

The Amazing Milk Machine

Activity Synopsis

This activity introduces students to the cow's digestive system. Students learn about ruminant animals and the four-compartment stomach of the cow. Students learn about milk production and steps dairy farmers take to ensure the safety and wholesomeness of milk.

Activity Outcomes

Students will be able to:

- Describe the cow's digestive system.
- List the four compartments of a cow's stomach and state one fact about each compartment.
- Describe how cows are milked.
- Identify three safeguards for keeping milk fresh and clean.

Cross-curricular Outcomes

Students will be able to:

- Identify what cows need to eat in order to grow and produce milk. (Environment and Ecology)
- Explain the journey of milk from production to the consumer. (Environment and Ecology)
- Explain the cow's digestive system. (Science and Technology)
- Write to discover, record and reflect on ideas. (Language Arts)
- Define, and correctly use, terms related to dairy farming. (Language Arts)
- Write a fully-developed paragraph using proper form. (Language Arts)
- Complete simple unit conversions within a system of measurement. (Mathematics)
- Compute math problems and make reasonable estimates. (Mathematics)

Activity Length

Part One: 45 minutes

Part Two: 30-45 minutes

Materials

- **Cow's Digestive System** fact sheet
- One 8-ounce single-serve plastic milk bottle

Advance Preparation

- Preview the suggested instructional strategy.
- Review "Modern Dairy Farming Practices & Milk Quality: Myths and Facts," *Dairy Council Digest*, May/June 2007.
- Visit the following Web sites for more information about cows and milk production. The sites include background information with interactive slide shows and virtual tours.
<http://www.dairyfarmingtoday.org/DairyFarmingToday/Home>
<http://www.moomilk.com/index.html>
- Duplicate **Cow's Digestive System** fact sheet, one per student.
- Obtain an 8-ounce single serve plastic milk bottle from the cafeteria or grocery or convenience store.

After you've completed this lesson

go to www.dairyspot.com and

- Complete our **User Survey** with your thoughts on this lesson and the entire program.
- **Enter your school librarian or media specialist** into our drawing for a chance to win a book bag, filled with dairy and nutrition-related books, for your school library!

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Part One: The Amazing Milk Machine

1. Introduce The Amazing Milk Machine activity.

- Ask students to imagine what it would be like to eat 480 hamburgers a day and drink a bathtub full of water.
- Conclude that while it would be impossible for a person to eat that much food, this is what the average dairy cow eats each day.
- Explain that cows are big eaters. They eat about 100 pounds of food each day.

2. Like people, cows need to eat a balanced diet to stay healthy.

- Dairy farmers rely on nutrition experts for advice on feeding their cows. Dairy **nutritionists** recommend balanced diets that consist of hay, grains, protein sources such as soy, and vitamins and minerals.
- Farmers feed their cows **forage**.
 - Examples include whole plants of corn; small grains such as oats, barley, or wheat; legumes and grasses. Many farmers grow these forages on their farms.
 - **Silage** is a type of forage that is made from chopped green grasses and foods such as corn, beans, and sorghum.
 - *Where is silage stored?* **Accept all reasonable answers.** Explain that in the past, farmers stored silage in silos. Today, many farmers use **bunker silos** and huge **silage bags**.
- Farmers also recycle different ingredients to feed their cows. These ingredients include citrus pulp, brewers' mash or grain, and whole cottonseed.
- The actual mix of food a cow eats is called a **ration**.
- Another important part of a cow's diet is water.
- Cows get thirsty and can drink anywhere from 25 to 50 gallons of water a day. That's a bathtub full!

3. Explain to the students that cows spend a lot of time eating and chewing their food.

- Cows are fed up to eight times a day.
- Cows spend about 6 1/2 hours a day eating.
- Dairy cows are incredible animals. During digestion, a cow's body changes the food she eats and the water she drinks into milk.

4. Tell students that they are going to learn about the cow's digestive system. Distribute copies of the **Cow's Digestive System** fact sheet to the students. Have them complete the fact sheet as you discuss the following. Ask them if they know where digestion begins. **In the mouth**

- Cows have 32 teeth, but they are different from ours.
 - Cows have a tough pad of skin instead of teeth on the top front and 8 incisors on the bottom front.
 - They also have six molars on the top and bottom of each side of their mouth to grind their food.
- When a cow chews her food, the food mixes with **saliva**. *What is saliva?* **A liquid produced in the mouth.**
 - The saliva **moistens the food** and allows it to move down the throat more easily.
 - A mature cow can make more than 45 gallons of saliva a day.
- Cows don't chew their food well at first, rather they gulp it down.
 - Unlike people, cows can do this because they are **ruminant** or **cud-chewing** animals.
 - Sheep, goats, camels, giraffes, deer, elk, and buffalo are also ruminant animals.

5. When a cow swallows her food, it travels down the **esophagus**.

- The esophagus of a cow is about 2 1/2 to 3 feet long.
- Muscles in the esophagus contract in a wave-like motion and push food along to the stomach.
- This movement is called **peristalsis**.
- Food travels down the esophagus to the stomach.

6. Cows and other ruminant animals have a digestive system that is very different from our own. Instead of one single stomach, cows have one large stomach with four compartments.

- The partially chewed food travels first to the **rumen**, which is the largest compartment.
 - The rumen is big enough to hold up to 50 gallons of partially digested food.
 - The food is mixed, moistened and softened, and good bacteria help digest or breakdown the food.
- The food then goes to the second compartment, the **reticulum**.
 - In the reticulum the partially digested food is formed into lumps, called **cuds**.
 - The cud is about the size of a tennis ball or your fist. *Have students make a fist to get an idea of the size.*
 - When the cow has eaten her fill, she burps up a small amount of food – the cud – to chew again.
 - Cows can spend up to eight hours a day just chewing the cud.

■ After chewing the cud thoroughly, the cow swallows it. This time it goes into the third compartment called the **omasum**.

- Here the food is softened and ground up some more.
- The omasum is important because it absorbs a lot (60 to 70%) of the water entering this compartment.

■ Finally the food moves to the fourth compartment, the **abomasum**.

- This is called the true stomach because this is where digestion actually occurs.
- Acids in the abomasum further digest the food.
- The abomasum is like our own stomach.

7. Point out that digestion is finished in the **small intestine and **large intestine**, much like humans and other mammals.**

■ The digested food passes into the **small intestine** where digestion is completed.

■ The small intestine of a cow is 130 feet long.

■ **Enzymes** in the small intestine breakdown carbohydrates, proteins and fats and change them into nutrients the cow needs to be healthy.

■ The nutrients from the food are absorbed into the blood. The blood carries many of the nutrients to the **udder**.

■ The main job of the large intestine is to absorb water and store waste materials that will eventually leave the body.

Suggested Instructional Strategy

Part Two: The Milk Producers

1. Begin this activity with a review of the cow's digestive system.

2. Hold up a bottle of milk and ask students:

- How many of you drink milk?
- What do you know about milk?

Record students' responses for future reference and discussion.

3. Remind students that all dairy cows are females. And like humans, they cannot produce milk until they give birth.

■ A cow usually has her first calf when she is about two years old.

- A cow that is making milk is called a **fresh** cow.
- Cows are usually milked for 10 months after giving birth.
- A cow takes a break the last two months until her next calf is born.
- When the farmer stops milking the cow, she stops producing milk. A cow that does not produce milk is called a **dry** cow.

■ A cow gives birth to one calf every year.

4. Explain that the cow is a very efficient machine.

- It takes her about two days to turn her food into milk.
- The average cow produces 6-7 gallons of milk each day. *How many 8-ounce glasses of milk does the average cow make each day?* **96 to 112 glasses** (1 gallon = 128 ounces;

128 ounces/8 ounces/glass = 16 glasses; 6 gallons x 16 glasses/gallon = 96 glasses and 7 gallons x 16 glasses/gallon = 112 glasses)

■ A gallon of milk weighs 8.62 pounds.

5. Milk is made and stored in the udder.

■ The udder hangs between the back legs of the cow.

■ The udder can hold about 10 gallons of milk.

■ **Teats** are the nipples on the udder where the milk comes out.

6. Explain that cows like routine and respond best to kind handling and treatment. It's very difficult to milk a nervous or frightened cow.

■ Ask students how many times a day farmers milk cows. **Two to three times a day.**

■ Most dairy farmers use **automated milking machines** to milk their cows.

- These machines are very efficient and comfortable for the cow.
- It takes about 15 minutes to milk a cow.
- Using the automated milking machines, one farmer can milk about 100 cows an hour.
- Prior to the invention of milking machines, a farmer could milk about 6 cows an hour by hand.

■ The farmer thoroughly cleans the milking equipment before and after each use.

- The farmer washes the cow's udder and teats before milking.
 - This keeps the milk clean.
 - This also sends a signal to the cow's brain that it is time to milk.
- The milking machine is attached to the cow's teats.
 - The machine gently squeezes out the milk.
 - Milking never hurts the cow. The action is similar to a baby sucking his thumb.
- Many dairy farmers have computers that keep track of how much milk a cow produces at each milking.
- Once cows are milked, they are free to eat and drink, take a walk, or just take it easy. It's a wonderful life!

7. Explain that once the cow is milked, the milk is never exposed to the air. And it is never touched by human hands.

- Milk flows from the cow through cooled pipes into a very large refrigerated tank in another part of the barn.
- Milk comes out of the cow at about 100°F. The body temperature of a cow is 101.5°F.
- Once in the refrigerated tank, the milk cools quickly to a temperature between 38° to 45°F. This is done so the milk stays fresh and good tasting.
- Farmers also clean and sanitize the pipelines and tanks daily to keep the milk free from bacteria.

8. Tell students that every day or two, a tank truck comes to the farm to pick up the milk and take it to the processing plant.

- The driver picks up milk from several different farms each day.
- The truck driver takes samples of the milk before pumping it into the truck to make sure the milk from each farm is safe to drink.
- The samples are also tested at the processing plant. Milk that does not pass certain tests is thrown away. It never reaches the grocery store.*
- Each truck has a special feature to keep it cold. A tank truck is like a thermos on wheels!

***Note:** U.S. milk and dairy foods are among the most highly regulated and tested food products in the world today. Milk and dairy foods are subject to up to 17 safety, quality and sanitation inspections before ever reaching a grocery store. Federal regulations require that every tanker of milk be tested for antibiotic residues and bacterial level. Milk that does not pass these stringent tests is discarded. When this happens, the dairy farmer responsible for the contaminated milk is financially liable.

Check for Understanding

Have students write a short paragraph summarizing something they've learned about cows and milk production. Instruct them to use new terms introduced in the lesson.

Going Further:

Vo-cow-bull-ary Ask students to record the alphabet down the left side of a piece of paper and keep track of dairy terms starting with each letter. Have students write a short definition for each term.

Featured Guest Does your school district have a Future Farmers of America (FFA) chapter? If so, invite a member to speak to your class about milk production. Or contact your local cooperative extension office to see if the agricultural agent or a 4H member can do a presentation about dairy farming for your class.

Milestones of Milk History Have students research milestones in milk history to see how certain events and inventions improved the safety, quality and availability of milk. Suggestions include the first transport of milk by tank trucks in 1914 or the use of farm bulk tanks for milk storage instead of milk cans in 1938. For additional suggestions, go to <http://www.idfa.org/facts/milk/milkfact/milk4.pdf>.

Virtual Dairy Tours Visit the following Web sites and have students take a virtual dairy tour.

<http://www.dairyfarmingtoday.org/DairyFarmingToday/Home>
<http://www.moomilk.com/index.html>