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| **Got Safe Milk:****How temperature affects food safety****and quality**.Author: Oseremi Olivia Jagbojo |
| **Unit Overview**  |
| **Target Audience:** 4 - 5th grade | **Est. Time:** six 50-minute class periods | **Content Area(s):** Dairy Science, FoodScience |
| **Abstract:**Milk is a natural drink that contains valuable and essential nutrients. In some families, no day goes by without consuming milk or some form of milk product. This mini-unit has been designed to give children an introduction to milk bacteria, milk storage, and the importance of maintaining appropriate storage temperature. Refrigeration is the single most principal factor in maintaining milk quality and temperature control is critical. Students will learn about temperature and how its relationship with the multiplication of bacteria cells in milk. They will also learn about ways through which bacteria can contaminate dairy milk.They will be introduced to the second law of thermodynamics and learn that heat is perpetually moving- through this lesson students will also discover that all materials do not conduct heat the same way i.e., although heat is moving, it does not very easily through certain materials.students will use what they learn to connect the concepts of heat transfer and temperature change to maintaining food quality. Through this lesson, students will determine appropriate storage conditions for dairy products and determine whether it was still fit for human consumption.Learner-centered approaches would be employed and taught using inquiry and problem-based learning methods. Storytelling would also be incorporated as a teaching method to provide a sense of community and a medium for connecting to the student’s lives. Specifically, storytelling would provide the framework for evidential reasoning in understanding the concepts that would be taught.Young children can grasp the basic concepts of food safety and how it affects them as human beings. Using milk as the baseline food example and through the relatable activities in this plan, teachers would be guiding the children into discovering and gaining new knowledge as well as appreciating the application of some fundamental science and math principles like thermodynamics, graph plotting, and solving mathematic word problems. |
| **Unit Goals/Objectives:**Students will be able to….* Outline management practices to eliminate potential contaminants.
* Explain how bacteria multiply.
* Demonstrate knowledge of how milk temperature affects the quality of the milk
* Explain how milk can be stored
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| **Lesson Summaries:**Lesson 1 – Milk bacteria Students will be introduced to food safety in dairy production. They will learn about contaminants and sources of contamination. Students will analyze a case of milk contamination and come up with their hypothesis. We will explore bacteria present in milk. We will talk about management practices to ensure that dairy milk is kept safe for consumption from the farm until it reaches the consumers. Students will be presented with a scenario where they can calculate the rate of bacteria growth within a period.Lesson 2 – Milk Temperatures In this lesson, students will learn about temperature changes. After which they will learn the differences between heat and temperature. The group will carry out a heat transfer activity. The class will be divided into 3 groups, each group will be handed one glass of hot water and 1 metal spoon, on each spoon is asmall scoop of butter. The spoon handle will be placed inside the hot liquid and at every 5-minute intervalthey will record their observations. They will all be asked to discuss their observations and explain the reason. Students will learn that heat is constantly in motion and we will discuss why maintaining the specific temperature of the dairy milk is important for it to remain safe for consumption.Lesson 3 –Milk Storage Students will learn the importance of expiration dates on milk containers and how to check them. They will be able to apply the same knowledge to verify the safety of other kinds of food.Students will learn the right way to store milk safely and why refrigeration is important. They will learn about some milk-handling tips.Students will learn how to apply food storage principles in deciding food safety. |
| **Lesson Timeline:** 50 minutes per lesson.Lesson 1:Milk Bacteria* Introduction (5 minutes)
* Pre-assessment note cards – Write what you understand by the phrase ‘*it is contaminated*’ (5 minutes)
* Introduce the moon milk story and allow students to work in small groups and develop their hypothesis (10 minutes)
* Let students think of how bacteria (living organisms) in milk can cause spoilage (5 minutes)
* Using play dough guides students to answer mathematics word problems and lets them determine the count of bacteria via binary fission (20 minutes)
* Wrap up (5 minutes)

Lesson 2: Milk Temperature* Introduction (5 minutes)
* Review the lesson (10 minutes)
* Heat transfer activity (20 minutes)
* Discussion (10 minutes)
* Notecards and wrap up (5 minutes)

Lesson 3: Milk storage* Introduction (5 minutes)
* Review lessons 1 and 2 (10 minutes)
* Let students contemplate how to tell that dairy milk is fresh (10 minutes)
* Discussion about expiration dates and what it means (5 minutes)
* What to do activity (10 minutes)
* Discussion about milk handling tips at home (5 minutes)
* Wrap up (5 minutes)
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| **Lesson 1: *Milk Bacteria*** |
| **Est. Time:** 50 minutes |
| **Lesson Learning Goals/Objectives:*** Outline management practices to eliminate potential contaminants.
* Explain how bacteria multiply.
* Demonstrate knowledge of how bacteria can contaminate dairy milk.
 | **Standards:***National:***FPP.01.01.01A.** Research and summarize the purposes and objectives of safety programs in food products and processing facilities.**FPP.01.02.01A.** Examine and identify contamination hazards associated with food products and processing.**FPP.01.02.01A.** Outline procedures to eliminate possible contamination hazards associated with food products and processing.*State:***EA-7.3** Recognize food safety principles and management techniques. |
| **Assessments****Pre-Assessment:** Pre-assessment note cards.**Formative:** Ask students to signify by raising their hands their understanding as the lesson proceeds. **Summative:** Ask a set of questions to assess student’s level on the lesson objective (let children give a chorus answer). Please note that assessment questions have been attached to the lesson plan. |
| **Vocabulary:** food safety, dairy milk, management practices, micro-organisms, binary fission |
| **Materials & Technology Needed:** computer and projector for instructor, slides, paper, play dough |
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| **Lesson Component** | **Instructions** | **Materials** |
| **Introduction***10 minutes* | **Pre-assessment*** Let all the students write what they understand by the phrase

‘it is contaminated’* Give an overview of what we will be learning about milk safety and bacteria.
 | Notecards Pencils/Pens |
| **Problem-solving activities***35 minutes* | * Tell a story about the ‘moon milk’ to create the context for the

problem.* Provide details of the story: Once upon a time in a faraway kingdom, two Princes were commanded to go on a journey to get a special milk drink called *moon milk*. The ‘purity’ of the milk will be determined and the Prince who can return with the milk still in its pure form will be crowned

king. Prince Abu and Prince Zazu successfully received the pure moon milk. On their way back had to choose to pass through either one of two caves. Prince Abu went through cave A, inside, he was very cold and shivered as he journeyed through, Prince Zazu on the other hand went through cave B, it was quite warm and he enjoyed every moment as he journeyed through. When they arrived, their moon milk was tested Prince Abu’s milk remained pure but Prince Zazu’s milk was no longer pure. Where did thecontamination in Prince Zazu’s milk come from?* Divide the class into 2 groups and ask each group to come up with a hypothesis to explain the source of the contamination.

**Answer** (The contaminant was already inside the bottle, the warm conditions in the cave ‘woke it up’)* **What is a contaminant?** Anything that can make a product unsuitable for its intended use. In the example of the ‘moon milk,’ the contaminant was invisible to the naked eye. Generally, some contaminants can only be seen under a microscope. They are called microorganisms. For example:

Bacteria.* **What are bacteria**? They are small single-celled organisms that can be found in **all-natural environments (**emphasis). There are different types of bacteria, some are good while some are harmful to our bodies and can make us sick. They can get into our dairy milk. Just like other living things, bacteria can grow.
* Let students answer the question ‘What do plants need to grow?’

by raising their hands (sunlight, water, soil)**.*** **What does bacteria need to grow**: nutrients and a conducive environment. Some bacteria can get nutrients from milk and if the temperature is right, it can encourage their growth.

**Note**: Total acceptable bacteria in pasteurized milk is 20,000/mL**Binary Fission activity:*** Using play dough, guide students in determining the bacterial count in a bottle of milk.
* **Question:** Bacteria *E. coli* doubles every 20 minutes. If there was only one cell in a cup of milk, how many would it be 1hr later
* **Answer:** There will be 8 counts of bacteria E. coli
* **Follow-up question:** How many will be in the cup of milk 30 minutes later?
* **Answer:** There will be 16 counts of bacteria E. coli

**Note**: Show a pictorial illustration of how bacteria multiply.Students will work in groups. When they arrive at the answer they areto exclaim: *“Binary Fission”*. | worksheet Computer PowerPoint presentationPlaydough |
| **Ask students:** Have you ever heard the term food safety? Follow up question do you think it means?Provide the adapted form of the USDA definition below:Food safety refers to the conditions and practices that preserve the quality of food and prevent contamination and illness.NOTE: Definition can be adapted to suit the language level of 4th graders.Show a pictorial illustration of how milk travels from the farm to the table.* **Ask**: Can anyone tell us how bacteria might get into the milk? **Answer**: cow udder, germs in the environment, insects, dairy workers, insects, unsanitary conditions.
* **Ask:** Can anyone tell us why it is important to wash our hands after using the restroom, or after playing outside?
* **Ask**: Can anyone tell us what we can do to prevent or eliminate contamination from the farm till it reaches the consumers? **Answer**: wash cow udder and equipment thoroughly, disinfect, use heat to kill the microbes, and keep refrigerated.

Have students explain how they think these management practices can prevent contamination. |  |
| **Wrap Up,***5 minutes* | **Recap what we discussed:** Contamination, contaminants, food safety, bacteria, and management practices in the dairy industry.**Assessment: 3-2-1 card.**Before they leave, students should 3 things they have learned, one thing they found interesting, and one question they still have. | Notecards, questions written on the board |
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| **Resources:** <https://ask.usda.gov/s/article/What-does-food-safety-mean> |

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| **Lesson 2: *Milk Temperature*** |
| **Est. Time:** 50 minutes |
| **Lesson Learning Goals/Objectives:**1. Define temperature and highlight its effects on food quality.
2. Explain the difference between heat and temperature.
3. Explain the concept of heat flow.
4. Apply the knowledge of heat flow to maintaining dairy milk quality and safety to other foods in general.
 |  **Standards:** *National***HS-ENV2-1:** Construct and revise an explanation based on evidence for the cycling of matter through sources and sinks and how energy is transferred.**FPP.01.01.01A.** Analyze and document attributes and procedures of current safety programs in food products and processing facilities.**FS-5.3** Explain the application of chemistry and physics to food science.**FPP.01.03.01A.** Identify and summarize the purposes of foodstorage procedures. |
| **Assessments****Pre-Assessment:** Ask two true or false questions to test retained knowledge from the previous lesson.* Bacteria multiplies very quickly a) True b) False
* Contamination can be prevented by washing and disinfecting a) True b) False

**Formative:** Ask students to signify by raising their hands their understanding of concepts as the lesson proceeds.**Summative:** Students will write 3 things they have learned, one thing they thought was interesting, and onequestion they still have. |
| **Vocabulary:** Temperature, Heat, Heat flow, Pasteurization |
| **Materials & Technology Needed:** computer and projector for instructor, slides, glass cups, metal spoon andhot water, thermometer |
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| **Lesson Component** | **Instructions** | **Materials** |
| **Introduction***10 minutes* | Review of last lesson: Go over what we learned last lesson and respond to the questions from the summative assessment note cards.Tell students we will be learning about temperature and how applies to milk safety**.** |  |
| **Instructional Activities****35** *minutes* | * Divide the class into 3 separate groups. Each group will have a glass containing hot milk. Scoop some butter on a metal spoon. Then dip the spoon handle into the cup.
* Let students take the temperature reading of the hot milk and record it.
* Ask each group to record their observations at every 10-minute interval.
* Ask: How can you tell the temperature of the hot milk? Ask a follow-up question how is the temperature of the hot milk different from the heat coming out of the cup?

Answers: Temperature is the measure of how hot or cold something is. It can be measured by using a thermometer.* Ask: What is heat? Answer: Heat is a form of energy and it flows from one object to another.

Heat flow: * Heat flows from one object to another because of a temperature difference. The cool object takes the energy and becomes warmer until both objects have equal temperatures. Usually, heat flows from the warm object to the cooler object. This is the second law of thermodynamics.
* Ask: Is raw milk from the cow warm or cold when it is collected?

Answer: WarmShow students a short video titled From Moo to youMilk transportation: When milk is collected from the cows, it is moved to a storage tank where it is quickly cooled before it is transported. It is driven to a processing plant in a giant tanker truck.* Ask: Why do you think the milk has to be cooled?
* Guide students in arriving at the correct answer by referring to the moon milk activity.
* Answer: Because bacteria need a temperature of 45 degrees and above to grow. It cannot grow when the temperature is cold. Cooling the milk will limit bacteria from growing and multiplying.

Temperature: Temperature is very important for food safety. If the temperature of food becomes conducive for bacteria to grow, the food will no longer be safe for consumption. Because heat is always moving, we cannot allow dairy milk to sit without doing something to keep it at the ideal temperature.Dairy Milk leaves the udder at a temperature of about 100 degrees Fahrenheit. It is very important to cool it very quickly. If milk is not cooled properly, the bacterial count will increase.How hot temperatures are used in the dairy industry.* Ask: Has anyone heard the word pasteurization before? Let students signify by raising their hands.

Pasteurization is a heat treatment that kills harmful microbes but does not affect nutritional value. There are two methods used:Traditional Pasteurization: where milk is heated to 161 degrees Fahrenheit for 15 secondsUltra-high temperature pasteurization known as UHT where milk is heated to 280 degrees Fahrenheit for one or two seconds.Both methods ensure milk is safe and healthy.Temperature value required for milk safetyIn Milk tank: 50 degrees Fahrenheit within the first hour and 40 degrees Fahrenheit within the second hourIn Refrigerator: 40 degrees Fahrenheit | Stopwatch, Glass cups, Butter, Spoon, Worksheets. |
| **Wrap Up,****Synthesis/Closure***5 minutes* | **Do a recap of what was discussed-** heat transfer, pasteurization, and the importance of temperature in milk safety.**Assessment: 3-2-1 card.**Before they leave, students should mention 3 things they have learned, one thing they found interesting, and one question they still have. | Notecards, |
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| **Resources:** [**https://www.youtube.com/watch?v=TcW8pwd4X0g**](https://www.youtube.com/watch?v=TcW8pwd4X0g) **(0:36 to 5:16) https://kids.britannica.com** |

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| **Lesson 3: *Milk storage*** |
| **Est. Time:** 50 minutes |
| **Lesson Learning Goals/Objectives:**1. Learn the importance of expiration dates on containers
2. Predict the storage environment of milk and milk products.
3. Learn about milk handling tips.
4. Learn the concept of shelf life
 |  **Standards:** *National***FS. 7.4** Analyze and document food preservation processes and methods on a variety of food products.**FPP.01.03.01C**. Prepare plans that ensure the implementation of proper food storage procedures**FPP.03.02.02 C.** Evaluate food quality factors on foods prepared for different markets. |
| **Assessments****Assessments****Pre-Assessment:** *Ask the class: Have you ever wondered if the milk in your refrigerator is still safe for consumption? Please raise your hand if yes***Formative:** Ask students to signify by raising their hands their understanding of concepts as the lesson proceeds.**Summative**: End of unit test. |
| **Vocabulary:** Expiration date |
| **Materials & Technology Needed:** computer and projector for instructor, slides, case study worksheet. |
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| **Lesson Component** | **Instructions** | **Materials** |
| **Introduction***10 minutes* | **Review of last lesson:** Go over what we learned last lesson and respond to the questions from the summative assessment note cards.Tell students we will be learning about how to store dairy milk at home. |  |
| **Instructional Activities***35 minutes* | **Milk sorting activity**Give students a worksheet showing pictures of 4 different dairy milk products with expiry dates written under them and let them sort them into two groups: Expired or not expired**Shelf life:** Food cannot be kept forever. After some time, it will go bad. After this time, it is no longer the best quality. Shelf life is the length of time that food can be stored. Expiry dates help us to know if the food is still safe. Other names of the dates on packages- ‘Best before’, ‘Use by’.**What is the best place to store dairy milk at home? (**Refrigerator**)****Remind** students in the last lesson we discussed why milk collected from the cow has to be rapidly cooled. **Recall:** Ask them if they remember any of these.‘What to do’ activity* Display different foods and provide information about expiry date, presence of bacteria, and required environment for bacteria growth.
* Children will complete the exercise.
* Displayed food: 1 sealed canned fruit, 1 opened canned fruit, opened milk in a carton, and a jar of milk.

**Discuss**: Is the expiry date all that we need to consider to determine food safety? Answer: No. Let students give other reasons.**In addition to what they may have mentioned:*** The condition of the package is important.
* How long a product has been sitting outside of the safe temperature environment

**Milk handling tips*** Milk should be the last grocery item you pick up before you leave the store.
* Return milk to the refrigerator after using.
* Do not pour unused milk back into the milk container.
* Do not keep milk in the refrigerator door, keep it inside the fridge where it is cooler.

Remember to check the expiration date before you consume. | Worksheet, computer, PowerPoint slides |
| **Wrap Up,****Synthesis/Closure***5 minutes* | **Recap what we discussed:** Expiration dates, milk handling tips**Assessment: 3-2-1 card.*** Before they leave, students should 3 things they have learned, one thing they found interesting, and one question they still have.

**Summative assessment reminder:** next class, students will have a test that covers lessons 1 to 3 | Notecards, questions written on the board |

***Formative Assessment***

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|  | Type of Assessment | Cues/Questions |
| Lesson 1 | Choral response/Hand signals | * Bacteria multiplies through a process known as (Binary fission)
* Some keywords when we talk about food safety include (prevent contamination and preserve quality)
* Bacteria can be seen with the naked eye only (No)
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**Summative Assessment Additional Explanation:** This assessment will be used for 4-5th grade students who have completed the *Got Safe Milk? How temperature affects food safety and quality*.

The following objectives will be measured in this assessment:

* Knowledge of Food Safety
* identify contamination sources of milk.
* Heating, Heat flow, and Pasteurization
* Knowledge of management practices on dairy farm
* Importance of expiry date
* Storage temperature

# ASSESSMENT QUESTIONS

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|  | **Temperature for bacteria growth (Fahrenheit)** | **Expiry date** | **What to do? (Fridge, shelf, trash)** |
| **A (unopened canned food)** | 70 degrees | 02/25/2023 |  |
| **B (opened canned food)** |  | 10/12/2024 |  |
| **C (milk in carton second use)** | 45 degrees | 11/12/2025 |  |
| **D (jar of milk, unused)** | 45 degrees | 04/22/2023 |  |
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***Got Safe Milk?***

 ***How temperature affects food safety and quality*.**

**End of Unit Summative Assessment**

# Name Date Score /20

**Directions:** Please answer all questions

1. Milk and milk products should be returned immediately to the refrigerator after use.

a) True b) False

1. All bacteria are bad. a) True b) False
2. When food has been contaminated, it is no longer good to eat it. a) True b) False
3. Bacteria can multiply. a) True b) False
4. Bacteria multiply very slowly. a) True b) False
5. By keeping the dairy farm clean, we reduce the chances of milk contamination. a) True b) False
6. Temperature is the measure of how hot or cold something is. a) True b) False
7. Heat does not flow from one object to another. a) True b) False
8. When milk leaves the udder of the cow it is very cold. a) True b) False
9. It is important to check the expiration date of a product before you consume it. a) True b) False