Upper Level Lesson 2: Milk Safety

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Standards:

These lesson tools meet the following Common CORE and PA educational standards.

Science: (PA Standards) S8.D.1.2, S8.B.3.3, S8.A.2.1, 11.3.6; **(Common CORE):** MS-LS1-5, MS-LS4-4, MS-LS4-5, MS-LS1-5, MS-LS4-4, MS-LS4-5, MS-LS1-5, MS-LS4-4, MS-LA4-5,

Reading: (PA Standards) R 1.1.8. A, R 1.6.8. A, R 1.8.8. A; **(Common CORE):** CCSS.ELA-LITERACY.RI.6.4, CCSS.ELA-LITERACY.RI.6.10, CCSS.ELA-LITERACY.W.6.1, CCSS.ELA-LITERACY.SL.6.1, CCSS.ELA-LITERACY.L.6.3, CCSS.ELA-LITERACY.L.6.4; CCSS.ELA-LITERACY.RI.7.4, CCSS.ELA-LITERACY.RI.7.10, CCSS.ELA-LITERACY.W.7.1, CCSS.ELA-LITERACY.SL.7.1, CCSS.ELA-LITERACY.L.7.3, CCSS.ELA-LITERACY.7.4; CCSS.ELA-LITERACY.RI.8.4, CCSS.ELA-LITERACY.RI.8.10, CCSS.ELA-LITERACY.W.8.1, CCSS.ELA-LITERACY.SL.8.1, CCSS.ELA-LITERACY.L.8.1, CCSS.ELA-LITERACY.L.8.3, CCSS.ELA-

Essential Question:

What steps ensure milk and dairy products are safe to consume?

Approximate Length:

This lesson has two parts. Teacher can choose to teach one part or both parts of lesson. Lessons and parts can be taught during one large block or divided into periods over 2 - 4 days. Each part should take about 60 - 70 minutes of class time, with these segments:

Segment	Responsible	Segment	Responsible
1) Lesson Overview — 5 min	Teacher	4) Lab Exercise — 20 min*	Students
2) Reading Passage — 10 min	Students	5) Lesson Review — 10 min	Class
3) Classroom Discussion — 10 min	Teacher/Class	6) Lesson Evaluation — 10 min	Teacher

**** In Part 2 of this lesson, the lab will be completed over course of four days. The lab will take about 20 minutes on Day 1, 15 minutes on Day 2, and 15 minutes on Day 4.***

Material List:

To complete the lesson and lab activities, you will need the following items:

- "Discover Dairy… And Milk Safety" Reading Passage (Copy for Each Student)
- "Discover Dairy … And Milk Safety" Lab Handout (Copy for Each Student)
- "Discover Dairy … And Milk Safety" UL Video Motivator (available to download or stream from www.discoverdairy.com or on the Discover Dairy Ipad Application)
- "Discover Dairy … And Milk Safety" transparency or graphics to project
- Projector or White Board to Show Motivating Video and graphics
- For Part I Lab: *(consider grouping students in groups of four and having these materials for each group)*
  - ⇒ 2% or whole milk
  - ⇒ Dishwashing liquid
  - ⇒ Plate
  - ⇒ Food Coloring
  - ⇒ Cotton Swab
- For Part II Lab: *(this lab should be conducted as an entire class)*
  - ⇒ 500 ml whole milk
  - ⇒ Fine-mesh cheesecloth
  - ⇒ Thermometer
  - ⇒ 50 ml, 500 ml, and 600 ml containers
  - ⇒ Four pieces litmus paper
  - ⇒ 50 ml buttermilk
  - ⇒ Hot plate
  - ⇒ Cotton twine
  - ⇒ Crackers
- Pencil or pen for each student

Activating Strategy:

The activating strategy should take about 10 minutes of classroom time, with four minute video included, to set stage for lesson. Teachers should explain that milk is one of the most highly regulated and safest foods available to consumers. Milk is tested up to 17 different times before it reaches a glass. Milk and dairy foods must undergo a number of safety and quality procedures, such as pasteurization, to make sure they are safe and wholesome to consume. This lesson will discuss what steps milk must go through to ensure safety and how dairy products are made from milk. ***Show video motivator.***

PART ONE — Milk Safety and Testing

Essential question:

"What steps ensure milk and dairy products are safe to consume?"

Key to answering essential question:

- Recognize the procedures that dairy farmers follow to produce a safe, quality product.
- Restate the steps in milk's journey from the farm to the marketplace.
- Define pasteurization and homogenization.

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Upper Level Lesson 2: Milk Safety

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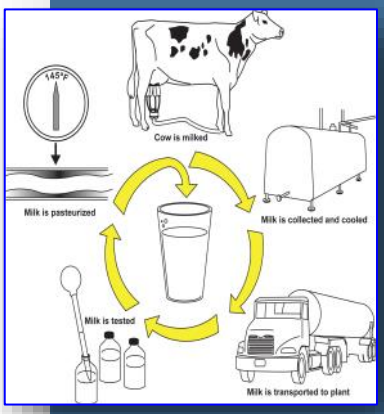

Food for Thought:

Ask Students what other foods would be regulated by the Food & Drug Administration.

Example of what happens when the milk, food coloring and dishwashing detergent react to one another.

Reading Passage: ***(Give students about 10 minutes to read page 1)***

Classroom Discussion: ***(Use transparency to walk through Reading Passage.)***

With recent food illness outbreaks, people are concerned about the safety of their food now more than ever. The U.S. Food and Drug Administration (FDA) and other regulatory agencies establish processes and protocols that all food must go through to ensure that it is safe for consumers to eat. *Answers to the questions below are found in the reading passage.*

- Milk and dairy products are among the most highly regulated foods in the nation.
  Ask students what steps go into assuring milk safety and quality?
- At the farm, cows producing milk must be kept clean and comfortable. Their barns must be kept very clean.
  Ask students who or what agencies make sure dairy barns and cows are kept clean and sanitary.
- Healthy cows produce quality milk. When cows do get sick, they are given medicine – much like an antibiotic a doctor would prescribe for humans.
  Ask students how we know for sure that there are no antibiotics in our milk.
- Cows are milked two to three times a day. Their udders and teats are cleaned and sanitized before they are milked to keep the milk clean.
  Ask students what temperature milk must be kept at to ensure that it is safe to drink.
- Milk from the farm is transported in insulated tanker trucks to processing plants. Before it is delivered to the plant, it is tested for safety and quality. Once it arrives at the processing plant, the milk is pasteurized.
  Ask students what pasteurization is and why it is important.
- Throughout the process, the dairy industry works closely with the FDA, state and federal regulators to monitor and test dairy production, processing and marketing to ensure the safety and wholesomeness of milk and dairy products.
  Ask students how many times milk is tested for safety and what happens to milk that fails the test.

Remind students that dairy farmers, industry personnel and federal and state regulators work to ensure the safety and wholesomeness of the milk we drink. This effort starts with the care dairy farmers give to their cows, and continues in the processing plant and marketplace.

Lab Exercise:

Teachers should prepare copies of the Milk Safety Lab 2.1 Worksheet *to distribute to the class to prepare for this exercise. Students should be divided into groups of four to complete the experiment, with one set of materials distributed to each group. Teachers should explain lab after handing out materials.*

Materials needed for lab (per group): 2% or whole milk, dishwashing detergent, plate, food coloring, and cotton swab per each group.

Part I Lab Explanation:

Explain that milk is tested up to 17 times before it reaches the grocery store shelf to ensure it is safe. Milk is tested for quality and safety at the farm level, in route to the dairy processing plant, and at several points during processing.

Explain that in this lab, students will simulate testing milk. In this test, students will test how milk reacts when food coloring is added to it. When food color is added to water, the water changes colors. But it takes a special ingredient to change the color of milk.

Follow the directions outlined in the Milk Safety Lab 1.1 Worksheet to complete the experiment. Record what happens and answer questions on lab handout. *For appropriate responses to lab questions, see answer key found on www.discoverdairy.com or in Discover Dairy Ipad app.*

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Upper Level Lesson 2: Milk Safety

Essential Question:

How are dairy products made from milk?

Part I Lesson Review:

Teachers can ask the following questions to evaluate whether students understand the steps that go into ensuring milk is safe to drink.

1. Who makes sure farmers keep their facilities clean and sanitary? Inspectors on both the state level and with the FDA (Food and Drug Administration) or federal level.
2. Where and how many times is milk tested as it moves through the processing chain? It is tested up to 17 times at several places: on the farm, in transport, and in the processing plant.
3. What temperature should milk be stored at to make sure it remains safe? 40° Fahrenheit
4. What is the process of heating milk to high temperatures to kill harmful bacteria? Pasteurization.
5. How can we know for sure that the milk we drink is antibiotic free? All milk is tested many times before it reaches the marketplace to make sure it is free from antibiotics.

Part I Lesson Evaluation: If desired, teachers can use the **Lesson 2 Part 1** section of the Discover Dairy post-test to evaluate students' ability to grasp lesson concepts. *This test can also be used at unit end.*

PART TWO — Dairy Products Made From Milk

Essential question:

How are dairy products made from milk?

Keys to answering essential question:

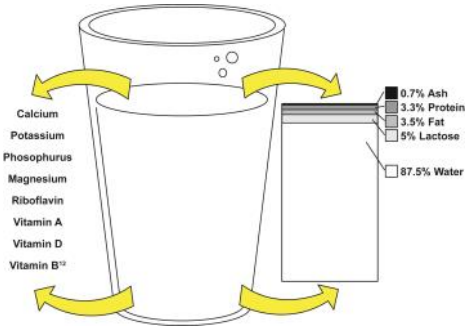
- Understand the composition of milk.
- Understand how cheese, yogurt, butter and ice cream are derived from milk.
- Understand how variables in milk composition affect foods produced from that milk.

Reading Passage: *(Give students 10 minutes to read over Page 2 of Reading Passage.)*

Classroom Discussion: *(Use* "Discover Dairy … And Milk Safety" *transparency or graphic to walk through Reading Passage. Answers to the questions below are found in the reading passage.)*

Explain that milk is one of the most nutrient-dense foods available in the marketplace. *Ask students what factors may change the composition of milk.*

In general, milk is 87.5 percent water, 5 percent lactose (or milk sugar), 3.5 percent fat, 3.3 percent protein, and 0.7 percent ash (or mineral). Nine essential nutrients are found in milk, including protein, calcium, potassium, phosphorus, magnesium, riboflavin, vitamin A, vitamin D and vitamin B^{12}.



Ask students why most experts agree that milk should be an important part of the diet.

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PART TWO — Dairy Products Made From Milk *(continued)*

Cheese, yogurt, ice cream and other dairy products are all made from milk.

- The protein in milk is essential to the production of **Cheese,** which consists of protein and milk fat. It is produced by coagulation of the milk protein casein.
  Ask students to explain the process of coagulation and what is produced from it.
- Milk sugar (or lactose) is key to the production of **Yogurt,** which is made when the lactose goes through fermentation.
  Ask students what fermentation is and how it is used to make yogurt.
- **Ice cream** is also made from the cream (or fat) in milk. The cream is combined with other flavors and ingredients, and then the mixture is stirred slowly while cooling to prevent large ice crystals from forming.
  Ask the students what they think gives ice cream its creamy, smooth texture.

The quality and attributes of milk can influence the taste, texture and yield of the products produced from it. For example, some breeds of dairy cows produce milk with higher fat levels. The higher fat levels will enhance the yield and flavor of butter produced from that milk. Higher cream levels will also enhance ice cream production. Yogurt production is influenced by the amount of lactose and milk protein in the milk, while cheese yields are affected by the protein and fat found in milk.

Follow-up Questions:

- Ask students how the quality and attributes of milk may affect the taste, texture and yield of products? *Milk with higher levels of fat could yield greater quantities of butter and ice cream, while higher levels of protein could yield more cheese. Using milk with higher fat levels could also affect the flavor of yogurt made from that milk.*
- Ask students what happens if bacteria was introduced into the milk? *Get them to explore answers.*

Lab Exercise:

Teachers should prepare copies of the Milk Safety Lab 2.2 Worksheet *to distribute to the class to prepare for this exercise. Students should complete experiment as class. Teachers should explain lab after handing out materials.* **** In Part 2 of this lesson, the lab will be completed over course of four days. The lab will take about 20 minutes on Day 1, 15 minutes on Day 2, and 15 minutes on Day 4.***

The following items are needed for the exercise (per class):

- ⇒ 500 ml whole milk
- ⇒ Fine-mesh cheesecloth
- ⇒ Thermometer
- ⇒ 50 ml, 500 ml, and 600 ml containers
- ⇒ Four pieces litmus paper
- ⇒ 50 ml buttermilk
- ⇒ Hot plate
- ⇒ Cotton twine
- ⇒ Crackers

Lab Explanation: Explain that in this activity, students will be fermenting milk products. The action of bacteria in milk causes a buildup of lactic acid, which causes the milk to curdle, forming a solid curd and a liquid whey. This is the first step in making cheese. Once the curd is made, it is separated from the whey and aged to make cheese. Encourage students to review the cautions and read the steps. Help them begin the experiment.

Cautions:

- Your hands must be washed thoroughly with antibacterial soap and water before and after each step.
- Beware of shock and burn hazards when using the hot plate.

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Food for Thought:

Ask Students to Name Other Foods That Have the Versatility of Milk. Ask Them to Describe Products That Can Be Made from Those Foods.

PART TWO — Dairy Products Made From Milk *(continued)*

Follow the directions outlined in the **Milk Safety Lab 2.1 Worksheet** to complete the experiment. Set aside time on Day 2 and 4 to complete experiment. Record what happens and answer questions on lab handout. *For appropriate responses to lab questions, see answer key found on www.discoverdairy.com or in Discover Dairy Ipad app.*

Lesson Review:

Teachers can ask the following questions to evaluate whether students understand how dairy products are made from milk.

1. Name three products that are made from milk: Cheese, Yogurt, Ice Cream, Butter.
2. What is needed to make milk into cheese? Rennet or another acidic compound.
3. What component of milk is key to making yogurt? Milk sugar or lactose.
4. What component of milk is used to make ice cream & butter? The cream (or fat) in milk.

Part 2 Lesson Evaluation: If desired, teachers can use the **Lesson 2 Part 2** section of the Discover Dairy post-test to evaluate students' ability to grasp lesson concepts. *This test can also be used at unit end.*

Summarizing Lesson:

Remind students that milk is one of the most highly regulated and safest foods available to consumers. Milk is tested up to 17 different times before it reaches a glass. Milk and dairy foods must undergo a number of safety and quality procedures, such as pasteurization, to make sure they are safe and wholesome to consume. Milk is also one of the most versatile foods, with cheese, yogurt, butter, ice cream and other products made from milk.

Summarize concepts identified in labs:

- Several steps are involved in ensuring milk and dairy products are safe to drink. Throughout the process, the dairy industry works closely with the FDA, state and federal regulators to ***monitor and test dairy production, processing and marketing to ensure the safety and wholesomeness of milk and dairy products.***
- Milk is one of the nutrient-dense foods available in the marketplace, with cheese, yogurt, butter, ice cream and other products all made from different components of milk. ***The quality and attributes of milk can influence the taste, texture and yield of products produced from that milk.***

valuation:

test comprehension of lesson content, use the "***Discover Dairy Upper Level Post Assessment"*** available online at www.discoverdairy.com or in the IPad application. For a writing assessment, have the students research an article on the Internet that identifies how the Food & Drug Administration regulates the food industry or specifically dairy production and processing.

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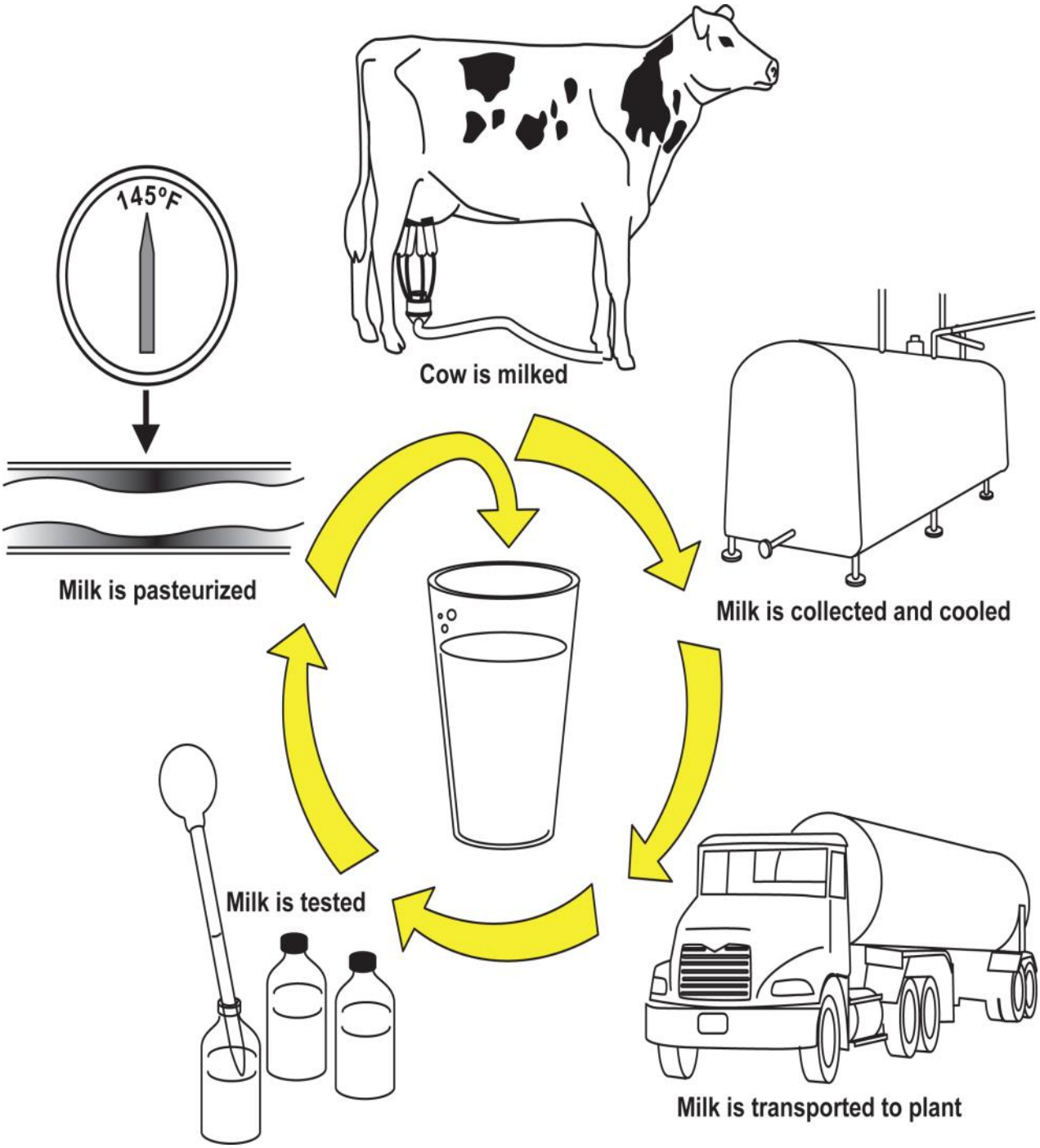
Milk Safety: The Steps from Cow to Consumer



Milk never touches human hands.

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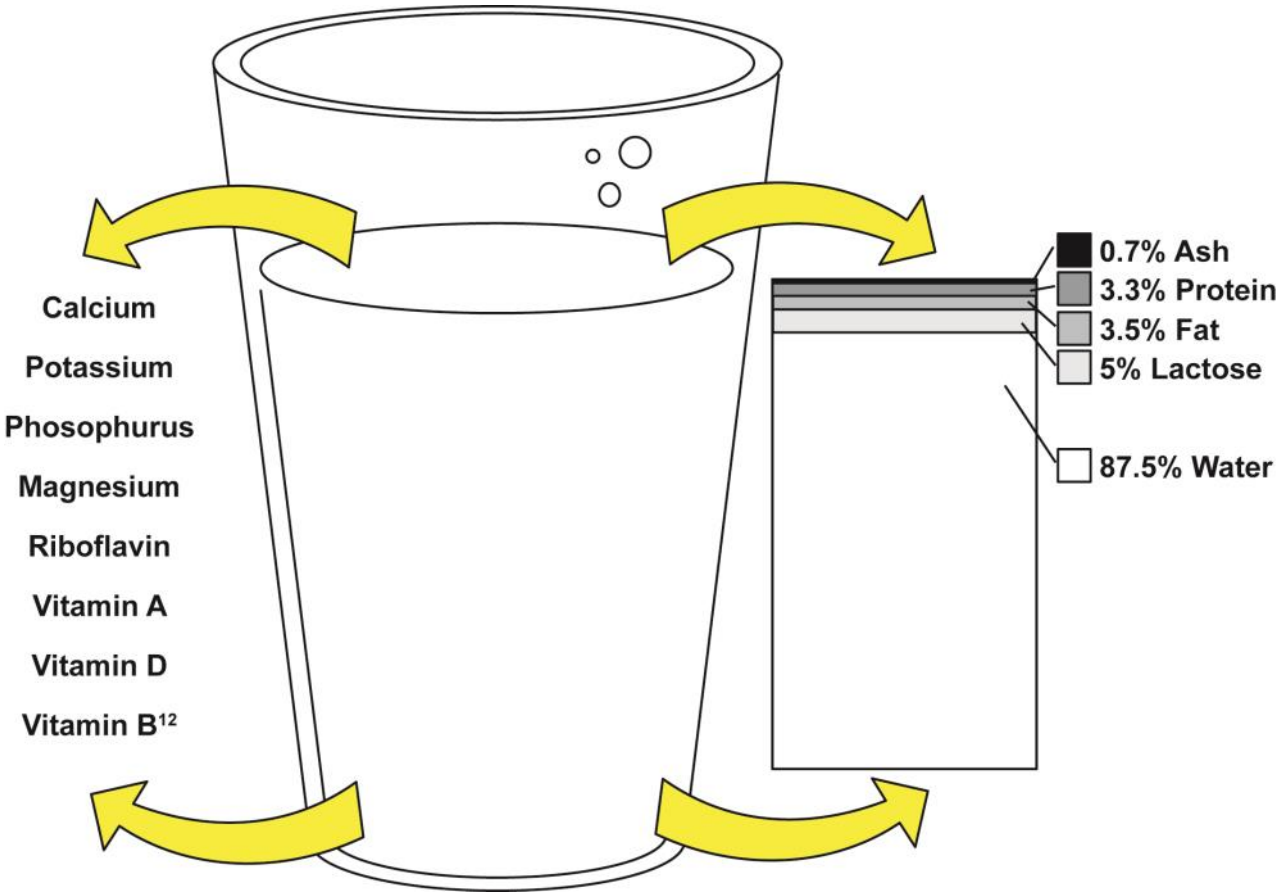
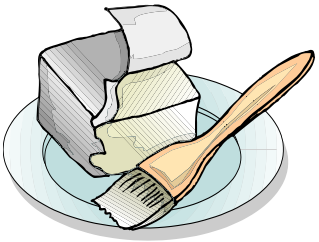
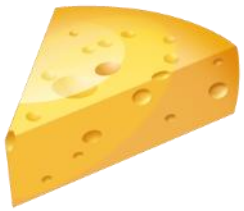
How Dairy Products Are Made





BUTTER IS MADE FROM THE CREAM IN MILK.



CHEESE IS MADE FROM THE PROTEIN AND FAT IN MILK.

MILK SUGAR (OR LACTOSE) IS ESSENTIAL IN MAKING YOGURT.

ICE CREAM IS MADE FROM THE CREAM OR FAT FOUND IN MILK.

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Lab 2.1: Milk Safety and Testing

Name: _____

What you will need: *2% or whole milk* *Food coloring* *Paper Plate*
Dishwashing liquid *Cotton swab*

Milk is tested up to 17 times before it reaches the grocery store shelf to ensure it is safe for you to drink. Milk is tested for quality and safety at the farm level, in route to the dairy processing plant, and at several points during processing. It is tested to make sure it doesn't contain any harmful contaminants and is safe to drink.

In this lab, students will simulate testing milk. Students will test how milk reacts when food coloring is added to it. When food color is added to water, the water changes colors. But it takes a special ingredient to change the color of milk.

Steps:

1. Pour enough milk onto a plate to cover the bottom.
2. Drop food coloring into milk. Record what happened on your hand-out.
3. Dip a clean cotton swab into the food coloring in the milk. Record what happens.
4. Now dip the cotton swab in dishwashing detergent liquid.
5. Touch the coated swab to the food coloring and milk in the center of the plate.
6. Do not stir the milk.
7. Record what happened and answer questions on handout.

How it works: *(Read after completing experiment)*

Milk consists of many different molecules, including fat, protein, sugars, vitamins, and minerals. If you'd touch a clean cotton swab to the milk, not much would have happened. The cotton is absorbent, so you would have created a current in the milk, but you wouldn't have seen anything especially dramatic happen.

When you introduce detergent to the milk, several things happen at once. The detergent lowers the surface tension of the liquid so the food coloring is free to flow throughout the milk. The detergent reacts with the protein in milk, altering the shapes of those molecules and setting them in motion.

The reaction between the detergent and the fat forms micelles, which is how detergent helps to lift grease off of dirty dishes. As the micelles form, the pigments in the food coloring get pushed around. Eventually equilibrium is formed, but the swirling of the colors continue for quite awhile after stopping.

Milk Testing Lab Reporting Form:

Answer the question below before conducting the lab:

1. What do you think will happen when you put the food coloring in the milk? _____

_____

Answer the questions below while conducting the lab:

1. What happened when you put the food coloring in the milk? _____
2. Why do you think the milk reacted differently to the food coloring than water does? _____

_____

_____

(Continue on Back)

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Milk Testing Lab Reporting Form:

Continue answering the questions below as you conduct the lab. Discuss your answer as a group.

3. What happened when you dipped the clean cotton swab into the milk? _____

4. What happened when you dipped the coated cotton swab into the milk? _____

5. How do you think the dishwashing detergent changed the way the milk reacted to the food coloring? _____

6. *Read the "How It Works" explanation at the bottom of Page 1.* How did this explanation compare to your answer to question #5 above? _____

7. What changes could you make to the experiment to make the milk react differently? _____

Additional Lab Questions:

1. How do you think this lab experiment may compare to actual milk quality and safety testing done in the market-place? _____

2. What other products do you think are tested in the marketplace? _____

3. How do you think chemistry plays a role in the safety of our food supply? _____

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Lab 2.2: Dairy Products Made from Milk

Name: _____

The following items are needed for exercise (per class):

- ⇒ 500 ml whole milk
- ⇒ Fine-mesh cheesecloth
- ⇒ Thermometer
- ⇒ 50 ml, 500 ml, and 600 ml containers
- ⇒ Four pieces litmus paper
- ⇒ 50 ml buttermilk
- ⇒ Hot plate
- ⇒ Cotton twine
- ⇒ Crackers

In this activity, you will be fermenting milk products. The action of bacteria in milk causes a buildup of lactic acid, which causes the milk to curdle, forming a solid curd and a liquid whey. This is the first step in making cheese. Once the curd is made, it must be separated from the whey and aged to make cheese. The physical characteristics of the cheese that you buy at the grocery store depends on many factors, including how long it is aged, what is used in the process, and what type of flavoring is added to it.

Cautions:

- *Work involved with this lab will occur over a four-day period.*
- *Your hands must be washed thoroughly with antibacterial soap and water before and after each step.*
- *Beware of shock and burn hazards when using the hot plate.*

Steps:

Day 1:

1. Use your Litmus paper to take the pH of both the butter milk and the whole milk.
2. Record both on the form on the back of this page. Also record the physical characteristics of both the whole milk and buttermilk (color, thickness)
3. Pour 500 mL of whole milk into your 600 mL container and 50 mL of buttermilk into your 50 mL container.
4. Heat whole milk to 37 degrees Celsius.
5. Add the buttermilk to the whole milk and stir well.
6. Cover the container with cloth or paper.
7. Incubate at between 25 - 35 degrees Celsius for 48 hours or until firm curd separates from whey.

Day 2:

1. Prepare piece of cheesecloth that will be thick and large enough to hold your curd.
2. Pour your curd into the cloth.
3. Use the Litmus paper to take the pH of the curd and record it on the back page. Record the physical characteristics of the curd
4. Collect the whey in the 500 mL container.
5. Use the Litmus paper to take the pH of the leftover whey and record it on the back page. Record the physical characteristics of the leftover whey.
6. Gather the edges of the cloth to form a bag.
7. Tie the bag with twine and hang it to continue draining.
8. After it is fully drained, discard whey and place bag in refrigerator.

Day 4:

1. Remove the cheese and taste with crackers.
2. Record what you learned on the reporting form.
3. Use the table on page 2 of this exercise to determine what percentage of the total each food represents in weight.

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Lab 2.2: Dairy Products Made from Milk

NAME: _____

	Whole Milk	Buttermilk	Curd	Leftover Whey
pH recording				
Is it acidic or a base?				
Color (white, off-white, yellow, gray)				
Thickness (watery/liquid/solid)				
Amount/Weight	500 mL	50 mL		

Answer the questions below related to the milk fermentation experiment: On Day 1, answer the first three questions; on Day 2, answer questions 4 - 5; and on Day 4, answer questions 6 – 7.

Day 1:

1. What do you expect to happen to the mixture of whole milk and buttermilk? _____

2. Why do you think it is important to wash your hands before each step? _____

3. Why do you think it is important to cover the mixture of whole milk and buttermilk before you incubate it? _____

Day 2:

4. What characteristic in the buttermilk made the whole milk curdle? _____

5. What role do you think heating the milk has in the experiment.? _____

Day 4:

6. What does the curd taste like? _____

7. What do you think will happen to the curd over time if it is left to age? _____

Discover Dairy... And Milk Safety Reading Passage

Milk is one of the most highly regulated and safest foods available to consumers. The milk in your glass was tested up to 17 different times before it reached you. Milk and dairy foods must undergo a number of safety and quality procedures, such as pasteurization, to make sure they are safe and wholesome for you to consume.

The composition and attributes of milk also makes it very versatile. Milk is used to make a variety of dairy products, including cheese, yogurt, butter and ice cream. Milk is also an ingredient in many other products, such as milk chocolate and protein bars, like the "Special K Snack Bar." The quality and composition of the milk can influence both the yield and the taste of these products.

Milk Quality and Testing

What steps do you think ensure milk and dairy products are safe to consume?

With recent food illness outbreaks, people are concerned about the safety of their food now more than ever. The U.S. Food and Drug Administration (FDA) and other regulatory agencies establish processes and protocols that all food must go through to ensure that it is safe for consumers to eat.

Milk and dairy products are among the most highly regulated foods in the nation. All milk and dairy products must undergo a number of safety, quality and sanitation procedures on the farm, in transit and at the processing plant to ensure their safety. Preserving the quality and safety of milk begins at the farm and follows through to the refrigerator.

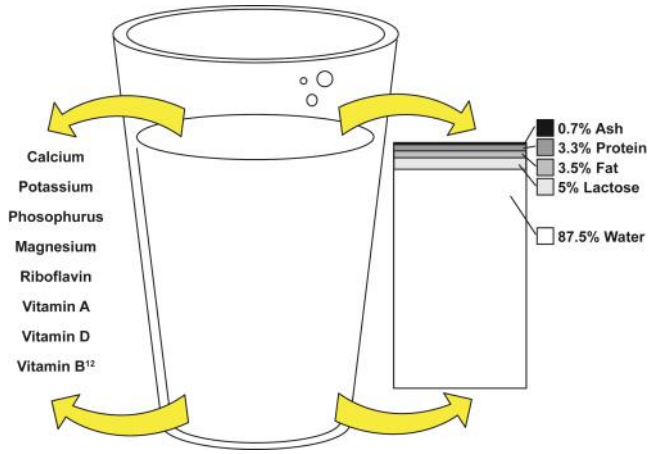
Those steps include:

1. At the farm, the ***cows producing the milk must be kept clean and comfortable***. Their barns must be kept very clean. The dairy farms are inspected regularly by a state sanitation inspector to make sure the milking equipment, housing facilities and cows are clean. Federal inspectors from the Food & Drug Administration (FDA) also inspect farms to ensure safety.
2. ***Healthy cows produce quality milk***. When cows do get sick, they are given medicine – much like an antibiotic a doctor would prescribe for humans. If a cow is given an antibiotic, her milk is discarded until she has tested or deemed by a veterinarian to be healthy again. The milk is tested before it is shipped for processing to make sure the milk is free of antibiotics residue.
3. Cows are milked two to three times a day. Their ***udders and teats are cleaned and sanitized before milking*** to keep the milk clean. The milk from a cow flows from her udder to pre-sanitized pipes connected to a large milk tank. The milk is quickly cooled to 40 degrees Fahrenheit. Human hands never touch the milk.
4. Milk from the farm is transported in insulated tanker trucks to processing plants. Before it is delivered to the plant, it is ***tested for safety and quality***. Once the milk passes several safety checks, the milk is ***pasteurized***. Pasteurization is the process of heating milk to high temperatures (at least 145 degrees Fahrenheit) for a short period of time. Pasteurization ensures milk and dairy foods are safe to drink and eat.
5. Throughout the process, the dairy industry ***works closely with the FDA, state and federal regulators*** to monitor and test dairy production, processing and marketing to ensure the safety. Every load of milk shipped from every farm in the U.S. is tested and re-tested for safety and quality – up to 17 times throughout the process. Any milk not meeting federal and state standards is discarded, never reaching consumers.

Dairy farmers, industry personnel and regulators work to ensure the safety and wholesomeness of the milk we drink. This effort starts with the quality care farmers give to their cows, and continues in the processing plant and at the marketplace.

Discover Dairy is an initiative of the American Dairy Association North East, Center for Dairy Excellence, Midwest Dairy Council and the Pennsylvania Dairy Promotion Program, and, funded in part by the Center for Dairy Excellence Foundation of Pennsylvania.

Discover Dairy... And Milk Safety Reading Passage



Dairy Products Made From Milk

How do you think dairy products are made from milk?

Milk is one of the most nutrient-dense foods available in the marketplace. The composition and attributes of milk have made it a nutritional mainstay in the human diet since biblical times. Milk's composition can vary depending on the species (cow, goat, and sheep) and the breed of that species (Holstein, Jersey, Ayrshire). The animal's diet and stage in life can also influence the composition.

In general, milk is:

- 87.5 percent water
- 5 percent lactose (or milk sugar)
- 3.5 percent fat, 3.3 percent protein
- 0.7 percent mineral (such as calcium)

Nine essential nutrients are found in milk, including protein, calcium, potassium, phosphorus, magnesium, riboflavin, vitamin A, vitamin D and vitamin B^{12}. Most health experts consider milk to be an important part of our diet because of the complete nutritional package it provides for the body.

Cheese, yogurt, ice cream and other dairy products are all made from milk.

- The protein in milk is essential to the production of **Cheese,** which consists of protein and milk fat. It is produced by coagulation of the milk protein casein. Coagulation (or curdling) occurs when the enzyme rennet or another acidic compound is added to the milk. The increased acidity causes the milk proteins to tangle into solid masses, or *curds*, which makes cheese. After the curds are formed, the remaining liquid (called whey) is drained off and sometimes used as an ingredient in other foods.

The quality and attributes of milk can influence the taste, texture and yield of the products produced from it. For example, some breeds of dairy cows produce milk with higher fat levels. The higher fat levels will enhance the yield and flavor of butter produced from that milk.

- Milk sugar (or lactose) is key to making **Yogurt.** When lactose goes through fermentation, or the conversion of carbohydrates into alcohols or acids under anaerobic conditions. It produces lactic acid. Combined with the milk protein, the lactic acid gives yogurt its texture and characteristic tang.
- **Ice cream** is also made from the cream (or fat) in milk. The cream is combined with other flavors and ingredients, and stirred slowly while cooling to prevent large ice crystals from forming. The result is a smoothly textured ice cream.

Lesson Vocabulary Definitions:

- **Pasteurization —** the process of heating milk to high temperatures (at least 145 degrees Fahrenheit) for a short period of time.
- **Fermentation —** the conversion of carbohydrates into alcohols or acids under anaerobic conditions.
- **Sanitation —** A means of promoting health through the prevention of human contact with harmful microbiological, biological or chemical agents of disease.
- **Antibiotic —** a product or medicine used to treat infection.
- **Coagulation —** curdling or a complex process in which compounds come together to clot.
- **Curds —** a dairy product obtained by coagulating milk with rennet or an edible acidic substance.
- **Anaerobic —** without oxygen or air.
- **Lactic Acid —** milk acid that plays a role in several biochemical processes.

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