

Farm • Lesson 5

Keeping Milk Fresh

Class periods required: One 30-min. class period

Supplement section: Farm PA PAS for FCS: 9.3.3 A, 9.3.3 B, 9.3.6 B, 9.3.9 A, 9.3.9 B.

National Education Standards: 8.2.1, 8.2.3, 8.2.5, 8.2.6, 9.2.1, 9.2.3, 9.2.5, 9.2.6; LA 2, 035, 132, 278; MA 130, 173; SC 3, 5, 041, 044.

LESSON SUMMARY

Students will learn about bacteria that can grow in milk and what farmers can do to keep milk safe, and the four principles of cleaning.

Objectives

The students will:

- Acknowledge that raw milk can contain spoilage and pathogenic organisms.
- Summarize the farmer's role in ensuring safe milk.
- Identify cleaning procedures during milking and complete the "Milk Explosion Activity" (which demonstrates that detergent dissolves the fat from surfaces and ensures that items get totally clean).
- Complete the NIE newspaper activity to find articles on milk safety in production, distribution to the consumer, etc. to determine positive practices, problems, and improvements that can be made for milk safety.

Materials Provided

Overheads:

1. So, What is Milk?
- 2-3. Cow to Carton
4. Common Trouble Spots
5. Pathogens in Milk
6. Tests for Milk Safety
7. Proper Cleaning

Handout:

1. Milk explosions

Teacher Information Sheets:

1. Evaluation for "Milk Explosion Activity"
2. Evaluation of NIE Newspaper Activity

Resources:

- Dairy producer's Guide to Food Safety at <http://www.ces.uga.edu/pubcd/B1084-w.html>

Suggested Presentation Aids

- Raw and pasteurized milk samples
- Food coloring
- Dishwashing liquid

LESSON PLAN

Introduction

- Pass the samples of raw and pasteurized milk around the class. Ask the students to compare the two samples on the basis of smell and appearance.
- Explain that bacteria grow in milk, and it is the farmers' job to keep the milk clean and fresh before it reaches the processing plant.

Lesson sequence

- **So, what is Milk?** (Overhead 1) Explain that milk is made up of 87 percent water and 13 percent milk solids. The milk solids are sugar, fat, protein, and minerals. Lactose, or milk sugar, gives you energy. Fat makes your hair shine, gives you energy, and contains vitamins. Milk protein builds and repairs muscles and other body tissues. Calcium, a mineral in milk, makes your bones strong and healthy.
- **Cow to Carton** (Overheads 2 and 3). Read the information on the overhead. Emphasize that the farmer must make sure the milk is kept clean at each step.
- **Common Trouble Spots** (Overhead 4). Overcrowding, poor ventilation, inadequate manure removal, muddy exercise lots, and dirty maternity stalls or calving areas can lead to high levels of bacteria in milk. Dirty milking equipment can also contaminate the milk.
- **Teats:** The teats should always be cleaned before milking. Often the hair on the udders is clipped to keep it from getting dirty. After the cows are milked, the teats are treated with antibacterial dips. Antibacterial dips keep the bacteria from growing in between milkings.
- **Environment:** The cows and the barn should be kept clean to keep numbers of bacteria in the environment low. Manure should be removed regularly from stalls, maternity stalls and birthing areas should be kept clean, and exercise lots should not be muddy. Drier bedding materials such as sand or crushed limestone are better for keeping bacteria from growing than wetter ones like hay. The cows' food should be kept clean and dry, and their water should be kept clean as well. If the cows get sick from their food, they could pass bacteria into their milk.
- **Equipment:** The milking equipment should be cleaned after every use. Proper cleaning requires time, temperature, concentration, and physical action. Equipment should also be designed so that filters can be changed easily and complete drainage can occur. Leakage should be monitored. If milk can leak out, then bacteria-laden air can get in.
- **Pathogens in Milk** (Overhead 5). Explain to the students that both pathogens and spoilage organisms can be found in raw milk. Grade A quality raw milk usually contains about 5,000 or more colony forming units of bacteria per milliliter (cfu/ml) before pasteurization. Colony forming units are bacteria that can grow to form colonies on plates. Each bacterium forms a colony, which can be seen without a microscope. Pathogens in milk can include *Listeria monocytogenes*, *S. aureus*, *E. coli*, and *Salmonella*. Yeasts, molds, viruses, and lactic acid bacteria such as *Lactococcus* can also contaminate milk. If high numbers of bacteria are present in the milk, they can produce toxins. While the bacteria themselves are killed by pasteurization, the toxins will not be destroyed. It's up to the farmer to make sure the milk is as clean as possible in the first place, and if pathogens are present, they can't grow to high enough numbers to produce toxin.
- **Tests for Milk Safety** (Overhead 6). When milk is received at a processing plant, scientists test it to see how much bacteria it contains. It is the farmers' job to make sure that the bacteria levels are low. The Standard Plate Count (SPC) is a universal quality test for milk. It counts all of the bacteria in the milk, whether they come

from equipment, cows, or the environment. Very high counts usually mean that the cows are sick. Laboratory Pasteurized Count (LPC) counts bacteria that can survive pasteurization and remain in pasteurized milk. Many of these bacteria come from the farm environment and grow readily on improperly cleaned or unsanitized milk equipment. High counts show that the milking equipment is not being cleaned well enough. High coliform counts show that the cows were milked in a dirty environment. Coliforms are types of bacteria like *E. coli* that come from dirty cows, dirty equipment, and mud getting into the milk.

- **Proper Cleaning:** (Overhead 7).

Time: Farmers have to make sure that the detergents used for cleaning have time to work. They also have to take apart some pieces of machinery like seals and gaskets and clean them separately.

Temperature: Hot water allows the “chemistry of cleaning” by bringing milk fats and proteins into solution.

Concentration: Cleaners always have to be used at the amounts recommended by the manufacturer or they might not work properly.

Physical action: All cleaning requires scrubbing of some kind. Many machines are “clean in place” (CIP), which means they clean themselves, but farmers still have to make sure the process is working correctly and scrub out parts that don’t get clean. These principles of cleaning are used universally in food production to keep the food free of bacteria. These same principles can be used at home when cleaning things like counter tops, cutting boards, and other food preparation areas.

Closure

- Let the students perform the “Milk Explosion Activity” (Handout 1). Explain that the detergent works by dissolving the milk fat, allowing the food coloring to go into solution. Using lots of detergent completely

dissolves the fat from surfaces and ensures that items get totally clean. When the fat in the milk is dissolved and washed out of pipes and containers with the water, the bacteria are carried away with it.

Suggested Learning Activities

- Pretend that you are a farmer, and the dairy plant tells you that the bacterial count of your milk is too high. Write a one-page report describing what you think could be causing the problem, and what you could do to solve it.
- Find newspaper articles that concern milk safety, production, distribution to the retailer, etc. Write a one-page report summarizing the article, emphasizing the main points, problems, positive practices, and improvements that should be made to ensure safe milk.

Evaluation

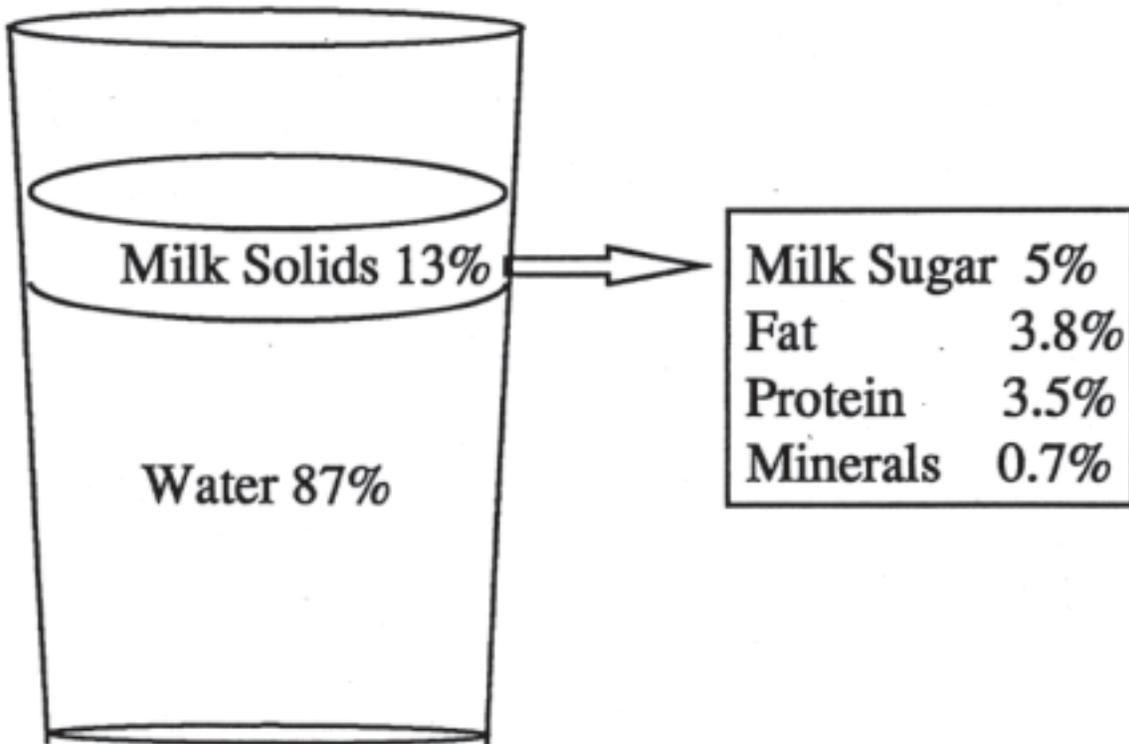
- Performance on “Milk Explosion Activity” (Teacher information sheet 1, Evaluation).
- Grade newspaper activity (Teacher information sheet 2).
- Quiz #5.
- Examination #2 at end of the Farm section.

References

- More activities with milk can be found in:
The Amazing Milk Book
By Catherine Ross and Susan Wallace
Addison Wesley Publishing Company
\$6.95

Overhead 1

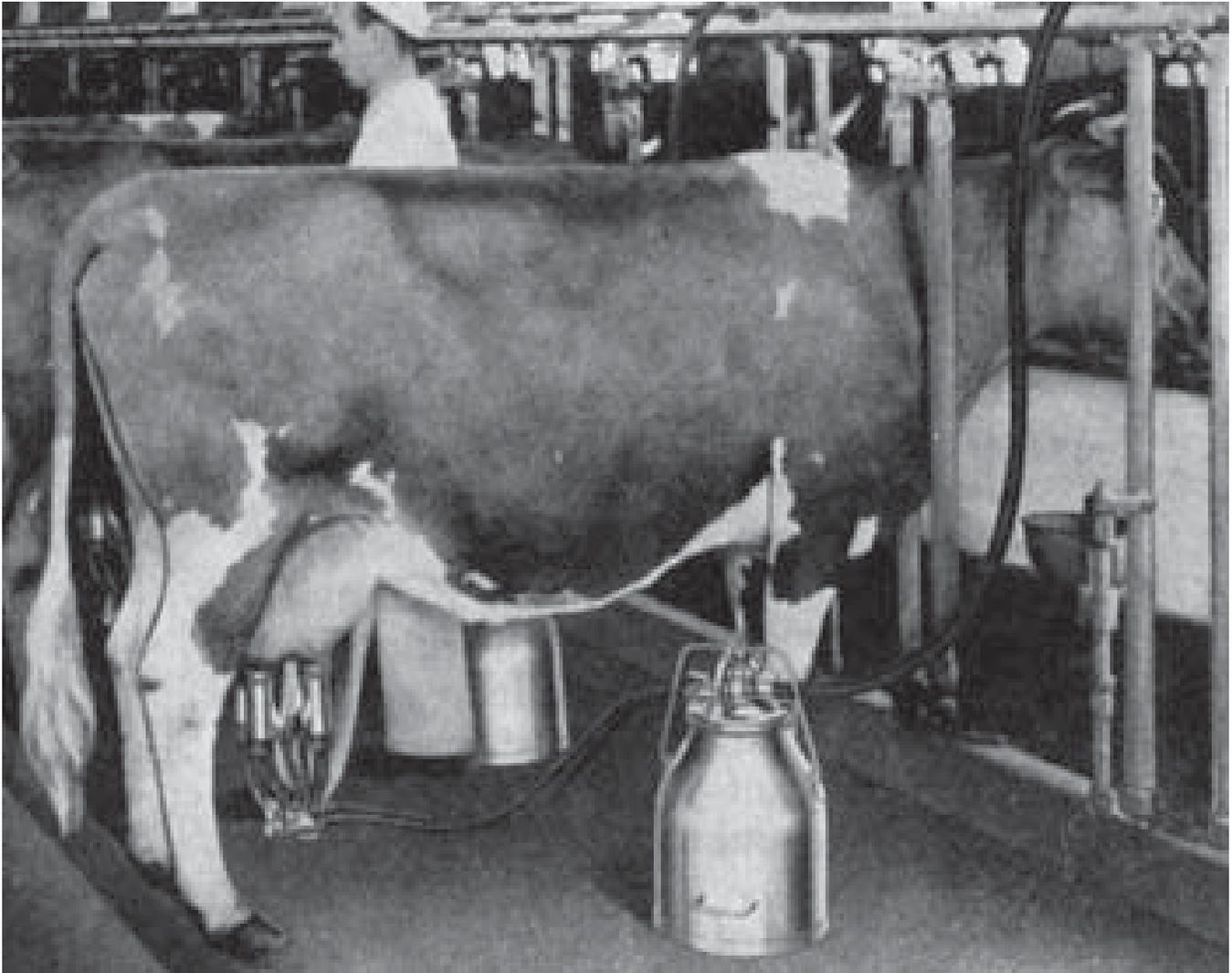
So, What is Milk?



Overhead 2

Cow to Carton

Did you know it takes two to four days for milk to get from the cow to your refrigerator? During that time, human hands do not touch the milk. The complicated process involves tanker trucks, huge refrigerators, pasteurizers and packagers. About 1700 dairy plants in the US produce 6 billion gallons of milk a year. Here is how.

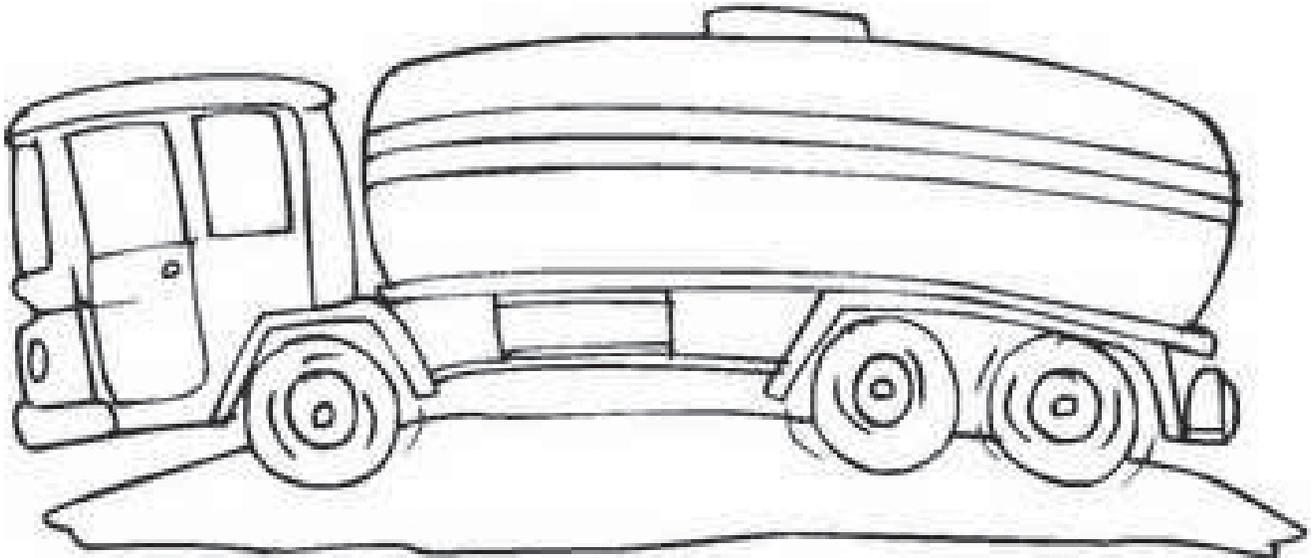


On the farm

1. Farmers milk their cows twice a day with milking machines. To make sure that everything is clean, they wash the cow's udder and teats with a disinfection solution. Then they rinse and dry them. The massaging action of cleaning stimulates the flow of milk. Then the farmer attaches the four rubber cups of the milking machine to the cow's teats. The milking machine gently squeezes and releases the teats to draw out the milk. It takes less than five minutes to milk a cow with a milking machine.

Overhead 3

2. Milk from the cow flows through a tube into a receiver jar. This jar stores the milk briefly until it is pumped into a large holding tank.
3. The Milk in the holding tank must be cooled quickly to just below 4° C (39° F) or about the same temperature as your refrigerator. This stops bacteria from growing and spoiling the milk.
4. Every other day, a refrigerated, stainless steel dairy tank truck stops at the farm to collect the milk and take it to the dairy plant. The driver also collects samples of the milk in sterilized bottles. These are taken to a laboratory to be tested for protein, fat, lactose and water content as well as impurities. Milk that contains pesticides, drugs like penicillin or harmful bacteria is rejected and the farmer who provided the contaminated milk may have to pay a heavy fine.



Adapted from The Amazing Milk Book by Catherine Ross and Susan Wallace.

Overhead 4



Common Trouble Spots

- **Teats:** The cow's teats need to be cleaned before and after milking, to reduce infection and keep bacteria out of the milk
- **Environment:** The cows' barn and grazing areas should be kept clean and relatively free of manure.
- **Equipment:** Milking equipment should always be cleaned after every use to keep it free from bacteria.

Overhead 5

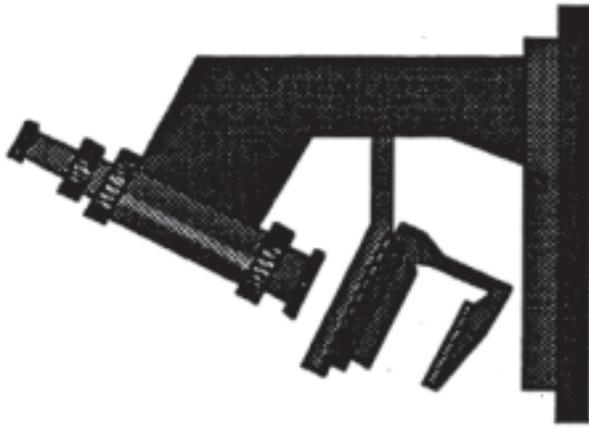
Pathogens in Milk

• *Listeria monocytogenes*

• *S. aureus*

• *E. coli*

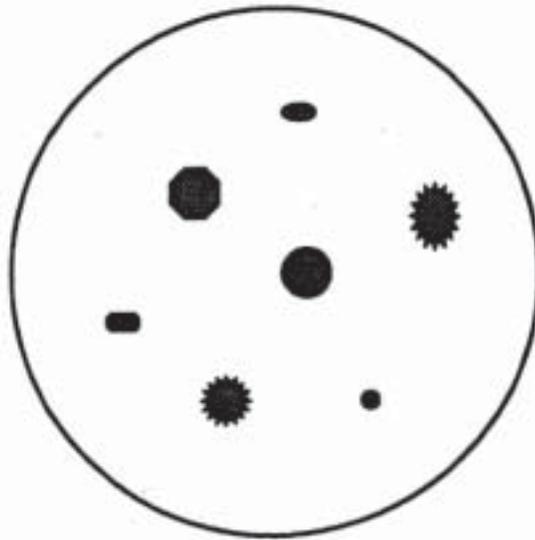
• *Salmonella*



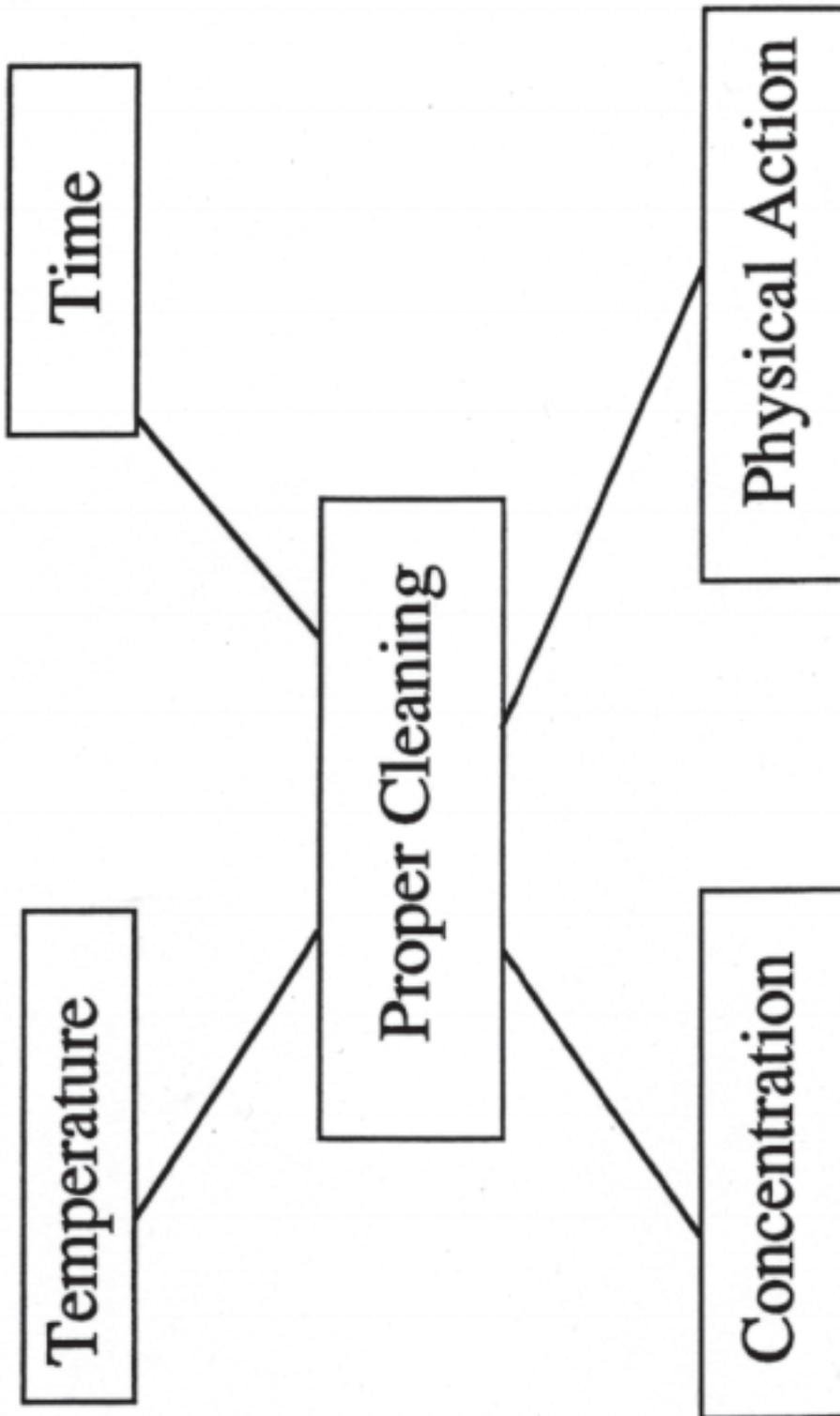
Overhead 6

Tests for milk safety

- SPC: Standard plate Count- Counts all of the bacteria in the Milk. Very high counts could mean the cows are sick
- LPC: Laboratory Pasteurized Count- Counts bacteria that can survive pasteurization of the milk. High counts mean that the cow or its environment are dirty.



Overhead 7



Handout 1

Milk Explosions

You can make milk explode into action just by adding detergent. If you add food coloring to the milk, you can watch while you create a small tempest in your teacup.

You'll need:

- Milk
- A bowl or teacup
- At least two colors of food coloring
- Liquid dish detergent
- A toothpick

1. Pour enough milk into your bowl to cover the bottom.
2. Carefully add to the milk a drop of each of your colors of food coloring. Keep the drops as far apart as possible from each other.
3. Put a drop of detergent on the tip of the toothpick and touch it to the food coloring.
4. Watch the fireworks! No noise, but lots of lovely swirls of color.

How does it work?

The effect of detergent on the surface tension of milk causes this explosion of color. When you touch the surface of the milk with the detergent, you weaken its surface tension at that spot, causing a ripple to explode outward and mix up the food coloring. What color have you ended up with? Try using different color combinations.

Teacher information Sheet 1

Name _____

Class/Period _____

Date _____

Evaluation for “Milk Explosion Activity”

Grade the “Milk Explosion Activity” for the following criteria using the grading scale of 1 – 4, with 4 being the highest and 1 the lowest score. Write comments in the boxes under each score heading.

| Criteria | 4 | 3 | 2 | 1 |
|-----------------------------------------------------------------------------------------|---|---|---|---|
| Directions: Read and follow each step as given in the experiment. | | | | |
| Conclusion: Complete and summarizes experiment. | | | | |
| Neatness: Clean, organized, and not sloppy. | | | | |
| Spelling: All words spelled correctly. | | | | |
| Information: Research information is correct, complete, and useful. | | | | |
| Handed in on Time: Handed in on due date. A point is deducted for each day late. | | | | |

Teacher information Sheet 2

Name _____

Class/Period _____

Date _____

Evaluation of NIE Newspaper Activity

Grade the NIE activity on the following criteria using the 0-4 rating scale. Four is the highest rate and zero is the lowest rate. Write comments in the boxes under the rating for each criterion.

| Criteria | 4 | 3 | 2 | 1 | 0 |
|-----------------------------------------------------------------------------------------|---|---|---|---|---|
| Content: Information is correct, complete, and useful. | | | | | |
| Neatness: Clean, organized, and not sloppy. | | | | | |
| Spelling: All words spelled correctly. | | | | | |
| Handed in on time: Handed in on due date. A point is deducted for each day late. | | | | | |
| Time Management: Time used wisely and working on project at allotted time. | | | | | |

3. What are the four principles of proper cleaning? Why is each one important?

4. Name and describe one test that determines bacteria count in milk.

5. Why should we avoid drinking raw milk?

Quiz 5 Key

Unit: Farm

Lesson: Keeping Milk Fresh

Matching: Match the vocabulary terms in column A with the definitions in column B. Write the letter of the definition in column B in the space next to the terms in column A.

| A | B |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| <u>E</u> 1. Standard plate count | A. A mineral in milk that contributes to healthy bones. |
| <u>C</u> 2. Lactose | B. Counts bacteria that can survive pasteurization and remain in pasteurized milk. |
| <u>A</u> 3. Calcium | C. A milk sugar that gives people energy. |
| <u>F</u> 4. Antibacterial dips | D. Types of bacteria like <i>E.coli</i> that come from dirty cows, dirty equipment, and mud getting into the milk. |
| <u>H</u> 5. Pasteurization | E. A universal quality test for milk. |
| <u>G</u> 6. <i>Lactococcus</i> | F. Keep the bacteria from growing in between milkings. |
| <u>B</u> 7. Laboratory Pasteurized Count | G. Lactic acid bacteria that can contaminate milk. |
| <u>D</u> 8. Coliforms | H. Milk heated and held at a temperature of 160-165° F for a short period of time to destroy any harmful bacteria. |

Short answer: Write short answers to the following questions and statements. Use complete sentences when answering questions.

- List the major components of milk and describe how each benefits our bodies. (20 points)
Lactose, or milk sugar, gives you energy. Fat makes your hair shine, gives you energy, and contains vitamins. Milk protein builds and repairs muscles and other body tissues. Calcium, a mineral in milk, makes your bones strong and healthy.
- What bacteria can live in milk? What can dairy farmers do to keep these bacteria from growing? (15 points).
Listeria monocytogenes, Staphylococcus aureus, Salmonella, and Escherichia coli live in milk. Farmers can keep the milk cold (below 40 °F) to keep bacteria from growing.
- What are the four principles of proper cleaning? Why is each one important?
 - Time: Sanitizers must be left on surfaces for the proper amount of time to be effective.*
 - Temperature: Hot liquids will dissolve fats, removing them from surfaces.*
 - Concentration: Cleaners must be used at the proper concentration to remove dirt and kill bacteria.*
 - Physical action: Scrubbing will remove bacteria that are attached to surfaces.*

4. Name and describe one test that determines bacteria count in milk.
 - a. *The Standard Plate Count or SPC is a universal quality test for milk. It counts all of the bacteria in the milk, whether they come from equipment, cows, or the environment. Very high counts usually mean the cows are sick.*
 - b. *Laboratory Pasteurized Count or LPC counts bacteria that survive pasteurization and remain in pasteurized milk. Many of these bacteria come from the farm environment and grow readily on improperly cleaned or unsanitized milk equipment. High counts mean milk is not being cleaned thoroughly.*
5. Why should we avoid drinking raw milk?
It can contain pathogens that will make us sick. Pasteurization kills these pathogens.

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