Dairy

*Lesson Plan for Grade 4, Mathematics & Science*

*Prepared by NAITC*

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

*for Mississippi Farm Bureau Federation - AITC*

# OVERVIEW & PURPOSE

In this lesson, students will investigate the physical changes that occur as milk is turned into butter.

# EDUCATIONAL STANDARDS

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

4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm, mm; kg, g, mg; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.

ELA-W.4.9 Draw evidence from literary or informational text to support analysis, reflection, and research.

ELA-SL 4.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 4 topics and texts, building on others’ ideas and expressing their own clearly.

**NALOs:**

T3.3-5 b Diagram the path of production for a processed product, from farm to table

# OBJECTIVES

* Students will examine the physical changes that occur as milk is turned into butter.

# MATERIALS NEEDED

Activity 1

* [Making Butter Observation Sheet](https://drive.google.com/file/d/1u4pb2Hnmrblvgq_tSWTFJKkrcDtBLWhT/view?usp=drive_link), 1 per group
* ¼ cup heavy whipping cream at room temperature per student
* Baby food jars or small jam jars, 1 per group
* Timer, 1 per group
* Kitchen Scale
* Butter Knife, 1 per group
* 2 crackers per student
* Glass Bowl
* Microwave
* Handmixer

Activity 2

* Collection of items to create a variable change (various sizes of containers, various types of milk, marbles, microwave, ice, etc.)
* 11 X 17 white paper, 1 per student

Essential Files:

* [Making Butter Observation Sheet](https://drive.google.com/file/d/1u4pb2Hnmrblvgq_tSWTFJKkrcDtBLWhT/view?usp=drive_link)

# Lesson Set Up:

Activity 1:

1. Collect necessary materials.
2. Divide students into groups either before or during class.
3. Prior to class, print 1 copy per group of the attached [Making Butter Observation Sheet](https://drive.google.com/file/d/1u4pb2Hnmrblvgq_tSWTFJKkrcDtBLWhT/view?usp=drive_link).
4. Distribute necessary materials to each group.

Activity 2:

1. Collect necessary materials.
2. Divide students into the same groups from Activity 1.
3. Distribute an 11 X 17 white piece of paper to each student.

# VOCABULARY

**buttermilk:** the liquid that is left after butter has been made from milk or cream

**chemical change:** a change that results in the formation of a new chemical substance through the making or breaking of bonds between atoms

**churn:** to make (butter) by stirring or shaking cream

**colloid:** a substance in which particles of one substance are dispersed through another substance

**emulsion:** a mixture of liquids in which small drops of one liquid are mixed throughout another liquid

**homogenized:** to treat (milk) so that the fat is mixed throughout instead of floating on top

**physical change:** a change from one state (solid, liquid, or gas) to another without altering the chemical composition of the substance

# Ag Facts:

* It takes 2.5 gallons (21.8) pounds) of whole milk to make 1 pound of butter.
* On opening day of the Minnesota State Fair, the state dairy princess, known as Princess Kay of the Milky Way, has her likeness carved in a 90-pound block of Grade A butter.
* Butter is most frequently made from cow's milk, but can also be made from the milk of other animals including sheep, goats, and buffalo.
* There were 8,500 milk cows in Mississippi in 2020.

# Background information for teachers:

Fresh milk is a mixture of cream and milk. The cream is less dense than the milk causing it to separate and rise to the top where it can be skimmed off. The milk left behind is called *skim* or *fat-free* milk. When fresh milk is taken from the dairy farm to a milk processing plant, it is separated from the cream in order to mix the precise amount of cream and milk to make 1%, 2% or whole milk. This process is called **standardization**. To accelerate the separation of cream from milk on a large scale, dairy processing plants use a machine called a centrifugal separator to help with this process.

Milk purchased from a grocery store does not separate. This is possible due to a process called **homogenization.** Homogenization shears the fat globules in the cream into smaller piecesmaking the milk and cream the same density so it does not separate.

Butter is a dairy product made by **churning** cream to separate the buttermilk from the butterfat. Heavy cream is an **emulsion.** Tiny globules of fat are suspended in a watery solution. Churning the cream forces the fat globules to slam into one another. If they hit each other with enough force, they will stick together eventually forming a chunk of butter. After removing the butter, a watery liquid will remain with small butter grains floating in it. This liquid is called **buttermilk**. The butter is rinsed, pressed, and kneaded to remove any remaining pockets of buttermilk or water. Butter remains a solid when refrigerated, softens to a spreadable consistency at room temperature, and melts to a liquid consistency at 32-35°C (90-95°F).

A **chemical change** is a change that results in the formation of a new chemical substance through the making or breaking of bonds between atoms. A chemical change creates a new chemical substance that typically has different physical properties when compared to the original substance. When a substance has undergone a chemical change, the process cannot be reversed. A **physical change** is a change from one state (solid, liquid, or gas) to another without altering the chemical composition of a substance. When a substance has undergone a physical change, the process can be reversed.

Three basic states of matter found on Earth are solid, liquid, and gas. The term, **colloid**, describes a substance that is a combination of different states. Colloids are made of tiny particles of solid, drops of liquid, or bubbles of gas that are evenly distributed throughout a liquid. They are not dissolved in the liquid and do not settle to the bottom or float to the top. Emulsions and foam are two types of colloids. Milk and cream are emulsion colloids with tiny globules of fat thoroughly mixed throughout water. Whipped cream is a foam colloid with tiny air bubbles thoroughly mixed throughout liquid cream.

Turning milk into butter is a physical change because the milk is changed from a colloid (cream) to a solid (butter) without altering its chemical composition. This physical change is reversible. The butter can be melted and mixed with the leftover buttermilk to make cream again.

# LEARNING PROCEDURES

Interest Approach:

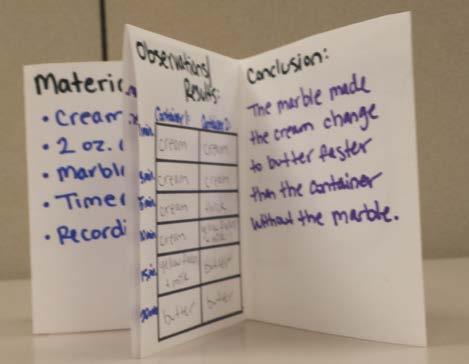
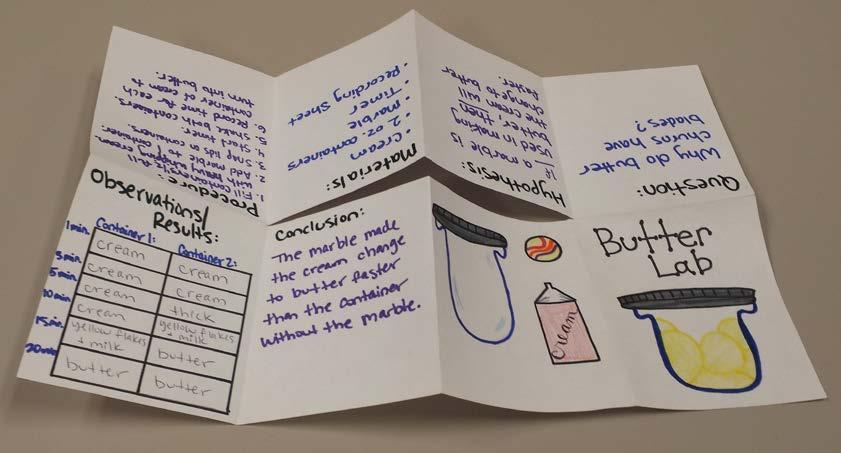
1. Ask the students to identify products made from milk. Examples include milk, butter, cheese, yogurt, cottage cheese, sour cream, ice cream, whipped cream, pudding, and cream cheese. List the items on the board.

2. After students have time to think and offer answers, explain to the students that all of these products begin on a dairy farm. Take the class on a virtual field trip to a dairy farm by viewing the video [From a Farm Family Near You: Bohnert Dairy Farm](https://www.youtube.com/watch?v=jaS0DdWX1mI).

**Activity 1: Making Butter**

1. Organize students into small groups. Provide each group with a small jar, heavy whipping cream, a timer, access to a kitchen scale, crackers, and a butter knife.
2. Each group should weigh their empty jar with the lid and record the weight on their *Making Butter Observation Sheets*.
3. Instruct the groups to pour the whipping cream into the jars until each jar is half full. Have the students note the appearance and consistency of the cream and record their observations. The groups should seal the lids tightly, weigh the jar, and record the weight.
4. Tell the groups to start their timers and begin shaking the jars. Group members should take turns shaking. You may choose to play music to encourage the movement.
5. Instruct the groups to stop shaking, pause their timers, and observe the contents of their jar every two minutes. Have them note the appearance and consistency of the cream and how it is changing on their observation sheets.
6. The groups should stop their timers and record the time when the solid butter has separated from the buttermilk. It will take 4-10 minutes to get to this point.
7. Allow time for the groups to weigh their jar of butter and buttermilk with the lid. Record the weight. Ask students to compare the weight of the heavy whipping cream to the weight of the butter and buttermilk. Did the weight change? Explain to the students that the weight of matter stays the same when it changes form.
8. Have the students spread their freshly made butter onto the crackers for a taste test.
9. Use the *Background Agricultural Connections* section of this lesson to discuss the difference between chemical and physical changes. Ask the students, "Is turning cream into butter a chemical change or a physical change and why?" (*It is a physical change because the change did not alter the chemical composition of the cream.*) "What factor caused the physical change?" (*churning*) "What states of matter were observed during the different stages of the butter-making process?" (*The cream is a colloid. When it is churned, it first turns into a foam (whipping cream) and then separates into a solid (butter) and a liquid (buttermilk).)*
10. Remind students that physical changes are reversible. Demonstrate the process of changing butter back into cream. In a microwave, melt the butter in a glass bowl. Pour in the buttermilk that was leftover from making the butter. Use a hand mixer to beat the mixture until it reaches the consistency of cream.

**Activity 2: Changing Variables** 

1. Discuss the idea that changing variables when making butter may affect the outcome. Temperature, time, container size, types of milk, and the addition of an agitator like a marble are examples of variables that can be tested.
2. Place students back into the same groups from *Activity 1*. Show the students the materials you collected for changing variables. Explain to the class that each group will develop a question and hypothesis regarding how a variable change might affect the butter-making process. Limited to the materials in front of them, the groups will plan and carry out an investigation to test how a changed variable affects the outcome of the butter.
3. Hand out an 11 x 17 piece of white paper to each student. Have each student create a foldable booklet for recording their data and observations and sharing their groups' findings.
4. Fold the paper in half vertically (hot dog fold) and crease.
5. Open the paper to the original size and fold in half horizontally (hamburger fold) and crease. Fold each side up from the opening to the middle and crease. The page should be folded to show impressions for eight identical pages.
6. Cut or tear the center crease line from the middle fold to the first crease.
7. Open and fold like an accordion to make a continuous book.
8. Write the title of your group's investigation on the front cover. Label each page in order—Question, Hypothesis, Procedure, Observations/Results, Conclusion. The back cover can be left blank or decorated.
9. After the investigations and booklets are completed, have each group share a summary of their group's investigation with the class.  
     
   

**Concept Elaboration and Evaluation**

After conducting these activities, summarize the following key points:

* Milk, typically produced by cows, is used to make butter, cheese, ice cream, yogurt, and other dairy products.
* A physical change takes place when a substance changes from one state (liquid, solid, or gas) to another state without altering the chemical composition of the substance.
* Changing milk to butter is a physical change.

# Additional Learning Procedures

To help students review and elaborate more about dairy, try using the [“Think Pair Share”](https://drive.google.com/file/d/1VfX8Ze7tKhdzLDghL0GG7PszNLycb-AN/view?usp=drive_link) method to allow students to think deeper and make new connections.

Additional Texts to Include:

[Out and About at the Dairy Farm](https://www.agfoundation.org/recommended-pubs/out-and-about-at-the-dairy-farm)

[What’s for Lunch, Milk](https://www.agfoundation.org/recommended-pubs/whats-for-lunch-milk)

[An A-MAZE-ing Farm Adventure](https://www.agfoundation.org/recommended-pubs/whats-for-lunch-milk)



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/.*