

Activity 3: Microbe Meals

In this activity, the students will determine which foods are the best sources of energy for yeast.

Background

Fungi are often confused with plants because their cells have cell walls and some of them grow above ground. Fungi, however, differ from plants in one very important way. They cannot make their own food; they are consumers. Some fungi are parasites, obtaining their food from living hosts and causing disease in the process. Other fungi feed off dead organisms or the wastes of living things and are called decomposers.

Yeast is a fungus whose feeding habits have proven to be beneficial to humans. These unicellular microbes can produce the energy they need by breaking down sugar in a process called *fermentation*. Fermentation of sugar yields the energy needed to grow as well as two byproducts—carbon dioxide gas and alcohol:



Fermentation is the reason humans can use yeast to make wine and other spirits. It is also the reason why yeast is used to make bread. The release of carbon dioxide gas during fermentation of the sugar makes bread dough rise.

Sugars and starches are excellent sources of energy for yeast. We know this because fermentation experiments have shown that there is a positive correlation between the amount of energy and the amount of byproducts produced. Both sugar and starch produce large amounts of carbon dioxide and alcohol when they are fermented.

Unlike sugar, some sweeteners are not good sources of energy for yeast. For example, yeast cannot break down the artificial sweetener, saccharin. Fungi, specifically yeast can metabolize aspartame, but its breakdown produces very little energy.

This activity was adapted from one at <http://www.microbeworld.org/home.htm> entitled: Can Microbes Tell the Difference? : The American Society for Microbiology: MicrobeWorld.

Learning Objectives

The student will:

1. Observe the effects of fermentation using varying sources of energy.
2. Conduct an experiment to determine which foods are the best sources of energy for yeast.

Materials for each group of 3-4 students

1. *Microbe Meals Student Guide*
2. 4 tsp (20g) rapid rise yeast
3. microwave or hot plate
4. measuring cup with half cup division (large graduated cylinder)
5. thermometer
6. metric ruler
7. microwave safe cups/containers or glass beakers
8. 1 teaspoon measuring spoon
9. Warm test solutions (foods). The solutions are: (see right column)
 - A. half cup (240ml); ½ can of regular cola
 - B. half cup (240ml); ½ can diet cola (with saccharin)
 - C. water with sugar (1 teaspoon per half cup of water)
 - D. water with aspartame – Equal®(1 teaspoon per half cup of water)
 - E. water with white flour (1 teaspoon per half cup of water)
 - F. water with wheat flour (1 teaspoon per half cup of water)
10. Four quart sized plastic freezer bags
**It is recommended that you use quality bags to prevent leakage.*
11. Surgical masks (students may be allergic to the yeast)
12. Gloves
13. Stopwatch, time device

Procedure

1. Review how fungi get their food and the process of fermentation.
2. Divide the class into groups of three or four, and then distribute to each group the *Microbe Meals Student Activity Sheets*, *four freezer bags*, and *one packet of yeast*.
3. Have each group select four foods to test as energy sources. One of the foods must be the water with sugar solution (control that will indicate a positive test).
4. Assign each group a number and tell the students to label each bag with their group number and the name of the test food.
5. Have each group warm the tests solutions to approximately 115°F (46.11° C) in containers in the microwave or in beakers on a hot plate (or provide the solutions already warmed).
6. Next, the students should add half a cup of solution to the appropriate bags. Add one teaspoon of yeast to each bag and gently mix by rocking the bag back and forth.
7. Before sealing the bags, students should push out as much air as possible.
8. Next, the bags are placed in a warm area of the classroom (can use an overhead projector or if it is warm outside, lay the bags in the sun).
9. The students monitor the bags every 10 minutes to make sure that the bags are producing carbon dioxide gas. The students measure the width of the bag with a ruler and record the size on the *Microbe Meals Data Sheet*. A graph can also be made plotting width versus time on the same sheet.
10. After 30 minutes, have each group collect the bags and make the final measurements.
11. Have the students complete the *Microbe Meals Analysis Sheet* and review their findings with the class.

Microbe Meals

Extension Activities

- *Visual Arts*: Create models of different types of yeast.
- *Science*: Use bacteria to make yogurt.
- *Math*: Calculate the amount of CO₂ produced using the constant 3.4mmol/g hr(the amount of CO₂ produced from 1 gram of yeast in 1 hour)
- *Language Arts*: Research a disease-causing fungus and create a story from its perspective.
- *Language Arts*: Write a “how to paper” that describes how to perform an experiment that tests the fermentation rate of a fungus.

Standards

National Science Education Standards, Grades 5-8

- Science Content Standard A: All students should develop abilities necessary to do science.
- Science Content Standard C: All students should develop understanding of the structure and function of living systems.
- Science Content Standard C: All students should develop understanding of regulation and behavior.

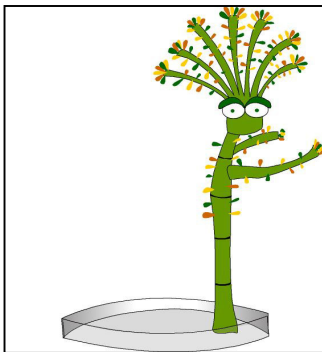
Books and Articles

- Dusenbery, David B. 1996. Life at Small Scale : The Behavior of Microbes. New York: Scientific American Library : Distributed by W.H. Freeman.
- Phaff, Herman. 1978. The Life of Yeasts Cambridge: Harvard University Press.

Web Sites

Starred sites are geared toward students.

- The American Society for Microbiology: MicrobeWorld
<http://www.microbeworld.org/home.htm>
- Stalking the Mysterious Microbe
<http://www.microbe.org/>
- Fleischmann's Yeast kid's site*
<http://www.breadworld.com/justkids/index.asp>



Microbe Meals

Although some fungi look like plants, they cannot make their food as plants do. Instead, fungi must take in food to get energy. For this reason, they are known as consumers. In this activity you will learn how yeast (*Saccharomyces cerevisiae*), a type of fungus, breaks down food for energy. You will test different foods to determine which foods are the best sources of energy for yeast.

Materials

1. *Microbe Meals Student Guide*
 2. envelopes of rapid rise yeast
 3. microwave or hot plate
 4. measuring cup
 5. thermometer
 6. ruler
 7. microwave safe cups/containers
 8. teaspoon measuring spoon
 9. four plastic freezer bags
 10. Warm test solutions (foods), the group needs one half cup of each.
The solutions are:(see right column)
 11. Surgical masks
 12. Gloves
 13. Stopwatch, time device
- A. Regular cola ½ can
 - B. Diet cola ½ can
 - C. water with sugar (1 teaspoon per half cup of water)
 - D. water with aspartame (1 teaspoon per half cup of water)
 - E. water with white flour (1 teaspoon per half cup of water)
 - F. water with wheat flour (1 teaspoon per half cup of water)

Procedure

1. Pick four foods to test as a source of energy for yeast. One of these foods must be the water with sugar solution- this food source will serve as your **control**.
2. Label the bags with the group number assigned by your teacher and the name of each food that you selected.
3. Warm the test solutions (approximately 115°F = 46.11°C) in cups/containers in the microwave or in beakers on a hot plate.
4. Add half a cup of test solution to the proper bags.
5. Add one teaspoon of yeast to each bag and gently mix by rocking the bag back and forth.
6. Push all the air out of each bag before sealing it.
7. Place the bags in a warm area of the classroom.
8. Monitor the bags every 10 minutes to make sure they are producing carbon dioxide gas. Measure the width of the bag with a ruler and record the size on the *Microbe Meals Data Sheet*. Graph the results on the same sheet by plotting the width of the bag versus time.
9. After 30 minutes, collect the bags and make the final measurements.
10. Complete the *Microbe Meals Analysis Sheet* and review your findings with the class.

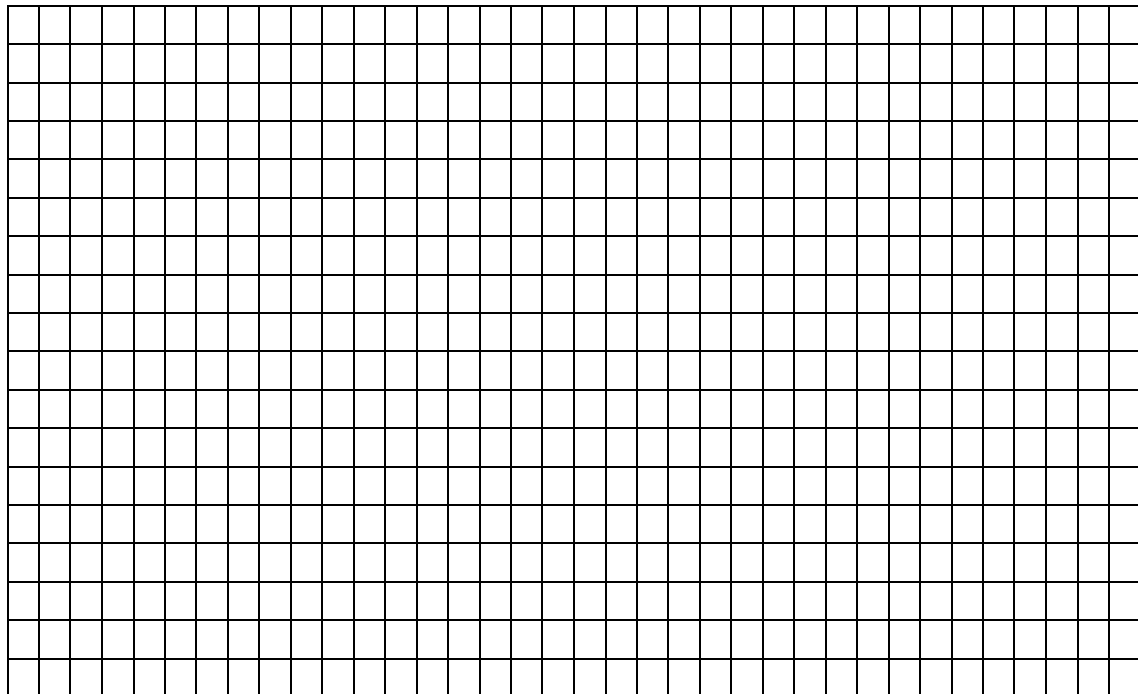
MISSION DEBRIEFING Student Guide

Name _____ Class _____ Date _____

Microbe Meals Data Sheet

Yeast Growth Table				
Bag #	Food Source	Bag Width (cm)		
		10 minutes	20 minutes	30 minutes
1	Water + Sugar			
2				
3				
4				

Yeast Growth Graph



Name _____ Class _____ Date _____

**Microbe Meals
Analysis Sheet**

1a. Which food produced the most carbon dioxide (CO₂)?

1b. Why do you think it produced the most?

2a. Which food produced the least amount of CO₂?

2b. Why do you think it produced the least?

3. Why do you think warm solutions were used for this experiment?

4. What might have happened if cold solutions were used instead?