ScienceNews

Activity Guide for Students: Fermentation and Pasteurization in the Classroom

Directions:
Have you ever wondered why people historically got sick when eating food when sickness from food is so uncommon today? Thanks to Louis Pasteur and his research, we know a lot more about how diseases are spread and how to protect ourselves from foodborne illnesses. Today, you will learn about his work in fermentation and pasteurization and do an experiment of you own.

Article analysis

Use what you learned about Pasteur, fermentation and pasteurization from the *Science News* article "Louis Pasteur's devotion to truth transformed what we know about health and disease" to answer the questions below.

1. Who was Louis Pasteur?

2. How was tartaric acid important to Pasteur's career?

3. Why was it important that Pasteur showed yeast are living things?

4. Microorganisms are living things too small to see with the naked eye and include fungi and bacteria. What kind of microbe is a yeast?

5. What do yeast do with sugar, and what is the process called?

6. Why do yeast ferment?

7. People use fermentation to make wine, beer and other products. But sometimes those products can become spoiled or get contaminated with microbes that are harmful. What method of food and beverage protection did Pasteur develop, and how does it work?

8. What questions do you have about the fermentation process? What might you want to investigate about pasteurization?

Preparing to do the experiment

Pasteur thought yeast was a "small plant," but today we know that it is really a microscopic fungus that consumes sugar to produce carbon dioxide, alcohol and energy.

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 + 2ATP$

Sugar → ethanol (alcohol) + carbon dioxide + energy

1. Yeast produces carbon dioxide, a gas, as it ferments sugar. What do you expect will happen to the balloons?

2. How do you think the water temperature will affect gas production?

3. The data you collect in this experiment will be graphed. What units will you use on the x axis and the y axis?

4. What temperatures should the class test (starting at room temperature, approximately 22° C)?

5. What should the control group be in this experiment?

6. What should be the length of time for each trial?

7. If time permits, how many trials should ideally be run at each temperature?

8. How can we measure the amount of gas produced, and what scientific unit could we use?

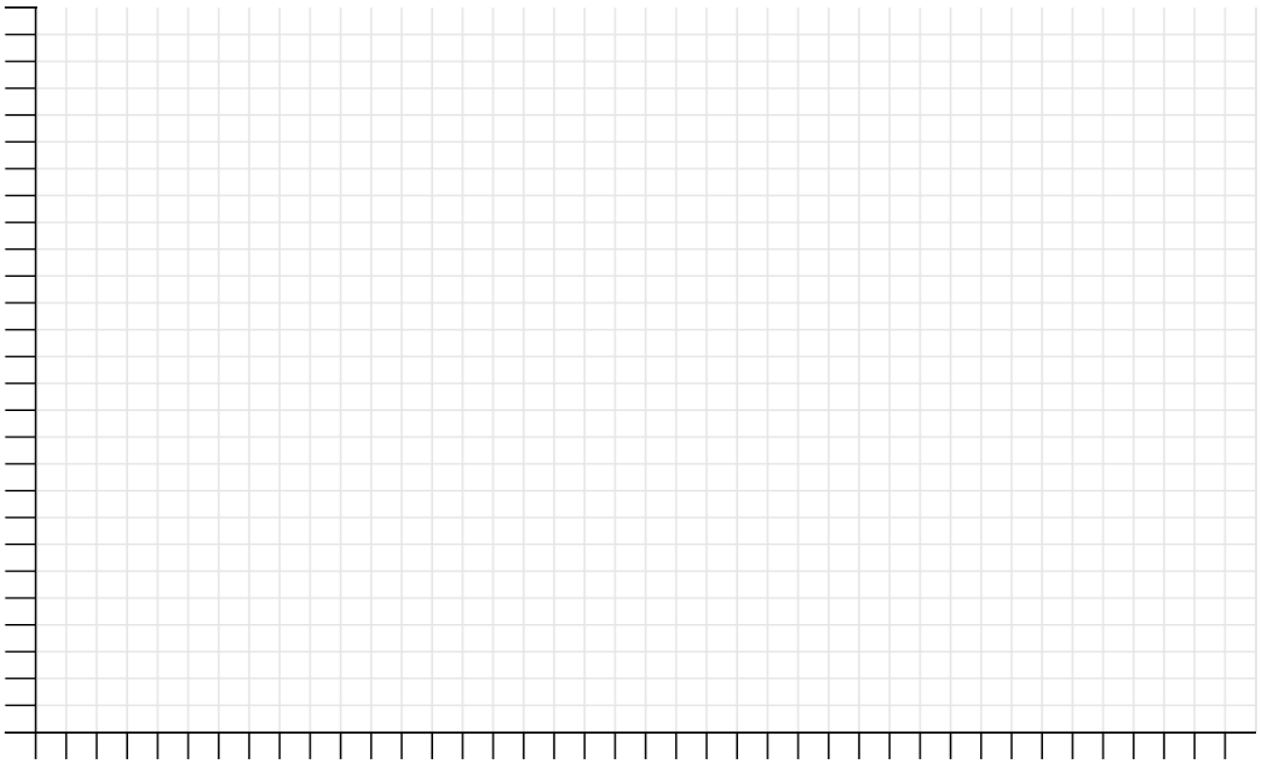
Fermentation experiment

With the experimental design you decided on as a class, prepare your yeast and sugar solution. As the yeast in the bottle ferments sugar, it will produce carbon dioxide and inflate the balloon. Record your circumference in the chart, calculate your volume and graph your data below.

1. Measure the circumference of your group's balloon and record it in your chart and on the board. Calculate the volume of your group's balloon and add the data to the chart using the formula: $V=(c^3)/(6\pi^2)$, where c represents the circumference. Continue to fill in the chart as other groups add their data to the board.

Group	**Control** 22° C	**Test Temperatures (in ° C)**								
		28	34	40	46	52	58	64	70	76
TRIAL 1 Circumference (cm)										
Volume (cm^3)										
TRIAL 2 Circumference (cm)										
Volume (cm^3)										
TRIAL 3 Circumference (cm)										
Volume (cm^3)										
TRIAL 4 Circumference (cm)										
Volume (cm^3)										
TRIAL 5 Circumference (cm)										
Volume (cm^3)										

2. Graph the volumes from each group. Remember to label your graph and axes.



3. What is it important to record what happens with the control group?

4. What was the relationship between gas volume and temperature?

5. At what temperature did the most fermentation occur? How could you tell?

6. At what temperature did yeast stop fermentation and gas production? How could you tell?

7. How might we know that the yeast died due to pasteurization?

8. How has learning about Pasteur's discoveries influenced your views about what you eat?

9. What other question would you like to answer about microorganisms in food?

Activity extension: Now that you have explored the history of Louis Pasteur and the importance of pasteurization, discover what diseases pasteurization prevents. Go online to search for clues and create a poster to educate people about pasteurization and food safety.

These prompts can guide your research. You can also ask your own questions.

1. What is a foodborne illness?

2. Name a foodborne illness that can be caused by drinking contaminated milk.

3. What are the symptoms of this disease?

4. Have there been any recent outbreaks of this disease? If so, what food products caused this outbreak?

5. Even pasteurized food can cause foodborne illnesses. Why is this the case?

6. Create a poster that shows how pasteurization protects people from your foodborne illness.