

Don't Cry Over Spoiled Milk!

Purpose

Students will understand and explain that Louis Pasteur wanted to find out what caused milk and wine to spoil. They will understand that he demonstrated that spoilage and fermentation occur when microorganisms enter from the air, multiply rapidly, and produce waste products, with some desirable results, such as carbon dioxide in bread dough, and some undesirable, such as acetic acid in wine. Students will understand that after showing that spoilage could be avoided by keeping germs out or by destroying them with heat, Pasteur investigated animal diseases and showed that microorganisms were involved in many of them.

Materials

For the teacher: oven, balance

For each student: goggles, copy of Black Line Master (BLM) *Don't Cry Over Spoiled Milk!*, science journal

For each group of students: 2-500 ml Erlenmeyer flasks, 500 ml milk, stopper, grease pencil, pH paper, oven-safe cup

For the class: 500 ml milk, 10 ml live culture plain yogurt, 30 ml powdered skim milk, thermometer, stirrer, hot plate, aluminum foil

Activity

A. Pre-Activity Preparation

1. Sterilize beakers, flasks, and stirrers before use.
2. Set up a station for each group with the materials listed for each group of students.
3. Set up a station for the class to make yogurt with materials listed in the *For the class* section.

B. Spoiling Milk and Making Yogurt

1. Distribute goggles and a copy of the BLM to each student. Divide students into groups and direct each group to a station. Tell them to follow the directions on the first section of the BLM.
2. Once all students have taken their initial pH readings, ask: "Is the pH of the milk sample acidic, basic, or neutral?" Discuss how the pH is neutral, being neither an acid nor a base.
3. Ask students: "Do you think that the pH data will change as the milk sits out over time? What observable properties might change? What do you think will cause the properties to change?"

(continued)



connecting across the curriculum

Social Studies

Have students read *Louis Pasteur: Disease Fighter* by Linda Wasmer Smith to learn more about Pasteur's historical work.



EXTENDING THE ACTIVITY

Have students research to find what other food products are made with the help of microorganisms.

Standards Links
7.4.12, 7.6.1

Activity (continued)

4. Direct the class's attention to the bottom portion of the BLM. Ask for one or more volunteers to follow the directions on the bottom half of the BLM to prepare the yogurt.
5. Allow each group to observe its yogurt mixture and ask questions, such as: "Is the pH of the yogurt mixture different than the pH of the milk samples? Why do you think this is so?"
6. Discuss the different ingredients in each and have students form hypotheses.





C. Tying It All Together

1. Explain that in the mid-1800s Louis Pasteur asked some of the same questions that were asked during the activity.
2. Tell students that after running his own experiments, Pasteur demonstrated that spoilage and fermentation occur when microorganisms enter the food or liquid from the air, multiply rapidly, and produce waste products.
3. Ask how this relates to what happened with the milk samples.
4. Discuss how the pH became more acidic as the milk spoiled.
5. Tell students that microorganisms are purposely added to milk mixtures to metabolize sugars and produce acids, making yogurt. Explain that yeasts are added to bread dough to metabolize sugars and produce carbon dioxide, making bread rise.
6. Explain that acids and carbon dioxide are two waste products of different microorganisms.
7. Ask students: "Have you heard of pasteurized milk and juice?"
8. Discuss how Pasteur found that heating foods, like milk, would kill harmful microorganisms, and that this prevented humans and other animals from getting infectious diseases from food products. Explain that using this knowledge, Pasteur found a way to prevent the spoilage of food.

Classroom Assessment

Basic Concepts and Processes

At the end of the activity, ask questions, such as the following:

-  What did Louis Pasteur discover about microorganisms?
-  How do spoiling milk and making yogurt relate to Pasteur's discoveries?
-  How do you know?
-  What waste products do microorganisms produce and how can they be helpful to humans?

Name: _____



Don't Cry Over Spoiled Milk!

1. Make a chart like the one below in your science journal, leaving enough room in each row to record pH and other observations each day for two weeks.
2. Carefully fill two 500 ml Erlenmeyer flasks with 250 ml of milk.
3. Use pH paper to find the pH of each milk sample and then seal one flask with a stopper.
4. Record the pH readings and any other observations in your science journal.
5. Place both flasks in an undisturbed area.
6. Each day of class, measure the pH and record your observations of each milk sample. Be sure to place the stopper on the same flask each day.
7. Record your observations for a period of approximately two weeks.

DATE	Uncovered Milk: pH and Observations	Covered Milk: pH and Observations

How to make yogurt:

1. Add 30 ml powdered skim milk to 500 ml whole milk.
2. Place the beaker on the hot plate and bring the mixture to a boil over medium heat for 30 seconds, stirring constantly.
3. Cool to 46-60° C.
4. Place 5-10 ml of plain yogurt in the cooled milk mixture.
5. Stir the mixture well and pour some into a sterilized cup for each group. Cover each cup with aluminum foil.
6. Pass out a cup of yogurt to each group. Each group should mark its cup and record observations of the mixture including consistency, pH, color, and smell.
7. Return the cups to the teacher, who will incubate each mixture at 32-43°C for 9-15 hours.
8. After the yogurt mixture has been incubated, each group should obtain its cup of yogurt and again make and record observations including consistency, pH, color, and smell.