

Activity 6:

Mold Growth

Objective

After observing mold growth on different types of bread, measure and record the growth rate.

Science Standards

- **Science as Inquiry:** Abilities necessary to do scientific inquiry
- **Life Science:** Matter, energy, and organization in living systems
- **Science in Personal and Social Perspectives:** Personal Health

Mathematics Standard

- **Measurement**

Materials Needed

Variety of breads (such as white, brown, whole wheat, rye, and sourdough) with and without preservatives

Variety of tortillas (such as flour and corn) with and without preservatives

Plastic zip-locking sandwich bags (16.5 cm x 14.9 cm)

Marking pen

Tape

Knife

Metric ruler

Transparent centimeter grid sheet

Large tray

Student Data Sheets

Background

Flour tortillas have been a favorite bread item for space flight since 1985.* Tortillas are an acceptable bread substitute because of ease of handling and reduced crumb generation in microgravity. Frankfurters and peanut butter and jelly are some of the foods and spreads used with the tortillas to make sandwiches. The tortillas are also used as a bread accompaniment to many of the food entrees such as beef tips in gravy and ham slices. The Space Shuttle galley does not have refrigeration for food storage; hence, all foods are stowed in locker trays at room temperature. Spoilage problems are encountered with commercial tortillas on space flight missions longer than 7 days.

Molds are naturally present nearly everywhere in our environment. In nature, molds are needed to break down

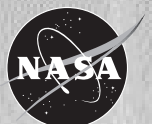
substances such as leaves and result in organic matter that enriches soil. When present in foods, however, molds may grow and cause an unsightly appearance and unappealing and unusual flavors. Some molds are capable of producing toxins, which are hazardous to human health. Dampness, warmth, oxygen, favorable pH, and the absence of light result in the optimum growth conditions for yeast, mold, and pathogenic bacterial growth. As mission length has increased, the need to develop a tortilla that is shelf stable at room temperature has become essential. A tortilla with a shelf life of 6 months was developed.

Foods and beverages are processed with preservatives to inhibit the growth of molds naturally present. The development of a shelf-stable tortilla for space flight required reducing the amount of available water, lowering the pH to prevent bacterial growth, and packaging in an oxygen-free environment to prevent mold growth. See the Space Tortilla Formulation (Recipe) in Appendix F.

Procedure

1. Measure and cut each bread and tortilla sample into a 10 x 10 cm square.
2. Cut a 5 x 5 cm square of paper, and dampen with water. Place into a numbered zip-locking sandwich bag.
3. Place each sample on dampened paper in the bag, and seal with a little air left in the bag. Tape the zip-locking seal as a safety measure.
4. List the ingredients from the information label on the food package wrapper. Identify flours, yeast, and preservatives. Label the package.
5. Place the labeled samples on a large tray to minimize handling. Keep the samples in a warm, dark place.
6. Make daily observations of any mold growth at the same time each day. Make observations of the types of mold present by noting the color and appearance of the molds and the rate of mold growth.
7. Measure the amount of mold surface area growth by placing a transparent centimeter grid over the sample.
8. Record your data on the Student Data Sheets.
9. Examine the mold with a stereo microscope or magnifier.

* Tortillas were requested as part of the food manifest by Astronaut Rodolfo Neri Vela (Mexico), Payload Specialist, STS-61B, 1985.



Caution: Molds should be handled carefully. Do not open the zip-locking plastic bag, and do not remove the mold samples from the zip-locking plastic bags. The spores, which is how mold is dispersed, may spread throughout the classroom and could cause allergic reactions.

Discussion

1. Which bread type(s) exhibited more mold growth over a long period of time?
2. On which bread type did mold first appear?
3. Were there any breads that had no mold growth? Why?
4. What was the difference between the tortilla and the bread as far as mold growth?
5. Molds vary in color and appearance. Many are white and resemble cotton while others are green, brown, black, pink, or gray. While some molds will grow on a wide variety of foods, others grow best on fresh fruits or vegetables. Describe the mold(s) that appeared on the bread products.

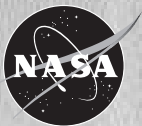
Extensions

Repeat the experiment, and change the variables.

1. Place some bread samples in the dark, and expose other identical pieces in the light.
2. Place some bread samples in a cool place (refrigerator), and expose other identical samples in a warm place.
3. Repeat the experiment with other types of major food groups that have flown in space. The Space Shuttle fresh food locker contains crew-determined food items such as oranges, apples, carrots, and celery sticks. Try a fresh fruit such as an orange or apple, a fresh vegetable such as a carrot or celery stick, and a milk group item such as a natural cheese.
4. Observe which colors of molds grow on a variety of foods and which mold colors are more specific to a certain food group.
5. Compare the space flight shelf stable tortilla formulation (listed in Appendix F) with the ingredients listed on a grocery store tortilla package wrapper or in a tortilla recipe you find in a cookbook for an Earth-based tortilla.

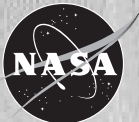
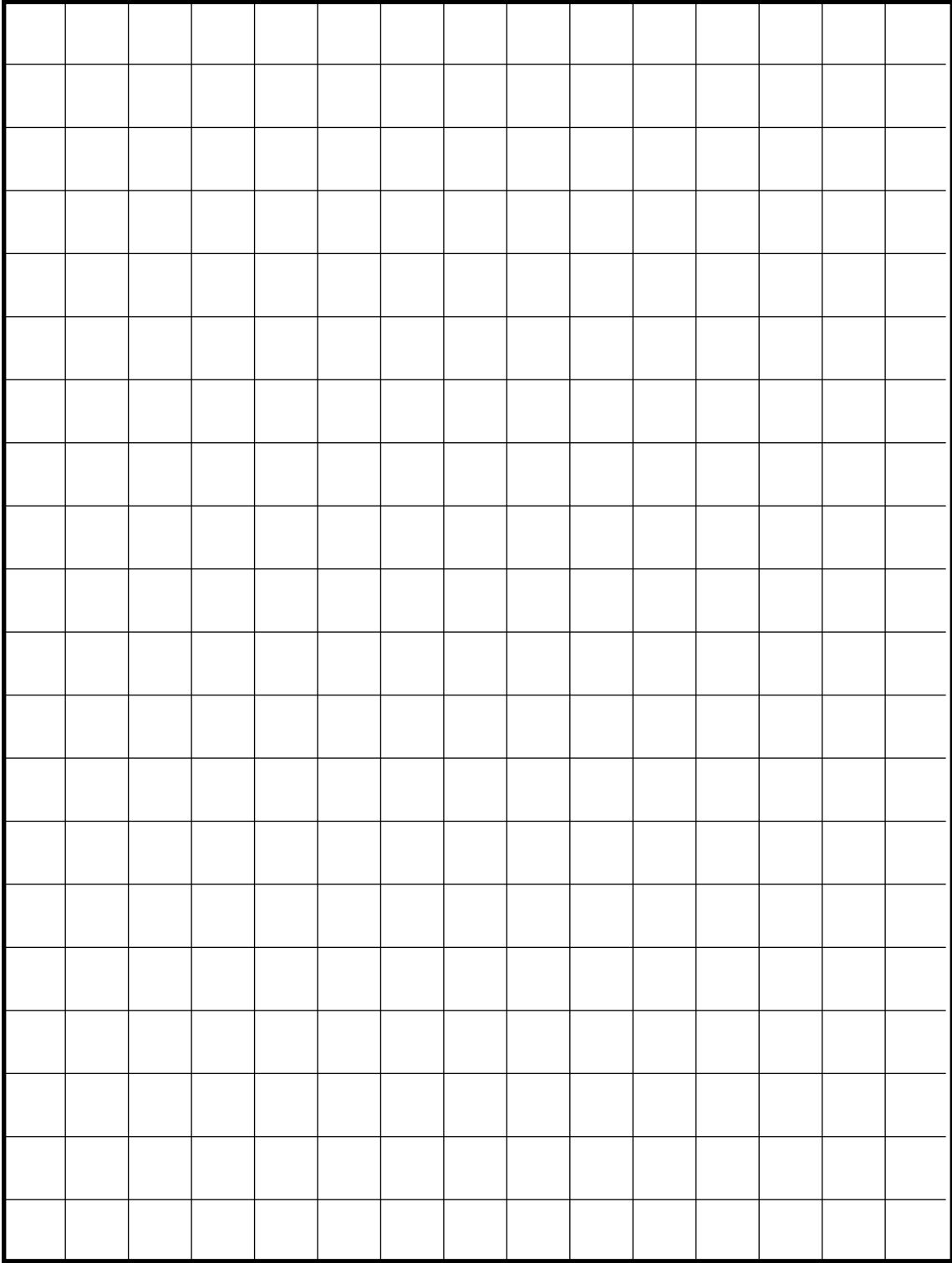
Assessment

Conduct a classroom discussion about the findings, and collect the completed Student Data Sheets. Have the students graph their data.



Metric Area Grid Template

This 15 x 20 cm gridded sheet can be used to make transparencies, which can be placed on any object and used to measure how many square centimeters the object contains.



Student Data Sheet

Name _____

MOLD GROWTH DATA RECORD SHEET

Kind of Bread _____ Sample # _____ Preservative _____ (yes / no)

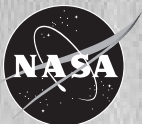
<u>Time (Day)</u>	<u>Mold surface area (cm)</u>	<u>Daily Observations</u>
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	_____
6	_____	_____
7	_____	_____
8	_____	_____
9	_____	_____
10	_____	_____

Ingredients List:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____

Ingredients Identification Key:

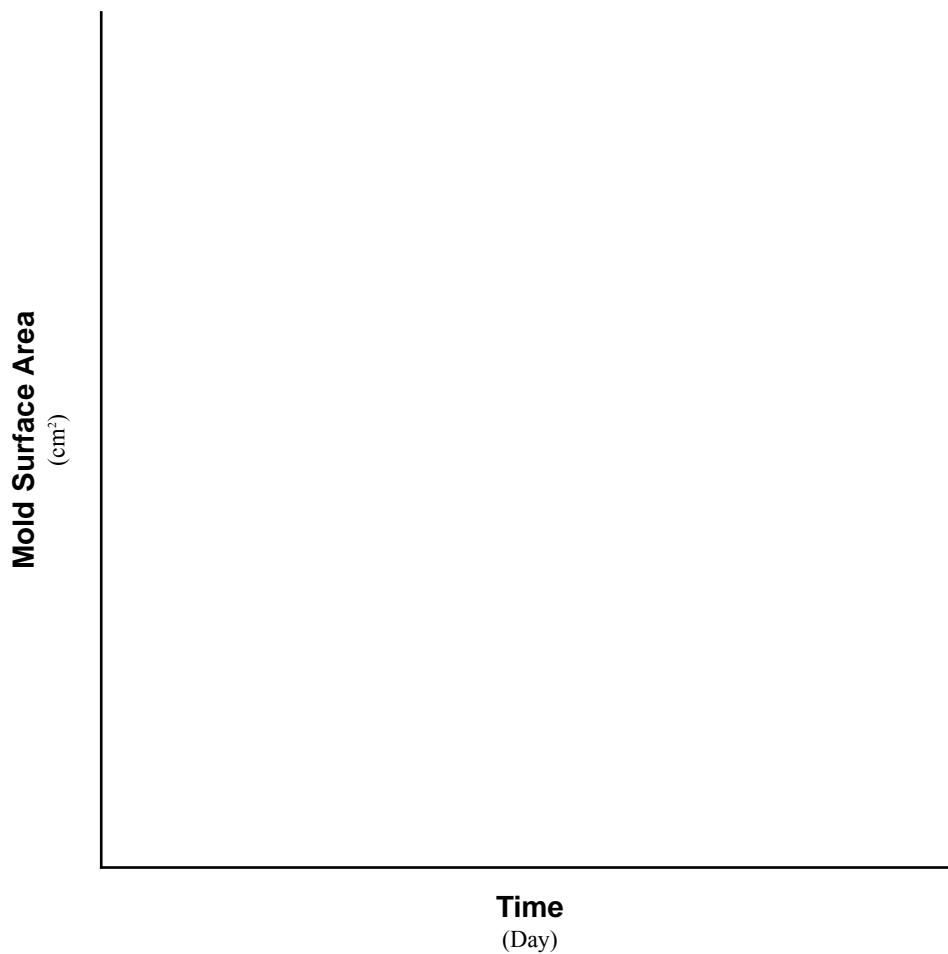
Flour (F)
Preservative (P)
Yeast (Y)



Student Data Sheet

Name

Mold Growth Data Line Graph



Instructions

Plot surface mold area growth vs. time.

Plot data from each sample onto the line graph.

Use a different color for each sample recorded on the graph.

Indicate on the graph whether the sample is with or without preservatives.

If there are preservatives, state the number of different preservatives present.

Conclusions

