



STEMsational Ag: The Virtual Farm

MIDDLE TENNESSEE STATE UNIVERSITY



Module 6: All About the Cows UNIT 1: A DAY IN THE LIFE Grades 9 - 12



 **USDA** National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

MIDDLE TENNESSEE
STATE UNIVERSITY.
CENTER FOR HEALTH
AND HUMAN SERVICES

MIDDLE TENNESSEE
STATE UNIVERSITY.
SCHOOL OF
AGRICULTURE

MIDDLE TENNESSEE
STATE UNIVERSITY.

I AM *true*
BLUE
MIDDLE TENNESSEE STATE UNIVERSITY

MT
Fermentation Science

This work is supported by the Agriculture and Food Research Initiative, Education and Workforce Development Program. [grant no. 2021-67037-33380/project accession no. 1024880], from the U.S. Department of Agriculture, National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.

0422-0610 / Middle Tennessee State University does not discriminate against students, employees, or applicants for admission or employment on the basis of race, color, religion, creed, national origin, sex, sexual orientation, gender identity/expression, disability, age, status as a protected veteran, genetic information, or any other legally protected class with respect to all employment, programs, and activities sponsored by MTSU. The Assistant to the President for Institutional Equity and Compliance has been designated to handle inquiries regarding the non-discrimination policies and can be reached at Cope Administration Building 116, 1301 East Main Street, Murfreesboro, TN 37132; Christy.Sigler@mtsu.edu; or 615-898-2185. The MTSU policy on non-discrimination can be found at mtsu.edu/iec.

Materials are intended for educational purposes only. Content Contributors and the STEMsational Ag team have reviewed to ensure all content is cited. Please contact STEMsationalAg@mtsu.edu with any concerns.



STEMsational Ag—The Virtual Farm

Welcome to Module 6 Unit 1: A Day in the Life



Introduction to the Unit:

- Read the article, "A Brief History of Milk" (*Source: Organic Valley website, <https://www.organicvalley.coop/blog/a-brief-history-of-milk/>*) on pages 3-9.
- After reading the article, write the five main take-aways from the reading.



A Brief History of Milk

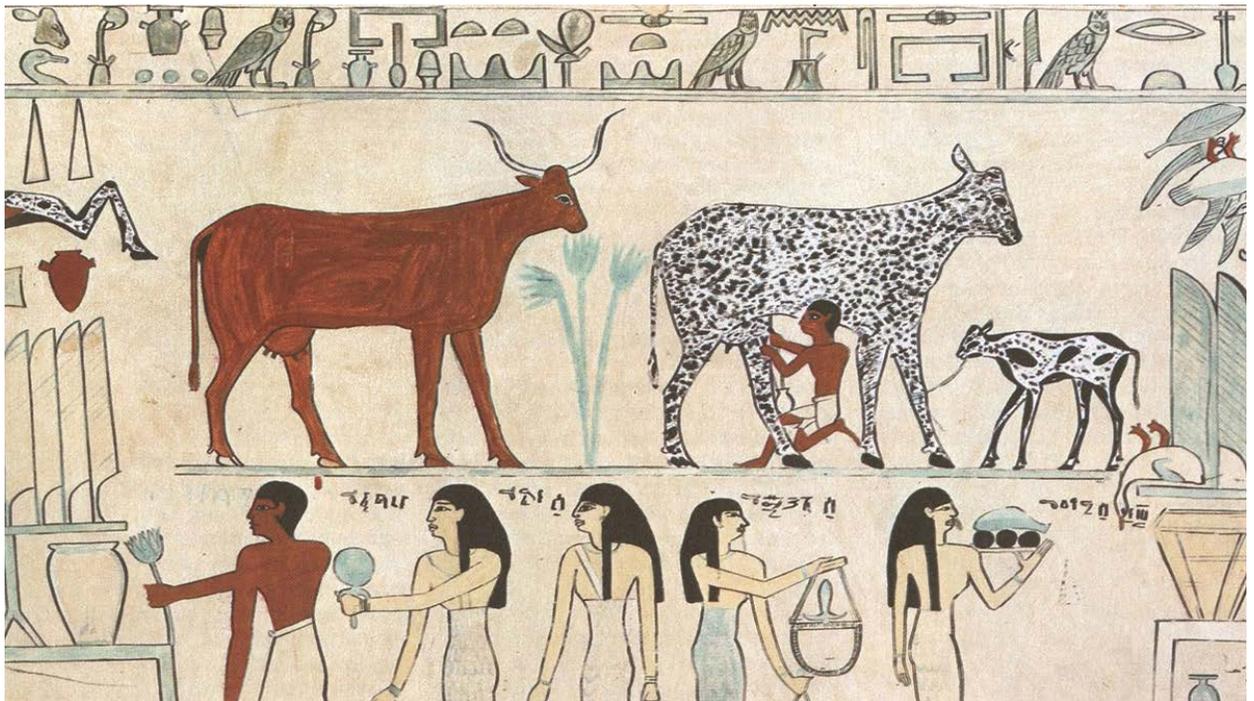
Aug. 24, 2020

by Jane Burns

When it comes to inventions and innovations, most make sense on a basic level. After all, human beings always wanted to fly. We've always wanted more efficient ways to wash our clothes, cook our food, or communicate with friends and loved ones.

Some things in our lives are a little less obvious, like drinking milk. Just who was the first person who looked at an animal feeding its baby and thought, "Hey, I want some of that"? And more importantly, why?

Milk's place in society is 10,000 years in the making, so that first question is a little elusive. The second, though, has become clear as milk drinkers today tap into the same things that early dairy-lovers did: nutrition, commerce, culture, and general deliciousness.



Old Egyptian hieroglyphic painting showing an early instance of a human milking a domesticated cow. Date unknown. (Source: Wikimedia Commons, scanned from 1000 Fragen an die Natur, via The Metropolitan Museum of Art, Rogers Fund, 1948.)



Milk's Humble Beginnings

It took the domestication of cattle, following on the heels of sheep and goats, to put the ancient dairy industry into motion and a quirk of genetics to move it along. Dairy got its start in what is now Turkey in about 8,000 BCE, and for reasons of food safety in the days before refrigeration, the first milk from animals was turned into yogurt, cheese, and butter. Then Mother Nature stepped in and changed everything.

As people and cattle migrated, they took with them a genetic mutation that mysteriously began to appear shortly after dairy products were developed—lactose tolerance.

Humans, like all mammals, weren't built to digest lactose, milk's natural sugar, beyond childhood. But around 6,000 BCE, the ability for some adult humans to tolerate lactose kicked in and was passed down through people in Europe as well as in parts of Africa and the Middle East. It's possible adult humans already drank other mammals' milk because illness was better than death during famine, and infants always needed milk if a mother or wet nurse wasn't available. As human beings changed and evolved, the foundation of our milk-drinking culture was laid.

That foundation stayed in place for quite some time. Not much changed with milk in the ensuing millennia except more people came to value it for nutrition and flavor, including some of the first American colonists who brought cows across the Atlantic.



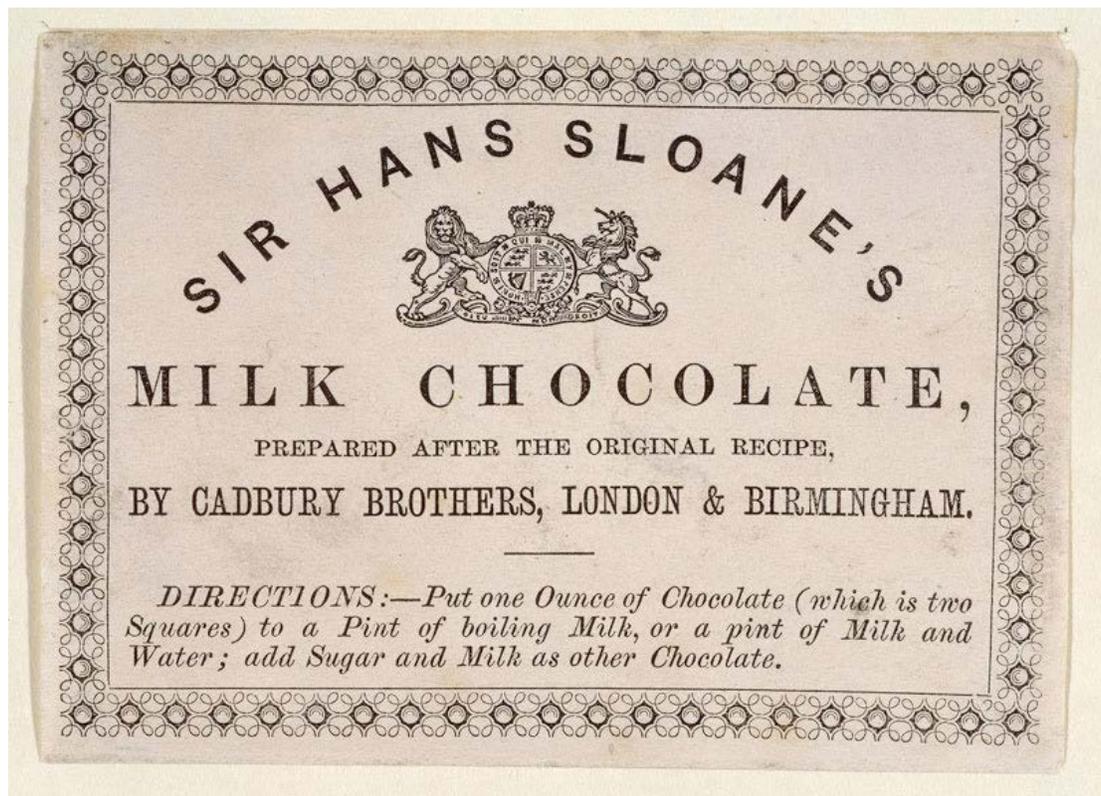
A woodcut image of a woman delivering milk, circa 1887. (Source: Wikimedia Commons)



The Innovation Age

Throughout the years, milk's perishable nature kept it close to the farm, quickly consumed as a beverage if not turned into cheese or butter. As the Industrial Revolution created an urban culture and larger-scale production, it also created problems for those who still wanted their milk. Distance and unsanitary urban dairies only exacerbated the risk of disease: Typhoid fever, scarlet fever, tuberculosis, and diphtheria could be transmitted through raw milk.

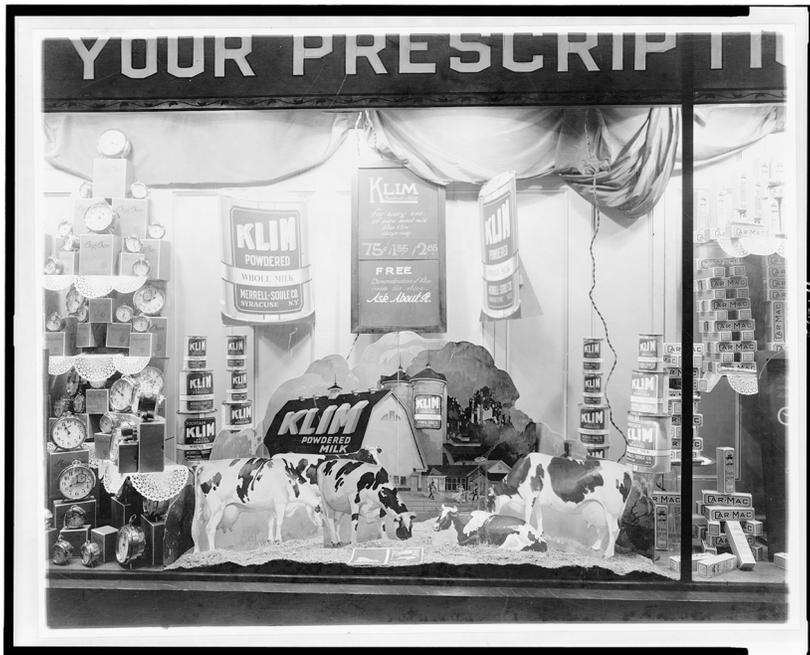
Pasteurization—the method of destroying harmful bacteria through heat—solved that problem, but it wasn't an immediate solution. For starters, Louis Pasteur's 1864 innovation first made its impact on wine and beer. It took 20 years until a German chemist named Frans von Soxhlet proposed applying the process to milk. In 1908, Chicago became the first municipality to require pasteurization for all milk sold. On a state level, Michigan became the first to enact a similar law in 1948. What had been a state-by-state regulation finally became a national standard in 1987.



Label for Cadbury's milk chocolate drink featuring a recipe credited to Sloane, Natural History Museum, circa 1850. (Source: Wikimedia Commons)



Previous centuries weren't without innovations beyond pasteurization, however. In fact, one 17th century development created what continues to be a favorite of kids and grownups alike: chocolate milk. In the late 1600s, Irish botanist Hans Sloane traveled to Jamaica, where the locals gave him a drink of cocoa and water. He found it nauseating, and instead added milk and sugar to make it more palatable. While it's uncertain that he was the first to ever combine milk and chocolate, Sloane brought his recipe back to England where it was manufactured and sold as medicine.



A display of Klim Powdered Milk in a drugstore window in Washington, DC, 1909. (Source: Wikimedia Commons)

By the turn of the 19th century, a Russian scientist had developed the technology to create powdered milk, which retains all of milk's nutrients at a fraction of its weight. Then and now, this innovation created a nutritious way to give milk portability and extended shelf life, qualities that continue to make powdered milk a common item in U.N. food supplies as well as a choice for hikers and outdoor enthusiasts.

The Civil War sparked further advancement of milk's role in our diets. Newly invented condensed milk, with 60% of its water removed and sweetener added, became part of the Union Army's food supply. It was followed in the market shortly after by un-sweetened evaporated milk.

Progress in making milk safer and more efficient to produce led to a 20th century full of growth and development that made it the go-to beverage in the American diet. And in the latter part of the century, Organic Valley helped lead the way.



Members of a mothers' committee serve lunch at a nursery school, 1942.

20th Century: School Lunches and the Organic Rule

Once again it was war—World War II in particular—that helped transform milk in the U.S. As soldiers were drafted into service, physicians noticed a pattern of malnutrition in many of the young men who had grown up impoverished during the Depression. In addition, while food rationing was an indelible part of the home effort, milk was not rationed, and consumption jumped. When the war ended, there emerged an ideal solution to address both children's nutrition and the boon of milk production: school lunches, with milk as part of the meal.

Some cities were already addressing malnutrition with federally supported milk programs that began in 1940. In 1946, President Harry S. Truman signed what is now known as the National School Lunch Act. Eight years later, the Special Milk Program helped bring another 400 million pints of milk into American schools in addition to what had already been part of the school lunch menu. The rules have evolved over the decades, but the end result is that milk in schools is now as familiar as reading, writing, and arithmetic.

Check out our Brief History of School Lunch for more on the evolution of this important program.



Children drinking milk at a Farm Security Administration farm workers' camp in Yuba City, California, 1940. (Source: Library of Congress)



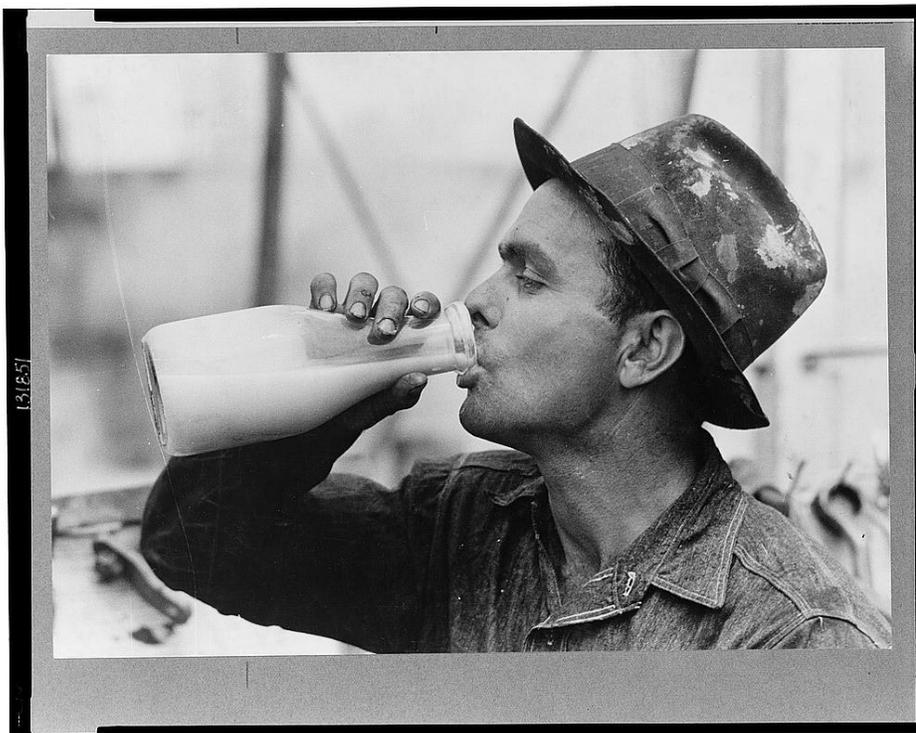
Late-20th-Century: Milk Leaps Forward

Milk's innovation continues to this day. Of particular note is ultra-filtered milk. With ultra-filtration, milk is mechanically filtered to create a higher concentration of protein while separating and removing some lactose and water. The result is low-sugar, high-protein milk. The technology itself is decades old, developed to treat whey, but it has emerged to create milk that packs a nutritious punch. It's now allowed for use in cheese production, too.

On the flavor front, it's no longer just traditional white and chocolate with the occasional guest appearance by strawberry—and milk drinkers are loving the options. One of the top-growing segments of the milk market is flavored milk, and these days that can be any a number of flavors: banana, root beer, "tutti-frutti," plus more grown-up flavors such as coffee and vanilla, and holiday favorites such as chocolate mint and pumpkin spice.

From pasteurization to powdered milk to ultra-filtered milk to pumpkin spice milk, 6 billion people's go-to beverage is light years away from its curious beginnings. Much has changed, but one thing remains the same: Milk is a tasty source of nutrition.

After all, if something's been around for 10,000 years, it must have been a good idea—whoever had it first.



Oil field worker drinking a bottle of milk at lunch, Kilgore, Texas, 1939 (Source: Library of Congress)



Pre-assessment:

Answer the following questions:

1. What technologies are utilized in the agriculture industry?
2. What technologies are utilized by dairy farms?

Purpose:

Students will be able to answer the following:

- I CAN explain the history and evolution of milk production.
- I CAN illustrate the importance of robotics in agriculture.
- I CAN describe the benefits of technology utilized in milk production and farming

National Agricultural Literacy Outcomes

Theme 4: Science, Technology, Engineering & Mathematics Outcomes

T4.9-12

- A. Correlate historical events, discoveries in science, and technological innovations in agriculture with day-to-day life in various time periods.
- C. Discuss population growth and the benefits and concerns related to science and technologies applied in agriculture to increase yields and maintain sustainability.
- D. Evaluate the benefits and concerns related to the application of technology to agricultural systems (e.g., biotechnology).
- E. Identify current and emerging scientific discoveries and technologies and their possible use in agriculture (e.g., biotechnology, bio-chemical, mechanical, etc.).



Vocabulary:

- **Biotechnology:** a biology-based technology that is used for agricultural, food science or medicinal purposes. In agriculture, the process involves creating or modifying DNA to impart beneficial genetic traits
- **Carbon Footprint:** members of the U.S. dairy industry – from the local farm to the retailer – have long played a significant role in our nation’s food system, communities and economy by providing wholesome, nutrient-rich products that are produced in a sustainable manner. Today, a gallon of milk is produced with 90 percent less land, 65 percent less water, 75 percent less manure and a 63-percent smaller carbon footprint than in 1944
- **Dairy Sustainability:** the practice of continuous improvement to provide consumers with nutritious dairy products in a way that makes the industry, people, and the earth more economically, environmentally and socially better – now and for future generations. Since 1944, the U.S. dairy industry has reduced its carbon footprint 63 percent. Compared to nearly 70 years ago, a gallon of milk today is produced using 90 percent less land and 65 percent less water from cows that produce 76 percent less manure
- **GMO (Genetically Modified Organism):** the process of intentionally making a copy of a gene for a desired trait from one plant or organism and using it in another plant. Fluid milk is not genetically modified nor are the cows that produce the milk
- **Milking Parlor:** a specialized area on the dairy farm where cows are milked two or three times a day. Equipment delivers the milk directly from the cows to a refrigerated holding tank to preserve freshness and safety. The milk is then quickly transported to the dairy plant. Parlors come in many types, including flat barn, herringbone, parallel, swing, walk-through and rotary
- **Robotic Milkers:** on-farm technology that allows cows to be milked without human interaction. Each cow has a transponder that dangles from a neck collar and contains her personal data. Cows enter a farm’s robotic milking machine when they wish to be milked and are identified by her transponder. The robot is triggered to prepare the milking process and the cow’s udder is automatically cleansed. Then, a laser beam detects the exact position of the udder so suction cups that draw milk from the cow can be attached by a robotic arm. The milking stops once the robot senses the flow of milk has slowed. A gate opens and the cow is free to return to her bed, eat or drink water

Materials Needed:

- Poster board
- Color pencils, crayons, or markers
- Any additional arts and crafts supplies desired



Activity

First, let's brainstorm!

- What are ways that technology is used in your life to make work or daily life more comfortable and convenient? Make a list.
- Answers may include (but are not limited to): computers, smart phones, Bluetooth, GPS, etc.
- Technology is also utilized on the farm to help farmers be more efficient and effective.

Part 1

- View the video screen shots and follow the narration from the video, "Fun on the Farm, Farmer Jared, Robotic Milking." on pages 13-22.
- Complete the worksheet provided, "Farm Technology" on page 23

Part 2

Modern farmers use technology in many other ways, too. They use satellite and sensor technologies like GIS (Geographic Information Systems) to collect information about their soil, crops, livestock, and even the weather. They use GPS (Global Positioning Systems) to map fields, guide tractors, and check crops, even at night. Drones and robots can be used to disperse chemicals, plow fields, plant seeds, weed, irrigate, and harvest the crops.

View the video screenshots and follow the narration from the video, "Fun on the Farm, Farmer Kelsey, GPS." See how Kelsey O'Shea of Mapleview Dairy in Madrid, N.Y., uses harvesting technology on pages 25-36.

These tools save time and money. For dairy farmers, it means more time spent caring for the cows themselves.

Farm Technology Poster

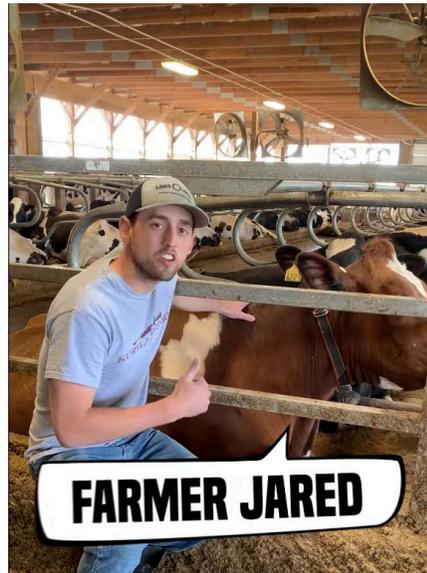
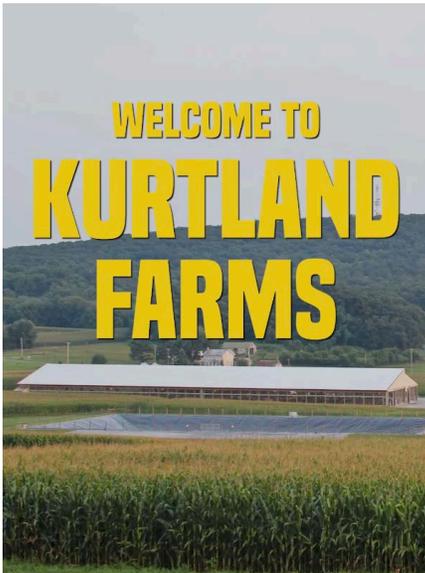
- Choose one of the technologies listed in this activity. Research how it is used on modern dairy farms.
- Create a poster giving a summary of the technology and how it is utilized. Include the major benefits the technology offers to farms, families, animals, and the environment.
- When the poster is complete, share with a parent, guardian, sibling, or friend.



Fun on the Farm

Farmer Jared | Robotic Milking

Also available online at: https://youtu.be/o8Ftm_tKnLw



Welcome back to Fun on the Farm. I'm Farmer Jared.



And I'm out here at Kurtland Farms today with "Maple Syrup."



I want to show you how she gets milked in the robot here in just a second.



One thing I want to point out before we send her into the robot to get milked is around all the cows' necks in our barn, right here. Like on Maple Syrup, they have a collar.



And on that collar, there is a responder that tracks all of that cow's information ...



similar to the Fitbit that one of you, or one of your parents, might have at home.



This tracks how many steps they take and how much time they spend chewing their cud. And it sends all that information back into our computer, which works with the robot. That lets us know what's going on with the cows.



So for a cow like Maple Syrup, who just had twin heifer calves a couple of days ago, this kind of information is extremely important to make sure that we can track her health and anything that might be going on with her.



So, come, follow us.

We'll show you how she's going to get milked.



I'm here with Maple Syrup. She's about ready to walk in the robot right here to get milked as soon as this cow is done.



We're going to go inside and watch the robot actually attach the teat cups to her and see her get milked.



The cool thing about the robots and how the cows get milked on our farm is they can go in anytime they want to. 24/7, the robots are running; they're working.

The cows can go and eat, go get a drink, come in here and get milked, then go lay down and rest or do whatever they want to do for the rest of the day.



So, we're going to watch from the inside, see how she goes in there and how everything happens automatically without us touching a thing.



Alright, Maple Syrup is about to come into the robot here to get milked.



You can see her sniffing around. She's coming in on her own; we're not out there pushing her in.



So as the robot is cleaning off her teats and getting ready to milk her, she actually gets a special treat as she's in the robot.



She gets a special pellet. It's in addition to the feed that she eats at the bunk.



If you remember, we looked at that feed on Monday, the first day out that you guys visited me here on the farm.

In just a couple of seconds, it's going to be done cleaning her off, and we'll show you how the milk cups actually attach to her teats. And we'll show you how the milk flows out of there into the weigh jar.



The robot uses lasers to detect where her teats are.



As it finds each teat, it's going to place each cup up on her teat and begin that separate quarter.



This entire time that she's in there, she's eating her pellets, hanging out, and nothing's really bothering her. This is all on her own.



So, as Maple Syrup's getting milked in there, she's eating this pellet right here. It's kind of like a candy for the cows.



She's enjoying it. It's kind of like her little snack. She's getting milked, hanging out. It doesn't get much better than that for the cows.



The robot just attached to Maple Syrup; all four of her quarters are now milking.



And you can see these hoses right here where the milk is actually flowing from Maple Syrup through the robot.



And it comes in here, inside the robot, first into what's called a milk jar.



And that actually weighs the amount of milk that she has produced each time that she comes into the robot.



So, now all of her information that is on her collar gets sent to the computer. We can see all the information about her.



We can see that she weighs just over 1,500 pounds. So far, she's given about six pounds of milk.



And she's expected to be in here about seven minutes total, including the time she got cleaned off and milked.



So, Maple Syrup just finished up getting milked.



She's on her way.



She's going to go back out there and get some feed from her feed bunk, drink a little bit of water, and maybe go lay down.



Make sure you tune in tomorrow so you can find out where the milk goes from here and how it gets to your house.



Farm Technology

Technology has made modern farming more productive. On dairy farms, it also keeps cows healthier and more comfortable. Jared Kurtz and his family, who own Kurtland Farms in Elverson, Pa., milk cows on their farm using robots!

PART 1: Robotic milking systems allow cows to choose when they want to be milked and provide farmers with valuable information on the health and habits of each animal. To see how, watch the video of Farmer Jared at https://youtu.be/o8Ftm_tKnLw. Think about how robotic milking systems help farmers take better care of their livestock. Then, answer the questions below.

1. How do robotic milking machines benefit farmers?

2. What kind of information do the sensors collect about each cow?

3. Why do the cows choose to be milked?

4. How do robotic milking machines help farmers take better care of each cow?



Post-Assessment

Respond to the Scenario:

Congratulations! You are now a dairy farmer, and you are producing dairy products!

- Which dairy products would you like to produce? Milk, cheese, yogurt, ice cream?
- Which technologies will you implement on your farm?
- Research the cost of implementing these technologies on your farm. How will you remain profitable as a producer? What are the benefits of implementing technology?



Fun on the Farm

Farmer Kelsey | GPS

Also available online at: <https://youtu.be/ki6XtYvszEU>



Hi there everybody. My name is Farmer Kelsey, and we are here at Maple View Dairy in northern New York.



And this week, we're going to learn all about technology on the farm.



Here at Maple View, we are a family-owned dairy farm that milks 3,300 cows.



We grow 5,000 acres of crops to feed our cows.



And we also raise another 3,200 young stock or heifers.



We are so excited to have you with us this week. But, before we head out ...



We want to get you up and MOO-ving.



(You may have seen us on Facebook or Instagram for some dairy dance-offs.)



Before we leave, I'm gonna teach you a new dance move.



So let's get MOO-ving!



Okay, everybody, let's learn our first dance move.

It's called The Twist!



[Music]



We're gonna start with our right foot, popping our right knee, and ...



our hands are gonna go out to the side.



And we're going to take that knee and bring it in and out, just like this.



So we're gonna do it four times.
Are you ready? 1 ... 2 ...



... 3 ... 4.



Now, we're gonna switch sides to our left leg,



leaving our hands out here ...

and we're gonna go...



1 ... 2 ...





3 ... 4.

So now, let's put it all together and do The Twist!



1, 2, 3, 4 ... 1, 2, 3, 4.



So now that we've gotten up and moving for the day, let's go learn about technology on the farm.

[Music]





This is a tractor. A tractor is like a really strong car that we use to help us plant or harvest crops or spread manure.



The tractor is driven with the help of GPS.



GPS stands for global positioning system and helps the tractor go in perfectly straight lines like we see on the three screens there.



You have probably seen technology like this in your car in the form of the GPS to help you know where to go.



Within the computer systems we have, we're able to select the piece of equipment we want and then select which field we're in, select what we're doing, and that will all combine together to tell us exactly where to drive our piece of equipment.



And in this case, how much manure to apply to make sure that we apply the same amount of manure across the entire field.



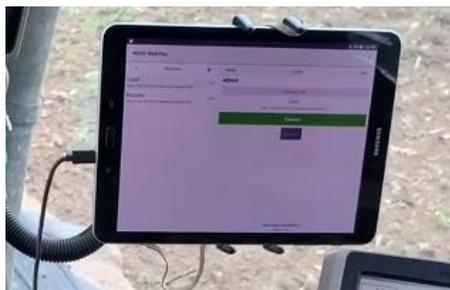
And it can adjust for whether we're going up a hill or down a hill or what type of soil we're on and what type of equipment we're using.



So all three of those digital screens work together.

[Music]

So we can see on each of the screens they give us different information about the piece of equipment we're in and what we're doing.





So that first screen's going to show us our piece of equipment on those grid lines using GPS to make sure we're in the perfect location.

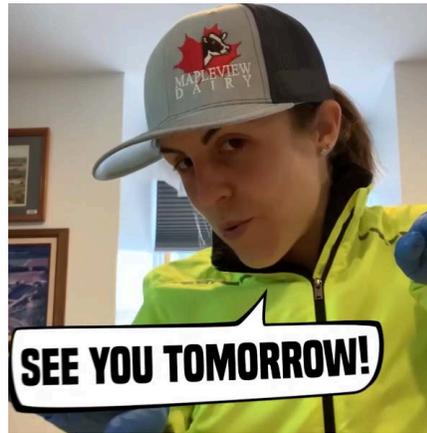


The other screens then help us use our tools or implements on the back ...

which in this case is a manure injector, to make sure that we're applying the right amount of fertilizer in the right place.



Thanks for joining us today to learn about technology on the farm. We're really happy to share with you how we use technology in our tractors and in the fields to help us get all of our fertilizer applied in a timely manner.



Be sure to come back tomorrow to learn another dance move and to check out our next piece of technology on the farm.