Dairy

*Lesson Plan for Grade 6 , English Language Arts*

*Prepared by NAITC*

*Modified by Mississippi State University, School of Human Sciences*

*for Mississippi Farm Bureau Federation - AITC*

# OVERVIEW & PURPOSE

Students will learn the role of bacterial fermentation and evaluate the effect of fat content, sugar content (lactose), and temperature in bacterial fermentation as they make yogurt.

# EDUCATION STANDARDS

**Mississippi College-and-Career Readiness Standards:**

RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

SL.6.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others’ ideas and expressing their own clearly.

**NALOs**

T3.6-8.b Evaluate food labels to determine food sources that meet nutritional needs

T3.6-8.e Explain the benefits and disadvantages of food processing

T3.6-8.g Identify agricultural products (foods) that provide valuable nutrients for a balanced diet

T3.6-8.i Identify sources of agricultural products that provide food, fuel, clothing, shelter, medical, and other non-food products for their community, state, and/or nation

OBJECTIVES

* Students will evaluate the effect of fat content, sugar content, and temperature in bacterial fermentation.
* Students will be able to discuss each step of the yogurt production process.
* Students will be able to list the two types of bacteria required for yogurt production.

# MATERIALS NEEDED

Interest Approach

* [How It's Made: Yogurt](https://www.youtube.com/watch?v=kecBi27dhjw) video

Teacher Materials:

* 2-3 hot plates or 1 double burner to heat milk
* 3 thermometers (Celsius or Fahrenheit)
* 3 or 4 medium to large pots
* 4 heavy-duty plastic bottles to hold hot water (8 ounces or larger)
* water
* 2 medium or large coolers for incubation (20 oz. or larger)
* Plain yogurt (1 - 6 ounce container provides enough yogurt for 1 class)
* Ice (enough for 1 cooler)
* Lactose-free milk (heat 1 cup per assigned group)
* Skim milk (heat 1 cup per assigned group)
* Whole milk (heat 1 cup per assigned group plus 2 additional cups) (seestep *4-5* in *Procedures*)
* 2 styrofoam cups labeled “whole milk- cold”

Student Materials, per group of 4-5 students:

* Styrofoam cup
* 1 Liquid measuring cup
* 1 Black permanent marker
* 1 Tablespoon
* 1 Thermometer (Celsius or Fahrenheit)
* 1 - 4x4 square aluminum foil
* 1 Cup of assigned heated milk
* 1 Paper cup containing slightly more than 1 tablespoon of plain yogurt
* Safety goggles
* aprons (optional)

Lab Extension Materials:

* Active culture sample (store bought plain yogurt)
* 1 microscope slide and cover slips
* 1 microscope cell stain
* 1 medicine dropper
* 1 small cup of water

Essential Links:

* [Magnificent Microbes lab sheet](https://cdn.agclassroom.org/media/uploads/2017/03/14/Magnificent_Microbes.pdf)
* [Magnificent Microbes Teacher KEY](https://cdn.agclassroom.org/media/uploads/2017/03/16/Magnificent_Microbes_Teacher_KEY.pdf)

# Lesson Set Up:

Review information found in the Background Agricultural Connections section of the lesson, lesson Procedures, and the attached Essential Files.

Note that this lab investigation will take two days to complete. Students will set up the lab investigation on day 1 and will complete the investigation on day 2.

Interest Approach:

* Have the video [How It's Made: Yogurt](https://www.youtube.com/watch?v=kecBi27dhjw) displayed on the screen

Teacher Preparation:

* Prepare materials for each group. It is recommended that you plan approximately one-week ahead to allow time to gather needed materials. You will need to have coolers and ice on hand the day the investigation begins. Additional coolers may be needed if you plan to complete the lesson with multiple classes.
* Assign each group a milk type. During the investigation, each group should receive 1 cup of their assigned milk type. For example, if you have six groups, two groups will receive 1 cup of heated lactose-free milk, two groups will receive 1 cup of heated skim milk, and two groups will receive 1 cup of heated whole milk (each heated to 175° F).
* You will also need to heat an additional 2 cups of whole milk for student observations of heated whole milk placed in a cold environment. After heating the milk to 175°F, allow it to cool to 120°F. Pour 1 cup of milk into two separate styrofoam cups. Then stir in 1 Tbsp. of plain yogurt.
* Toward the end of the investigation:
  + Boil enough hot water to fill the four heavy-duty plastic bottles with very hot water and place them in one of the coolers. This will act as an incubator for the warm environment.
  + Fill the second cooler with enough ice to fill half way. This cooler will act as the cold environment. If accessible, a refrigerator can be used as an alternative to the cooler.
  + Each group will leave 1 cup of their assigned milk type (whole milk, lactose-free milk, or skim milk) in the warm cooler. For the class to observe, you should also place 2 cups, filled with heated whole milk, in a cold cooler (ice-filled) overnight.
  + Students will record observations the following day.

# Vocabulary

**active cultures**: also called a live culture; this is a colony of living microorganisms (e.g. bacteria), growing within a substance such as yogurt. Active cultures are responsible for turning milk into yogurt through fermentation

**bacteria**: single celled organisms that can multiply through cell division

**fermentation**: a food-based reaction caused by the action of enzymes that breaks compounds into simpler substances; used for food preservation and preparation

**yogurt**: a milk-based food product that is prepared from the bacteria of fermented milk

# Ag Facts:

* Yogurt was created by accident. Many historical accounts attribute the origins of this creamy treat to primitive methods of milk storage in containers made of animal stomachs. The natural enzymes curdled the milk resulting in what we now know as yogurt.
* Yogurt is alive with "good" bacteria called l*actobacillus bulgaricus* and *streptococcus thermophilus* which improves digestive health.
* Dairy generated $24 million in Mississippi in 2020.
* 8,500 milk cows in Mississippi in 2020.
* 65 Grade A dairy herds in Mississippi in 2020.

# Background Information for Teacher:

Milk, cheese, yogurt, and ice cream are all part of the dairy group. Drinking milk helps build strong bones. Unfortunately, most Americans do not drink or eat enough foods from the dairy group every day. For this reason, it is important to learn about the science and nutrition of dairy foods. In this lesson, students will explore milk by learning about the role of bacteria in yogurt production and the many health benefits associated with consuming dairy products.

When milk is **fermented** with **bacteria**, the sugar in milk, lactose, will turn into lactic acid. The lactic acid will cause the milk to curdle and thicken. This process is used to make certain dairy products, like yogurt. **Yogurt** is made by mixing two types of bacteria, Lactobacillus bulgaricus and Streptococcus thermophilus. In mass yogurt production, bacteria are added to milk and the mixture is heated. The heating process promotes fermentation and helps the yogurt develop the desired consistency, flavor and acidity. Once the desired consistency has been reached, the fermentation process is stopped. The yogurt can then be chilled or heated. Chilling allows the bacterial culture or **active culture** to stay alive. If the yogurt is heated, the cultures are destroyed. Consuming these products will help maintain and/ or restore normal intestinal bacteria.

# LEARNING PROCEDURES

Interest Approach:

1. Tell students that you are thinking of a food that requires bacteria and fermentation to make. Allow students time to think, then ask them if they can name the food you are thinking of *(yogurt)*.
2. Provide further clues until students can identify yogurt as the food you are thinking of. Examples include:
   1. This food is considered "live" because it has active bacteria cultures.
   2. This food contains "good" bacteria that aids in digestion.
   3. This food is sweet, tangy and creamy.
   4. It comes in many forms including low fat, fat free, and Greek.
3. Ask if students know how yogurt is made. Show the video clip, [How It's Made: Yogurt](https://www.youtube.com/watch?v=kecBi27dhjw).

Lab Procedure:

1. Distribute lab materials. It is recommended that materials are organized into stations for easier distribution. Students should be arranged in small groups of 4-5. Each group shouldreceive the lab supplies outlined in the *Materials* section as well as 1 copy of the *Magnificent Microbes* lab sheet.
2. Before beginning the lab investigation:
   * Require students to wash their hands.
   * For food safety reasons, DO NOT allow students to taste any of the yogurt samples. It is not safe to taste samples due to the inability to completely control contamination from bacteria present in the surrounding environments. If you would like your students to taste different types of yogurt, purchase pre-packaged yogurt from a store. Packaged yogurt should be refrigerated until tasting.
   * Emphasize the importance of practicing good food safety behaviors by not consuming substances used as part of the lab investigation.
3. Launch **Day 1** of the lab by asking students to make a prediction about which milk type will produce the most yogurt and why (see top of page 2 of the lab sheet.
4. You (teacher) should prepare the milk (see *Teacher Pre-Lab Preparation*). Students will allow milk to cool and then mix in plain yogurt. Yogurt is produced from bacterial fermentation of milk. The lactose in milk is fermented by the bacteria. Bacteria or “yogurt cultures” used to make the yogurt in this lab are obtained from the addition of the plain yogurt. The bacteria will ferment the lactose present in the milk and produce lactic acid. The lactic acid will act on the milk protein, providing yogurt with its characteristic texture and tang.
5. Instruct students to make visual observations of their assigned milk type. Students should specifically observe the texture, color, and odor. Groups should then be allowed to share their assigned milk types to allow students to complete Table A on the 4th page of their lab sheet.
6. Begin **Day 2** of the lab by showing students the provided video lab demonstration, [Lab: Magnificent Microbes](https://youtu.be/4pYYuSWdoY4?t=2m14s). The video will help students understand what they should see in their milk mixtures on day two of the lab.
7. Instruct students to gather the milk samples they stored on day 1. Students should make observations of their assigned milk type. Students should specifically observe differences in texture, color, and odor. Do not forget to pass out the cold storage whole milk samples for students to observe. Observations should be recorded on Table A of the lab sheet.
   * *Lactose-free Milk* (Warm Storage): Students should observe a small amount of liquid on top of the milk. When stirring, the milk should have a thick texture; however, compared to skim and whole milk the texture will be less thick. This milk type will be less thick compared to skim and whole milk due to the absence of lactose. Typically in yogurt production, lactose is fermented by the bacteria producing the lactic acid needed to produce yogurt.
   * *Skim Milk* (Warm Storage): Students should observe very little liquid on top and the thickness should be between Lactose-Free and Whole Milk-Warm.
   * *Whole Milk* (Cold Storage): Students should observe no formation of yogurt, however, a small amount of liquid may be produced.
   * *Whole Milk* (Warm Storage): Students should observe formation of a thick yogurt with little to no liquid produced on top. The comparison between the cold and warm storage will demonstrate the role of temperature in yogurt production. Warm temperatures are needed to encourage bacterial growth. Temperatures that are too hot or cold will negatively impact bacterial growth and may cause denaturation of the milk proteins.
8. Allow students to work in small groups on the *Magnificent Microbes* lab sheet and respond to lab questions. Encourage students to refer to the table in the reading to help support their conclusions. Answers to the questions can be found in the attached Teacher Key.
   * (Optional) Launch the lab extension by allowing students to observe an active yogurt culture under a microscope.

**Concept Elaboration and Evaluation**

After conducting these activities, review and summarize the following key concepts:

* When milk is fermented with bacteria, the sugar in milk, lactose, will turn into lactic acid. The lactic acid will cause the milk to curdle and thicken. This process is used to make certain dairy products, like yogurt.
* Yogurt is made by mixing two types of bacteria, Lactobacillus bulgaricus and Streptococcus thermophilus.
* Consuming products, such as yogurt, will help maintain and/ or restore normal intestinal bacteria.

Additional Learning Procedures

To help students review and elaborate more about dairy, try using the [“Think Pair Share”](https://drive.google.com/file/d/1qq9tS-89Zvb_DrZ8N867ZwG_wHL02nr2/view?usp=drive_link) method to allow students to think deeper and make new connections.

Additional Things to Consider:

[Kiss the Cow!](https://agclassroom.org/matrix/resource/27/)

[Make Mine Ice Cream](https://agclassroom.org/matrix/resource/224/)

[The Perfect Barn](https://agclassroom.org/matrix/resource/1000/)

[Jack & the Hungry Giant Eat Rice](https://agclassroom.org/matrix/resource/286/)



Source: <https://www.agclassroom.org/teacher/matrix/>

*The MS Farm Bureau Women’s Committee has additional resources to help aid you in this lesson with a lifesize cow prop, please contact Dedra Luke at 601-977-4169 to learn more!*

*For more information and additional lessons visit*

*https://msfb.org/ag-in-the-classroom/lesson-plans/.*