

Dairy Products: From Sun to Farm to Table

Suggested Grade Level: 3-5

Time: 4 20-30 minute segments with optional extensions

Subject: Science, Energy, Ecosystems, English Language Arts, Informational Reading, Research, Agriculture, Dairy

Overview: In this four-part, cross-curricular lesson, students will discover how cows convert sunlight into nutritious dairy products. They will participate in a relay game to explore the flow of energy from plants to people, read the Kids Connection Magazine "More Than Milk," conduct online research on dairy products, and create their own butter.

Objectives:

1. Describe how cows turn plants into dairy products that provide energy for people.
2. Recite the steps of how milk moves from the cow to the grocery store.
3. List at least five retail dairy products.

Background Information:

Kansas dairy farmers bring us fresh milk every day. They work hard to care for dairy animals. They milk cows, feed them proper nutrition, make sure animals have access to fresh water, bottle feed calves, put down clean bedding, prepare fields, plant crops, check crops, harvest crops, fix broken machinery, assist animals with medical needs, calving, and general health and wellness. Kansas dairy farmers' schedules include, but are not limited to, working with nutritionists, veterinarians, health inspectors, milk truck drivers, and salespeople. They build terraces in sloping fields to save topsoil and lay drain tile. They plant cover crops in between rotations to improve soil health. The bottom line is that Kansas dairy farmers work hard so we can have milk! They work hard to get their land in the best shape possible to raise the best crops, feed their animals with the best nutrition, and give us the freshest milk possible!

One cow weighs 1,500 pounds and produces 2,500 gallons per year. That is 8 gallons of milk, 3.3 pounds of butter, or 7.0 pounds of cheese daily (Silver). A high-producing cow can produce 11.6 gallons of milk a day. That is 5 lb of butter or 10 pounds of cheese. One cow consumes the following daily: 20 pounds of grain and concentrated feed, 35 gallons of water (about a bathtub full), and 35 pounds of hay or silage. A cow converts roughage and grains not consumed by people and turns them into high-energy foods. Cows can digest it because they have four compartments in the stomach (Nebraska). Dairy farmers use a feed mix called TMR, which stands for "Total Mixed

Ration," to ensure that dairy cows get a balanced diet. Dairy farmers create TMRs with the optimal combination of forage and feed, thereby providing their cows with a balanced array of nutrients (Eckelkamp). Cows can digest it because they have four compartments in the stomach: rumen, reticulum, omasum, and abomasum.

Cover crops are planted in fields between crop rotations to build soil health because organic matter from the live roots of plants makes the soil airy and helps with water quality. Cover crops also conserve water and help keep soil from washing away. Farmers plant cool-season cover crops, such as wheat, oats, and barley, or legumes, including field peas, clover, alfalfa, chickpeas, and soybeans, during the cold months. They plant warm-season cover crops in the warm months, including sunflowers, buckwheat, squash, chicory, millet grasses, grain sorghum, and corn. Other cover crops include radishes, turnips, beets, and carrots (Cover).

Kansas Connections:

Kansas, which ranks 16th for overall milk production in the U.S., is home to 173,000 milk cows that live on more than 220 dairy farms. Kansas has six plants that produce dairy products. These dairy farms and plants are crucial to the Kansas economy, as they support local businesses and contribute to the community's tax base. This is particularly important to Kansas rural economies; for every dollar a dairy farm spends, about \$2.50 in wages and transactions flow back into the local economy. In 2020, the milk produced in Kansas totaled over \$688 million. The average single cow produces about \$11.36 (about 7.55 gallons) of milk per day. That's a cash cow! The Kansas dairy industry has created 1,330 jobs directly and indirectly around 4,000. Dairies have created jobs on farms, in trucking, breeding services, sales, repair services, veterinary care, pharmaceutical services, dairy nutrition, and other consulting services (Kansas).

Materials:

- Sun, to Moo, to You Relay Cards
- Kansas Agriculture in the Classroom's Kids Connection Magazine "More Than Milk" <https://ksagclassroom.org/resource-center/connection/>
- Small jars for making butter (baby food jars work great, but for a non-breakable option, here is a link for plastic jars with lids; any small container will work; it is best to be able to see into the jar as the butter forms; 4 oz jars would work well also)
https://www.amazon.com/dp/B098NVM28C?psc=1&ref=ppx_pop_dt_b_asin_title
- Heavy cream
- Crackers or bread for tasting butter

Instructional Format:

1. Review background information. If students have no background knowledge of where milk comes from, you may want to use this lesson first: A Day in the Life of a Kansas Dairy Farmer



<https://ksagclassroom.org/kansas-lesson-plans/daylife-dairyfarmer/>. If you have previously introduced dairy farming, you may skip to Activity 1.

2. Conduct engagement exercise.
3. Conduct Activity 1.
4. Conduct Activity 2.
5. Conduct Activity 3.
6. Conduct Activity 4.
7. Review the vocabulary.
8. Present the Career Information to students.
9. Optional: Complete the assessment(s).

Engagement: Ask the class, “Can you get energy by eating grass or standing in the sun?” Allow students to share their ideas, then explain that plants make their own food through photosynthesis, but humans must eat food to get energy and cannot digest hay or grass. Explain that cows are a link in the energy chain from plants to people. One cow weighs about 1,500 pounds and produces around 2,500 gallons of milk per year. Cows convert plant energy that humans can’t digest into high-energy foods. Finally, draw a simple diagram on the whiteboard: **Sun → Plants → Cow → People**.

Procedures:

Activity 1: Sun, to Moo, to You

Activity

1. In preparation for this activity, copy the Sun, to Moo, to You Relay Cards onto 3-5 different colored sheets of cardstock. Cut each card out to create a set of relay cards for 3-5 teams.
2. Divide the students into teams of seven students. Teams with fewer than seven students must select one or more members to complete the relay twice.
3. Assign each team a color based on the color of their *Sun, to Moo, to You Relay Cards*. Outside, the students line up in single-file lines with their teams. Five yards in front of each team’s starting line, place a jump rope. Several feet beyond the jump rope, spread the team’s relay cards face down. Five yards further, place a finish line.
4. Explain to the students that they are about to participate in a relay race team competition. Emphasize the importance of supporting one another and contributing to the team’s goals. Demonstrate how each student will individually leave their team’s starting line. They will run to the jump rope and jump rope five times. Next, they will pick up one of the seven relay cards and run to the finish line. Once they finish, they will yell, “Moo!” to signal the next teammate in line to begin the relay.
5. Once the entire team has crossed the finish line, the team members will work together to put each relay card in the correct order. The cards will create a sequence illustrating how energy flows during the process of making milk. When the team has completed the entire relay, team members must all sit quietly in a



line. The first team sitting quietly on the grass wins! The winning group reviews the correct order with the class.

6. After conducting these activities, review and summarize the following key concepts:
 - Dairy cattle produce milk. Milk and other dairy products, such as yogurt and cheese, are a healthy source of protein in our diet.
 - All energy is originally derived from the sun.
 - Plants produce energy through photosynthesis, and cattle eat plants such as grass, hay, and grain. Cattle convert plant energy into milk, which provides healthy food for our diet. (From the Sun, to Moo, to You)

Activity 2: From Cow to Table

Discussion

1. Hand out copies of Kansas Agriculture in the Classroom's Kids Connection Magazine, "More Than Milk." For a review of the previous instruction on dairy, the magazine could be read silently, aloud, or in a group, according to the teacher's preference.
2. When you get to page 4, read about the different types of automated milking machines and watch these video examples. For Kids: How Cows are Milked by AgriComm: https://www.youtube.com/watch?v=IWFEyh_fp7o Robots Revolutionize Milking Cows by syracuse.com (2:50 min) <https://www.youtube.com/watch?v=c4XLZEI154U>
1. Ask the class how farmers milked cows before the process was automated.
 - In the past, it took up to one hour to milk six cows by hand. Today, people can milk 100 or more cows per hour using modern machines and technology.
 - Before modern milk delivery, people who traveled and needed milk had to bring their cows with them.

Activity 3: Yum, Yum (Dairy Products)

Activity

1. Ask students to raise their hands and take turns naming products that come from milk. Write answers on a whiteboard or paper for the class to see.
2. After listing all they can think of, challenge individuals or groups to use the internet to discover at least three products that aren't listed. Give 5-10 minutes or time as needed, and reconvene the class to share and add to the list.
3. You could also use this segment as a homework or computer lab assignment. An optional assignment could be a report, oral or written, on how one product is made from milk. Optional, again, would be for a group to survey classmates or school staff on their favorite dairy products and create a graph to show the data.

Activity 4: Make Your Own Butter

Activity



1. Fill a jar halfway with heavy cream and screw the lid on tight. For individual servings of just a tablespoon or so of butter, use 2 Tablespoons of cream. Otherwise, students may get tired of shaking.
2. Instruct students to shake the jar up and down until the cream thickens and begins to stick together.
3. Then, have students open the jar and pour any remaining liquid into another container. Explain that this is the buttermilk, and everything else is butter.
4. Instruct students to knead the butter under cold, running water for several minutes to remove any remaining buttermilk; otherwise, the butter will spoil quickly. You can skip this step if you have students sample the butter on crackers or bread immediately.
5. Instruct students to knead in salt, if desired.
6. Refrigerate the butter.

Vocabulary:

- **Rumen:** The first stomach compartment where bacteria start breaking down roughage.
- **Reticulum:** The second compartment that traps foreign objects and helps mix food.
- **Omasum:** The third compartment that absorbs water and nutrients.
- **Abomasum:** The fourth compartment, also called the “true stomach,” where digestion with acids occurs.
- **Udder:** a bag on a female cow that holds the milk she makes.
- **Pasteurization:** a heating process that kills any harmful bacteria in milk.
- **Homogenize:** a process that blends fat into milk and keeps fat from separating in milk.
- **Cream:** the fatty part of milk that rises to the top in fresh milk.
- **Whey:** the liquid part that separates from the solid part during cheesemaking.
- **Buttermilk:** the liquid part left over after the butter has separated from the cream.

Kansas Curricular Standards:

Next Generation Science Standards

5th Grade

Energy

5-PS3-1. Use models to describe that energy in animals’ food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.

Ecosystems: Interactions, Energy, and Dynamics

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Language Arts

3rd Grade

Reading: Informational

Key Ideas and Details



RI.3.2 Determine the main idea of a text; recount the key details and explain how they support the main idea.

RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

Integration of Knowledge and Ideas

RI.3.7 Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).

Research to Build and Present Knowledge

W.3.7 Conduct short research projects that build knowledge about a topic.

Speaking and Listening

Presentation of Knowledge and Ideas

SL.3.4 Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.

4th Grade

Reading: Foundational

Fluency

RF.4.4 Read with sufficient accuracy and fluency to support comprehension.

RF.4.4a Read complex text with purpose and understanding.

Reading: Informational

Key Ideas and Details

RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

RI.4.2 Determine the main idea of a text and explain how it is supported by key details; summarize the text.

RI.4.3 Explain events, procedures, ideas or concepts in a historical, scientific or technical text, including what happened and why, based on specific information in the text.

Integration of Knowledge and Ideas

RI.4.7 Interpret information presented visually, orally or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

Writing

Research to Build and Present Knowledge

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.

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

5th Grade

Reading: Foundational

Fluency

RF.5.4 Read with sufficient accuracy and fluency to support comprehension.

RF.5.4a Read complex text with purpose and understanding.

Reading: Informational

Key Ideas and Details

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.

RI.5.2 Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

RI.5.3 Explain the relationships or interactions between two or more individuals, events, ideas or concepts in a historical, scientific or technical text based on specific information in the text

Integration of Knowledge and Ideas

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

Writing

Research to Build and Present Knowledge

W.5.9 Draw evidence from literary or informational texts to support analysis, reflection and research.

National Agricultural Literacy Standards:

Agriculture and the Environment

- Explain how the interaction of the sun, soil, water, and weather in plant and animal growth impacts agricultural production (T1.3-5 b.)
- Recognize the natural resources used in agricultural practices to produce food, feed, clothing, landscaping plants, and fuel (e.g., soil, water, air, plants, animals, and minerals) (T1.3-5 e.)

Food, Health, and Lifestyle

- Diagram the path of production for a processed product, from farm to table (T3.3-5 b.)
- Distinguish between processed and unprocessed food (T3.3-5 c.)
- Explain the costs associated with producing and purchasing food (T3.3-5 d.)
- Explain the practices of safe food handling, preparation, and storage (T3.3-5 e.)
- Identify careers in food, nutrition, and health (T3.3-5 f.)
- Identify food sources of required food nutrients (T3.3-5 g.)

Science, Technology, Engineering and Mathematics

- Compare simple tools to complex modern machines used in agricultural systems to improve efficiency and reduce labor (T4.3-5 a.)
- Describe how technology helps farmers/ranchers increase their outputs (crop and livestock yields) with fewer inputs (less water, fertilizer, and land) while using the same amount of space (T4.3-5 b.)
- Provide examples of science being applied in farming for food, clothing, and shelter products (T4.3-5 d.)

Culture, Society, Economy, and Geography

- Describe how supply and demand impact the price of agricultural goods (T5.3-5 a.)
- Discover that there are many jobs in agriculture (T5.3-5 b.)
- Explain how agricultural events and inventions affect how Americans live today (e.g., Eli Whitney - cotton gin; Cyrus McCormick - reaper; Virtanen - silo; Pasteur - pasteurization; John Deere - moldboard plow) (T5.3-5 c.)
- Explain the value of agriculture and how it is important in daily life (T5.3-5 d.)
- Provide examples of agricultural products available, but not produced in their local area and state (T5.3-5 e.)

Companion Resources:

“Chuck’s Ice Cream Wish (Tales of the Dairy Godmother)” by Viola Butler (Book)

<https://newyork.agclassroom.org/matrix/companion-resources/1034/>

“Clarabelle (Making Milk and So Much More)” by Cris Peterson (Book)

<https://agclassroom.org/matrix/companion-resources/11/>

“From Milk to Ice Cream” by Stacy Taus-Bolstad (Book)

<https://lernerbooks.com/shop/show/12829>

“Milk (What’s For Lunch)” by Claire Llewellyn (Book)

<https://oregonaitc.org/product/milk-whats-for-lunch/>

“Milk Comes From a Cow?” by Dan Yunk (Book)

<https://agclassroom.org/matrix/resource/381/>

Dairy Byproducts Poster

<https://ksagclassroom.org/supporting-resources/dairy-byproducts/>

Dairy Discovery Zone: Farm Families <https://www.dairydiscoveryzone.com/farm-families>

Dairy Fun Facts Poster <https://ksagclassroom.org/supporting-resources/dairy-fun/>

General information that students might ask about dairy:

https://www.discoverdairy.com/wp-content/uploads/2019/08/VFT-Vocab-and-FAQ-Guide_PreK-to-6-Grade.pdf

How Milk Gets from Farm to Fridge by Dairy MAX:

https://www.youtube.com/watch?v=0XSoTEcD_vQ (4:08 min, can skip to 2:48 to see how milk leaves the farm in a truck if you’ve watched other videos of cows getting milked)

Kansas Dairy Poster <https://ksagclassroom.org/supporting-resources/kansas-dairy/>

Kansas Foundation for Agriculture in the Classroom Kids Connection Magazine, “More than Milk”

<https://ksagclassroom.org/resource-center/connection/>

Lesson Plan: A Day Without Dairy <https://www.agclassroom.org/matrix/lesson/255/>

Lesson Plan: FoodMASTER: Milk and Cheese

<https://www.agclassroom.org/matrix/lesson/260/>

Lesson Plan: It’s a MOO-stery! <https://www.agclassroom.org/matrix/lesson/16/>

Lesson Plan: Sun, to Moo, to You! <https://www.agclassroom.org/matrix/lesson/251/>



Lesson Plan from Kansas Foundation for Agriculture in the Classroom:

<https://ksagclassroom.org/kansas-lesson-plans/daylife-dairyfarmer/>

More lesson plans by grade level: <https://www.discoverdairy.com/>

<https://www.discoverdairy.com/elementary-curriculum/>

Career Information:

There are so many jobs related to the dairy industry! Here are a few:

Nutritionist: Researches nutrition, reproduction, growth, and development of livestock.

Crop Scouts: Assess crop performance and problems of crops grown for feeding purposes.

Housing Specialists: Handle the design and ventilation of dairy production buildings, hog operations, chicken dwellings, and other related facilities.

Mechanics: Keep machinery in operating order.

Truck Drivers: Haul produce, animals, equipment, and processed goods from farms to stores

Accountants: Advise the farm on business decisions and financial matters.

Advertisers: Assist in selling the end products to stores and customers.

Food Safety Inspector: Inspects all aspects of food production from the farms, processing plants, and products to ensure safe and healthy products for consumers.

Veterinarians: Study, treat, and control animal injuries and diseases.

Many of these careers require a college degree or vocational training; some, such as veterinary medicine, require advanced degrees.

Assessment:

Informal assessment: Use exit cards at the end of each segment. Examples: List or draw how we get energy from the sun to our bodies via milk (sun, grows grass and hay, cows eat grass, cows make milk, we drink milk), list at least five dairy products, draw or describe how milk gets from the cow to the store, describe how cream turns into butter, and define vocabulary words.

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Sun, to Moo, to You!

