more.
6. Questions to answer during the experiment:
  - a. What do you observe in the first 5 minutes?
  - b. What do you observe in 20 minutes?
  - c. What do you observe in 60 minutes?
  - d. What is blowing up the balloons?
  - e. Yeast is added to bread dough. Why does the bread rise?
  - f. What evidence do you see that yeast produce gas in bread?

Questions to answer after the experiment:

- g. What group got the most gas? What did they change?
  - h. What group got the least gas? What did they change?
  - i. If you wanted to make bread rise the more quickly, what would you do?
  - j. If yeast represents all microorganisms, what does it need to grow?
  - k. Why would a baker need to understand the needs of yeast?
7. At the end of the experiment, your group should report to the class. Plan to explain what you did and what happened. Think of reasons why you got the results you did.