SCIENCE ON THE FARM

DEAR EDUCATOR,

Do your students know the role that technology plays on today's Florida dairy farms? Modern farmers use smartphones, GPS, drones, and robots all along the supply chain. Precision farming, coupled with the latest research, allows 21st century dairy farms to improve animal care, sustainability, and nutrition continually.

This teaching kit, developed by curriculum specialists Young Minds Inspired (YMI) in partnership with Dairy Council of Florida (DAFNC), is designed to help you introduce your students to the important roles that technology and bioscience play in modern farming, and help them understand how these advances in agricultural practices contribute to the health of our environment, our families, and the animals farmers care for.

We hope that you will share this program with other teachers in your school. Although the materials are copyrighted, you may make as many copies as needed for educational purposes.

Sincerely,

Teresa Moran-Wiebe
Dairy Council of Florida

Dr. Dominic Kinsley
Editor in Chief
Young Minds Inspired

Questions? Contact YMI toll-free at 1-800-859-8005 or by e-mail at **feedback@ymiclassroom.com**.

TARGET AUDIENCE

Middle school students in grades 6-8

PROGRAM OBJECTIVES

- Educate students about scientific technologies used in 21st century farming
- Explore environmentally beneficial techniques used in modern agriculture
- Raise awareness of principles farmers use to make sure cows are well cared for
- Examine efforts to make food more nutritious

PROGRAM COMPONENTS

- This teacher's guide
- Three student activity sheets that align with Florida Standards (FL NGSSS)
- Access to Interactive Virtual Farm Tours at **https://www.youtube.com/watch?v=QEQdevziyYE**
- Microsite with standards chart, answer key, bonus activity, and supporting resources at **ymiclassroom.com/fdf**

HEALTHY COWS ACTIVITY 1

Farm Technology

Ask students to think about ways they use technology to make work easier or to live more comfortably. Their examples may include computers, Bluetooth, and GPS maps. Tell students that technology is also used on farms to help produce the food we eat.

Have students read the activity introduction, and discuss how it may have changed their ideas about what it means to be a farmer. Then have students go to **https://www.youtube.com/watch?v=gDPGj8zdoDM** to watch a video of Lindsey Rucks explaining how farmers use pedometers to monitor cows' health at a Florida dairy farm. Afterwards, have students respond to the focus questions in writing or in a class discussion.

For Part 2, view the video about technology at **https://www.youtube.com/watch?v=kkyh0Q1JljM** and the video link on the activity sheet. Then, divide students into groups and assign each team one of the technologies mentioned: drones, GPS, GIS, robots. Provide time for research, then bring the groups together to share what they learned.

HEALTHY FAMILIES ACTIVITY 2

Farm Biology

This activity explores how advances in bioscience have helped improve farming practices and provide a scientific perspective on the GMO debate. Begin by discussing how species evolve through natural selection. Organisms with genetic mutations that help them adapt to their environment are most likely to reproduce and pass their beneficial genes on to their offspring.

Remind students that farms are the original biotech labs. It was experiments with selective breeding of pea plants that led Gregor Mendel to discover the underlying rules of genetics.

Explain how farmers have used selective breeding to create new kinds of food. Ancient wheat farmers, for example, would select plants with larger kernels of grain as seed for their next crop. Farmers have also used cross breeding — mating organisms that display a desired genetic characteristic to create a new hybrid, such as seedless watermelon.[1]

Since the 1990s, genetic engineering has provided another way to improve crop yield and quality. By adding a new gene to a plant's DNA, scientists have created crops that can resist insect pests and weeds without being harmful to humans. This genetic engineering has allowed farms to reduce herbicide and pesticide use, thereby reducing impacts on the environment.[2]

Animals and plants created through genetic engineering are sometimes called GMOs — genetically modified organisms. Some people worry that GMOs have unknown consequences. However, the benefits of GMOs are improving agriculture around the world.[3] Golden rice, for example, is a GMO that has the potential to prevent blindness in children. Genetically engineered crops can also help conserve soil and water. The cost savings help make nutritious foods more affordable for consumers.

Have each student compare genetic engineering with selective breeding by comparing and contrasting each method based on the examples provided. Then ask them to write a paragraph explaining the subsequent nutritional benefits to families.

HEALTHY FARMS ACTIVITY 3

Farm Ecology

Advances in technology and bioscience help farmers produce better crops, but without a healthy growing environment, those crops are doomed to fail. Explain to students that farmers use practices that protect and nurture the environment. This is called *sustainable agriculture.* These practices help conserve energy and water, minimize pollution, and build soil health.

Tell the students to read about the sustainable agriculture practices in the first column on the activity sheet, and then decide if that practice helps conserve energy, conserve water, minimize pollution, and/or build soil health. Then ask students to think of a way they can help achieve the same environmental goals at home.

Answers: 1: A, B, C, D; 2: C; 3: A, B, C; 4: B, C, D; 5: C; 6: A, C; 7: C. For more detailed information, download the Answer Key at **ymiclassroom.com/fdf**.

HEALTHY FARMS BONUS ACTIVITY

Dairy Ecosystems

This crossword puzzle highlights sustainable practices farmers follow to produce high-quality milk. It can be found at **https://www.floridamilk.com/stem-crossword-passage.stml**. Answers appear on the Answer Key at **ymiclassroom.com/fdf**.

Resources

- **Virtual Dairy Farm Tours** https://www.youtube.com/watch?v=QEQdevziyYE
- **Dairy Council of Florida (DAFNC)** floridamilk.com
- **Agricultural Biotechnology** fda.gov/food/consumers/agricultural-biotechnology
- **Young Minds Inspired** ymiclassroom.com/fdf

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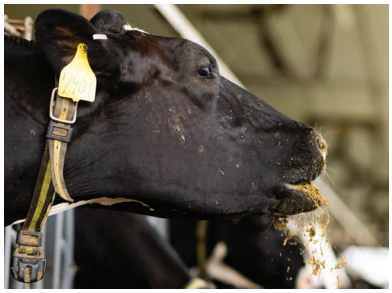
1. Learn more about selective breeding of watermelon: https://www.watermelon.org/the-slice/where-does-seedless-watermelon-come-from/
2. https://www.tandfonline.com/doi/full/10.1080/21645698.2020.1773198
3. For more on the debate over GMOs, students can watch the film "Food Evolution," available at https://foodevolutionmovie.com/.

Adapted from a program developed by American Dairy Association North East.

HEALTHY COWS ACTIVITY 1

FARM TECHNOLOGY

Technology has made modern farming more productive. On dairy farms, it also keeps cows healthier and more comfortable. Milking R Dairy of Okeechobee, Fla., uses collars on their cows to monitor the animals' health in real time, much like a fitness watch!



Milking R Dairy of Okeechobee, Fla., uses collars to monitor their cows' health.

Part 1

Cow pedometers can be in the form of an ankle bracelet or a neck collar that cows wear all the time, much like a fitness watch. These track each animal's steps as well as other health and habits of the cows. To see more about this, watch the video of Lindsey Rucks at **https://www.youtube.com/watch?v=gDPGj8zdoDM**. Think about how cow health monitors help farmers take better care of their cows. Then, answer the questions below.

1. How do cow pedometers or collars (sensors) benefit farmers? _____

_____

_____

_____

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

_____

_____

3. Why would a cow's number of daily steps change? _____

_____

_____

4. How would a farmer use the information collected by a sensor? _____

_____

_____

Part 2

Modern farmers also use other types of technology and data to care for their farms, solve problems, and improve their results. This is a precision farming approach to farm management. For example, some farmers 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. Check out how Larson Dairy in South Florida uses technology and science to sustainably care for the land they crop to feed their cows at **https://www.youtube.com/watch?v=kkyh0Q1JljM** and **https://www.youtube.com/watch?v=0AVyJlXW3uY**. These tools save time and money. For dairy farmers, it means more time spent caring for the cows themselves.

Choose one of the technologies listed in the paragraph above. Research how it is used on modern dairy farms and write down 3-4 benefits it offers to farms, families, animals, and the environment. Write your list on the back of this sheet.

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HEALTHY FAMILIES ACTIVITY 2

FARM BIOLOGY

The Austin family in Marianna, Fla., tend to their cows.

Farms are the first biotech labs. Since ancient times, farmers have used *selective breeding* to make the foods we eat more widely available and nutritious. Today, scientific developments have enabled the transfer of specific genes from one organism to another. This process is called *genetic engineering*.

The chart below shows the impact of selective breeding and genetic engineering on modern farming, including examples that improve our food supply. Discuss the chart with your class and then use the space below and the back of the sheet to compare and contrast the two methods.

Part 1

Selective Breeding	Genetic Engineering
Choose parents with traits you want. These will be passed on to the offspring.	Add the gene for the trait you want into the DNA of the organism so it can be passed on to the offspring.
Examples	**Examples**
1. Disease-resistant wheat is created by breeding hardy wheat plants with wheat plants that have a high yield. As a result, families have better access to nutritious grains for a lower cost.	1. Scientists have engineered salmon so that it grows quicker, making the salmon available for market faster. The salmon is grown in controlled environments.
2. By selectively breeding bulls with dairy cows that produce high levels of milk protein, the resulting offspring will likewise produce high-protein milk.	2. Scientists have created a special type of soybean that produces oil with more “healthy” fat and no trans fat, which can raise cholesterol and increase risk of heart disease.
3. Hardy snacking apples are created when a sweet variety of apple is grafted onto the trunk of a fungus-resistant variety. This gives the benefit of higher-producing sweet apple trees that are fungus-resistant. This means more fruit for more families.	3. When scientists added the genes that produce Vitamin A in carrots to white rice DNA, they created “golden rice” — a food rich in Vitamin A for countries where Vitamin A deficiency causes childhood blindness.
Similarities:	
Differences:	

Part 2

Dairy farmers use many other types of biotechnology to improve food production. How does biotechnology on dairy farms support people’s nutritional needs? Write your answer on the back of this sheet.

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HEALTHY FARMS ACTIVITY 3

FARM ECOLOGY

Larson Dairies in Okeechobee, Fla., use anaerobic digesters to convert methane, a greenhouse gas released from cow manure, into a source of electricity.

Today's dairy farmers use sustainable farming practices

to protect the environment by conserving energy and water, reducing pollution, and building soil health. Soil health refers to the soil's ability to function as an ecosystem that can support plants, animals, and humans. For more examples of these practices, check out the Moos News at **https://www.youtube.com/watch?v=0AVyJlXW3uY**.

Look at the chart below. Read about the sustainable farming practices in the first column, and then decide if that practice helps conserve energy, conserve water, reduce waste and pollution, or build soil health by putting an "X" in the correct box. You may mark more than one box for each sustainable practice. Then, fill in a way you can help achieve those same environmental goals at home.

Sustainable Farming Practice	A. Conserves Energy	B. Conserves Water	C. Reduces Waste and Pollution	D. Builds Soil Health	E. What I Can Do
1. Cow manure is used in place of commercial fertilizer to improve soil quality.					
2. Methane digesters use the gas given off by cow manure as fuel to generate electricity.					
3. Some dairy farmers use a device called a plate cooler to cool the milk as it comes from a cow. Cold water passes right from the well through the plate cooler and absorbs heat from the warm milk. Farmers then re-use this water in different ways: as drinking water for cows (who prefer warm water); to cool the cows with a fine spray when it is hot; to wash farm equipment and clean the barn floor.					
4. Field cover crops keep soil and nutrients in place and reduce runoff.					
5. Solar panels on the farm generate electricity.					
6. Recycled materials such as sand, which can be reused time and again, are used as comfortable bedding for the cows.					
7. Orange peels, cotton seeds, and other leftovers are mixed with grain to provide nutritious cow feed.					

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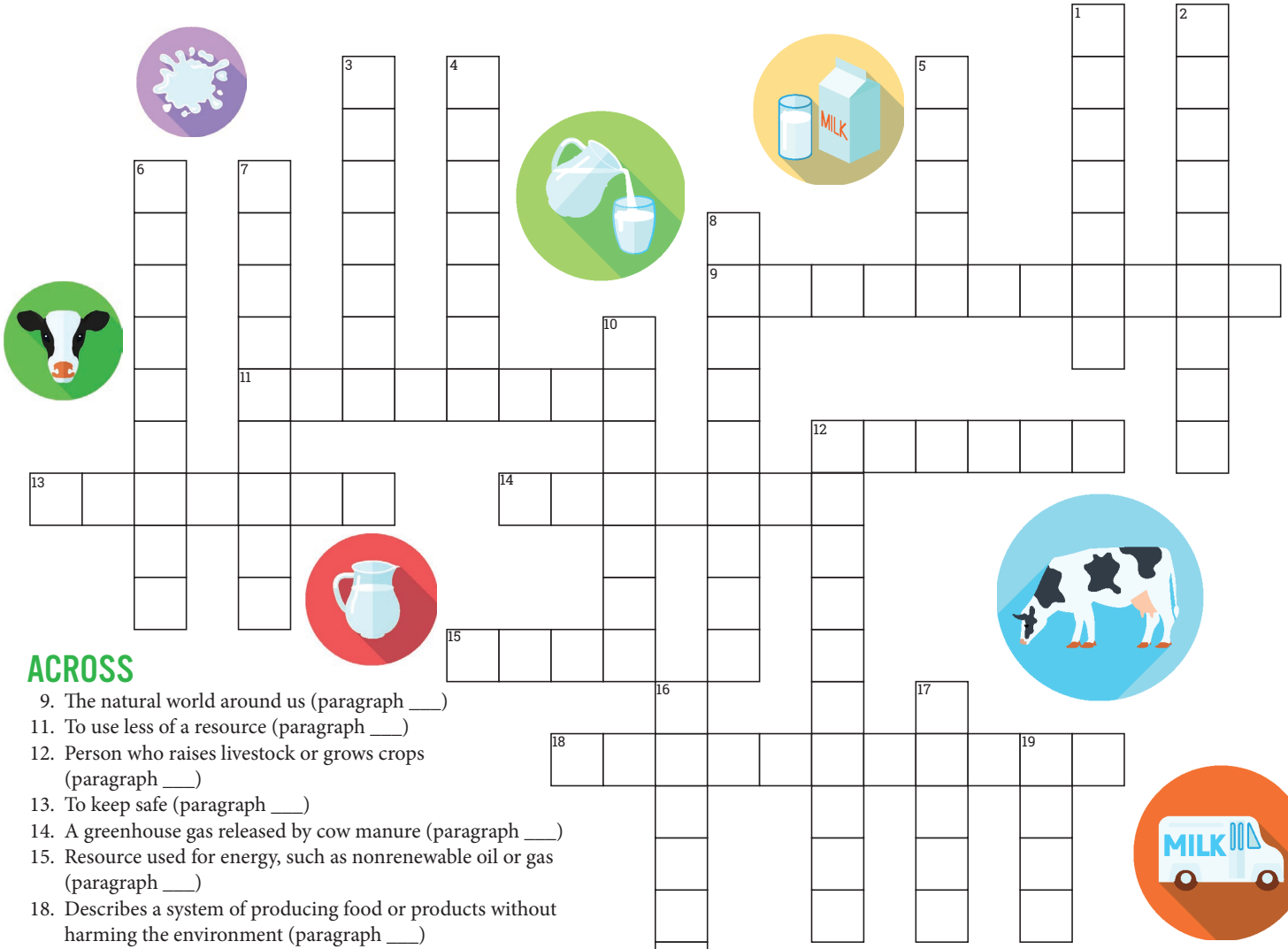
HEALTHY FARMS BONUS ACTIVITY

DAIRY ECOSYSTEMS

Dairy farmers work hard to produce high-quality milk while protecting the environment.

Refer to the STEM Crossword Passage, at **https://www.floridamilk.com/stem-crossword-passage.stml**, to complete this crossword puzzle. Next to each clue, write the paragraph number where you found the answer.



ACROSS

9. The natural world around us (paragraph ___)
11. To use less of a resource (paragraph ___)
12. Person who raises livestock or grows crops (paragraph ___)
13. To keep safe (paragraph ___)
14. A greenhouse gas released by cow manure (paragraph ___)
15. Resource used for energy, such as nonrenewable oil or gas (paragraph ___)
18. Describes a system of producing food or products without harming the environment (paragraph ___)

DOWN

1. The flow of money for farms and their neighbors (paragraph ___)
2. The people who live, work, and share a region (paragraph ___)
3. When soil washes or falls away (paragraph ___)
4. To make something usable again (paragraph ___)
5. A critical natural resource that flows in rivers and streams (paragraph ___)
6. Release of gases into the atmosphere (paragraph ___)
7. Producing more with fewer resources or less waste (paragraph ___)
8. An energy source that can be easily replenished (paragraph ___)
10. A balance between the CO_2 that is released and absorbed (paragraph ___)
12. Used to enrich soil to feed plants (paragraph ___)
16. A place where inland streams and rivers meet ocean water (paragraph ___)
17. Milk and milk products (paragraph ___)
19. A piece of earth that can be used for grazing animals or growing crops (paragraph ___)

WANT TO LEARN MORE?

To discover more about how dairy farmers are working to protect the environment today and for future generations, choose a topic from these clues, research it, and write a few sentences on the back of this sheet about what you learn to share with your classmates.

Dairy Council of Florida

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SCIENCE ON THE FARM ANSWER KEYS

Use these answer keys to guide discussion when reviewing student responses to the activity questions.

FARM TECHNOLOGY

PART 1

1. **How do cow pedometers and collars (sensors) benefit farmers?**
   They help by collecting data or information about each cow to then help the farmer care for them better. The farmer will use the information to make the best decisions about how to care for their cows.

2. **What information do these sensors collect about each cow?**
   They record how many steps a cow takes, if cows are lying down, how long a cow chews her food, and how much milk she produces.

3. **Why would a cow's number of daily steps change?**
   If they are in heat, or it is time to be bred, cows' steps will increase significantly. If they are not feeling well and spending more time lying down, they will decrease significantly.

4. **How would a farmer use the information collected by a sensor?**
   Sensors give farmers information about each cow in real time so the farmers can see when changes occur. This allows the farmer to identify those cows and give them extra attention. It also allows the farmer to monitor the herd's performance as a whole.

PART 2

Precision farming is the use of science and technology to improve farm management. The tools listed below can help increase efficiency and accuracy in all steps from planning through harvest.

Students should note that all these tools cut costs for the farmers, which leads to lower prices at the grocery store – so, they ultimately provide greater access to nutritious foods for more families. Precision farming also reduces the environmental impact of farming because more accurate measurements of soil health allow farmers to use fewer pesticides, commercial fertilizers, and chemicals across the board, and only where needed. Students should also provide examples, such as:

Global Positioning Systems (GPS)
Used to help farmers map their fields, guide farm equipment in the field, and check crops.
- Reduce labor costs and enable work to be done on off-hours or when labor is unavailable
- Help maximize and better plan usage of fields
- Help farmers plan for and protect against weather events
- Allow for direction of crop dusters and aircraft sprayers without human "flaggers" needing to be present

Geographic Information Systems (GIS) & Sensor Technology
Used to help farmers analyze soil conditions, estimate their harvest, and determine where and how much fertilizer and/or pesticide they need to apply. Students can read more here: https://smallfarms.cornell.edu/2017/04/use-of-gis/.
- Reduce costs of irrigation, fertilizer, and/or pesticides used by pinpointing specific areas where they are needed
- Reduce environmental impact by minimizing tilling and pesticide use
- Increase profits through better estimation of harvest times and yield, and faster remediation of issues like erosion and insect outbreaks
- Help farmers plan which crops to grow, and where, in order to best maintain the soil
- Allow for more effective planning by providing projections of current and future fluctuations in precipitation, temperature, and crop output

Drones/Robots
Used for milking and feeding cows and to plant seeds, weed, irrigate, and harvest crops.
- Reduce costs and reliance on labor for tasks that are time-intensive
- Provide greater efficiency in feeding cows and harvesting crops, and more evenly disperse water and seeds
- Increase health of crops by providing real-time, accurate data about soil health

SCIENCE ON THE FARM ANSWER KEYS (continued)

FARM BIOLOGY

Selective Breeding and Genetic Engineering

Similarities: Both processes produce offspring that have different or desired genetic traits to improve the health or production of the animal.

Differences: Selective breeding operates through natural reproductive and growth processes. Genetic engineering operates by scientific manipulation of an organism's DNA.

How does biotechnology on dairy farms support people's nutritional needs?

Biotechnology allows dairy farmers to grow more feed crops using the same amount of land, water, and other natural resources. These crops make up a large part of the cows' diet, which is carefully designed by nutritionists to keep the cows healthy and productive, while continuing to reduce farmers' costs. The result is that more people have affordable access to nutritionally-rich milk and dairy products.

Follow-Up Activity Idea: To complete this lesson, as a discussion or writing project, have your class brainstorm other nutritional concerns that biotechnology may someday address.

SCIENCE ON THE FARM

HEALTHY FARMS ACTIVITY 3

FARM ECOLOGY

Sustainable Farming Practice	A. Conserves Energy	B. Conserves Water	C. Reduces Waste and Pollution	D. Builds Soil Health	E. What I Can Do
1. Cow manure is used in place of commercial fertilizer to improve soil quality.	Energy is needed to manufacture commercial fertilizers and transport them to farmers. Using manure from the farm reduces energy consumption and costs.	Many commercial fertilizers need to be mixed with water, but cow manure contains water that helps fertilize the fields.	Using manure to fertilize crops makes it a resource rather than a waste product.	Cow manure is a natural fertilizer that feeds crops. Manure application also provides carbon and nutrients to the soil, and increases soil productivity.	Compost at home and use that compost to fertilize your garden, trees, shrubs, etc.
2. Methane digesters use the gas given off by cow manure as fuel to generate electricity.			When released to the atmosphere, methane is a potent greenhouse gas. But when methane is used to generate electricity, it produces water and carbon dioxide, a less potent greenhouse gas. In addition, methane does not produce many of the potentially harmful pollutants released by other energy sources, such as coal and oil.		Conserve energy at home. Turn off lights and appliances when not in use, use energy efficient light bulbs, etc. (See https://www.alliantenergykids.com/UsingEnergyWisely/SavingEnergyAtHome for numerous other suggestions.)

(continued)

SCIENCE ON THE FARM

HEALTHY FARMS ACTIVITY 3

FARM ECOLOGY ANSWER KEY (CONTINUED)

Sustainable Farming Practice	A. Conserves Energy	B. Conserves Water	C. Reduces Waste and Pollution	D. Builds Soil Health	E. What I Can Do
3. Some dairy farmers use a device called a plate cooler to cool the milk as it comes from a cow. Cold water passes straight from the well through a plate cooler and absorbs heat from the warm milk. Farmers then re-use this water in different ways: as drinking water for cows (who prefer warm water); to cool the cows with a fine spray when it is hot; to wash farm equipment and clean the barn floor.	By using a plate cooler and transferring heat from the milk to the cold water, it takes less energy to heat the water for cleaning equipment and less energy to cool down the milk in the bulk tank.	Water is used over and over instead of drawing fresh water for each activity. By utilizing the plate cooler water elsewhere on a farm, for example for the cows' drinking water, farmers use less water.	As it goes through the barn, the water may pick up things like manure from the barn floor. When applied to fields, the manure in the water serves to fertilize crops, thereby making it a resource rather than a waste product.		Turn off the faucet when brushing your teeth, take shorter showers, collect rainwater to water indoor plants.
4. Field cover crops keep soil and nutrients in place and reduce runoff.		Helps keep streams flowing free and clean. Also improves soil health and soil porosity. The soil can hold more rainwater, reducing the need for additional irrigation.	Vegetation and groundcover help to filter pollutants such as pesticides and sediment from field runoff.	Reduced runoff and erosion helps keep nutrients in the field where they belong instead of washing away with rain. This, in turn, increases soil quality for the following season. Also improves soil's ability to retain water and benefits the soil microbial community.	Participate in events organized to plant vegetation along stream banks, lakefronts, etc. Plant native vegetation in your yard, school grounds, etc. Some schools and homeowners construct rain gardens (www.epa.gov/soakuptherain/soak-rain-rain-gardens).

(continued)

SCIENCE ON THE FARM

HEALTHY FARMS ACTIVITY 3

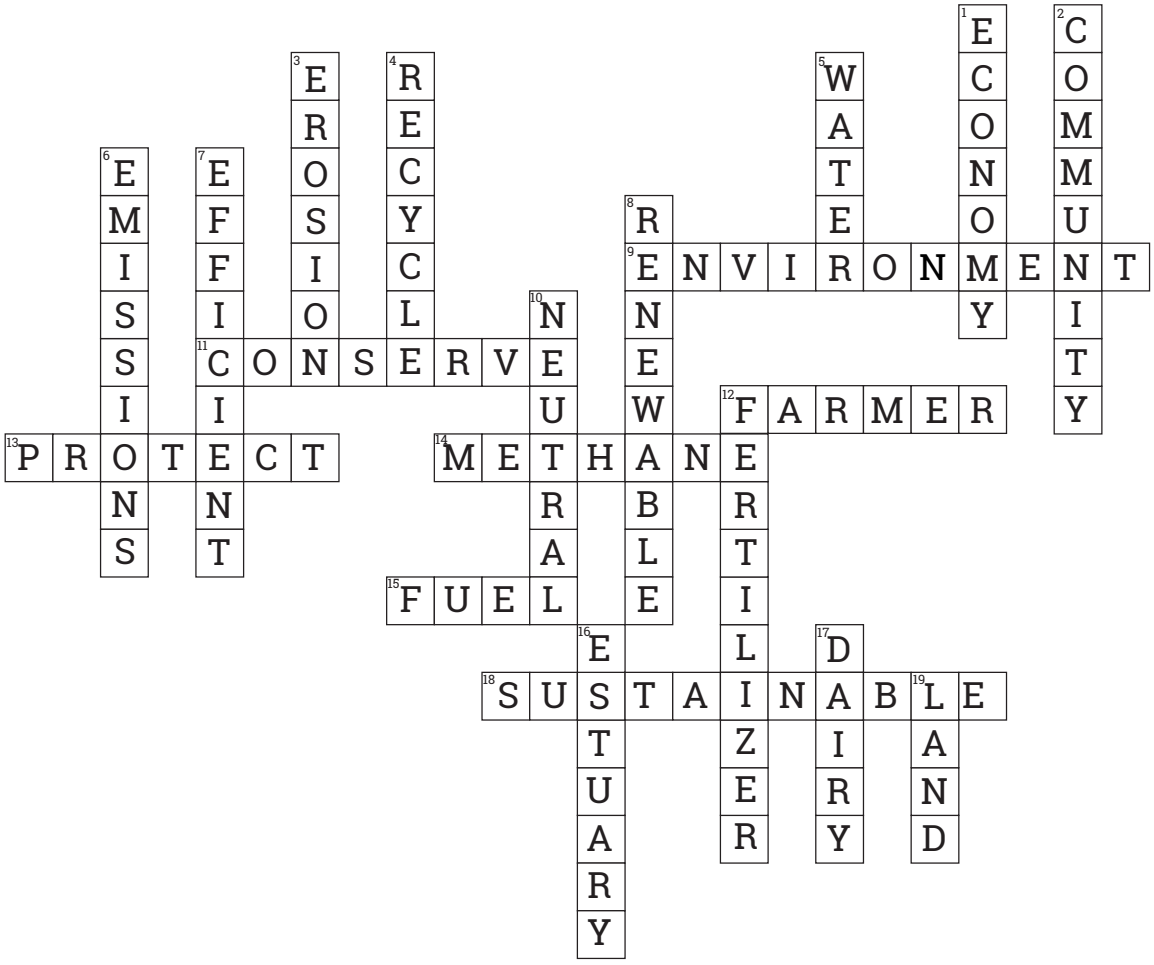
FARM ECOLOGY ANSWER KEY (CONTINUED)

Sustainable Farming Practice	A. Conserves Energy	B. Conserves Water	C. Reduces Waste and Pollution	D. Builds Soil Health	E. What I Can Do
5. Solar panels on the farm generate electricity.			Solar power does not emit greenhouse gases or other air pollutants.		Conserve energy at home. Turn off lights and appliances when not in use. Use energy efficient light bulbs, etc. (See https://www.alliantenergykids.com/UsingEnergyWisely/SavingEnergyAtHome for numerous other suggestions.) Consider using solar power for your home.
6. Recycled materials such as sand, which can be reused time and again, are used as comfortable bedding for the cows.	Using these materials reduces the need to truck in other bedding materials, or at least reduces the number of necessary shipments due to reuse on the farm, thus reducing fuel consumption and costs.		Keeps these materials out of landfills.		Use the reverse side of printed papers for note-taking instead of a fresh sheet. Start a home compost pile with food waste to help feed your garden.
7. Orange peels, cotton seeds, and other leftovers are mixed with grain to provide nutritious cow feed.			Keeps these “leftovers” out of landfills.		Compost “leftovers” at home and use that compost to fertilize your garden, trees, shrubs, etc.

SCIENCE ON THE FARM

HEALTHY FARMS BONUS ACTIVITY

DAIRY ECOSYSTEMS ANSWER KEY



"Multiple" indicates that the word can be found in more than one paragraph of the article.

Paragraph Numbers

Across

9. 2 (multiple)
11. 15
12. 1 (multiple)
13. 9
14. 14
15. 7, 14
18. 3 (multiple)

Down

1. 3
2. 3
3. 15
4. 11 (multiple)
5. 6 (multiple)
6. 5 (multiple)
7. 8
8. 5
10. 6
12. 13
16. 12
17. 1 (multiple)
19. 4 (multiple)

SCIENCE ON THE FARM

DAIRY ECOSYSTEMS ANSWER KEY (CONTINUED)

Sustainability is the Goal

(Source: https://www.floridamilk.com/stem-crossword-passage.stml**)**
The paragraphs are numbered below. References to the words featured in the puzzle are underlined.

Sustainability is the Goal

1. Being a dairy (#17 Down) farmer (#12 Across) takes a 24/7 commitment every day of the year. Even on holidays, the cows must be milked and cared for. In Florida, there are about 125,000 dairy cows that collectively produce about 300 million gallons of milk a year. The milk is then turned into all types of dairy products including fluid milk, cheese, yogurt, and ice cream.

2. Caring for the land, water, and air remains a daily commitment by dairy farmers. Most dairy farmers make their home at the farm, giving them even more incentive to be a good neighbor and protect the environment (#9 Across) around them.

3. The future of sustainable (#18 Across) dairy farming is happening today. Dairy farmers are focused on sustainability throughout all of their farm practices. The dairy community is dedicated to addressing climate change and water quality while contributing to a sustainable food system that improves the environment around them and their farm. They support practices that make sense for the economy (#1 Down), help the environment, and are socially responsible to the rest of their community (#2 Down) and our world.

4. Every day, dairy farmers impact the land (#19 Down), water, and air we all share. But as good environmental stewards, they have always innovated and adopted new practices and technologies to produce the same amount of food using fewer natural resources, while ensuring their milk still provides the same great nutrition.

5. The dairy industry is doing more every day to drive down greenhouse gas emissions (#6 Down) and enable renewable (#8 Down) energy adoption. They upcycle more waste into more resources and continue to invest and advance excellence in animal care.

6. As part of this pledge, America's dairy farmers have set aggressive new environmental sustainability goals to achieve greenhouse gas neutrality, optimize water (#5 Down) usage, and improve water quality. Climate neutrality refers to the idea of achieving net zero greenhouse gas emissions by balancing those emissions so they are equal (or less than) the emissions that get removed through the planet's natural absorption; in basic terms it means we reduce our CO2 emissions to reach a neutral (#10 Down) state.

7. The latest research shows that the U.S. dairy industry accounts for only about 2 percent of U.S. greenhouse gas emissions. Still, dairy farmers are working on ways to reduce that figure even more: Over a recent 10-year period, dairy farming used about 21% less land, 30.5% less water, 20% less fuel (#15 Across), and 17% less feed. Their work continues as the dairy industry has committed to achieving greenhouse gas neutrality by 2050.

SCIENCE ON THE FARM

DAIRY ECOSYSTEMS ANSWER KEY (CONTINUED)

Sustainability is the Goal (continued)

(Source: https://www.floridamilk.com/stem-crossword-passage.stml**)**

8. More milk is produced today with only 9 million cows than with 26 million cows in 1944. While providing a supply of healthy milk for consumers and protecting the environment, dairy farmers oversee some of the most efficient (#7 Down) and productive cows in the world!

Fresh Air & Clean Water For Everyone

9. Clean air is important to everyone, and farmers do everything they can to protect (#13 Across) air quality by keeping barns clean and using special manure storage facilities to help control odors.

10. Research and development has inspired new practices and innovative technologies to improve manure and odor management. For example, dairy nutritionists can formulate diets for cows that reduce the odor of manure. Other technologies such as air-filtration systems in barns, odor-reducing additives for manure-storage facilities and even methane digesters, which use manure to produce electricity, are being incorporated in some dairy farms.

11. All dairy farms must meet state and federal standards for manure storage, handling, and recycling. Dairy farmers recycle (#4 Down) manure according to detailed nutrient management plans that help conserve soil and protect local waterways, streams, rivers, and estuaries.

12. An estuary (#16 Down) is a partially enclosed coastal body of water, normally brackish with a river flowing into it. It must have a free flow out to a large body of water such as an ocean or sea. The Everglades has one of the largest estuaries in the United States. Because dairy cows need to drink clean water to stay healthy and produce quality milk, farmers take water protection and conservation practices seriously.

13. Cow manure is used as fertilizer (#12 Down) for crops, part of a sustainable cycle that allows dairy farmers to make nutritious foods available to people.

Other Sustainable Dairy Farming Practices

14. Some dairy farms are using technology that has environmental benefits. Methane digesters, for example, allow dairy farms to produce renewable energy. A digester collects methane (#14 Across) gas released from cow manure and other materials and converts it to electricity. This “biogas” is a renewable fuel that can be used to generate electricity or renewable natural gas for both the dairy farm and the local community.

15. Dairy farmers continuously work with government and university experts to find even more ways to use less and conserve (#11 Across) more natural resources. For example, they have found creative ways to recycle water, and other materials, and prevent soil erosion (#3 Down) — activities that help ensure their farms remain economically viable. The use of solar panels for energy power is also becoming more prevalent.

SCIENCE ON THE FARM

Florida Standards for Dairy Lesson

Activity 1 – Farm Technology

Computer Science/Technology

SC.68.CS-PC.2.3	Describe the influence of access to information technologies over time and the effects those changes have had on education, the workplace, and the global society.
SC.68.CS-PC.2.6	Identify and discuss the technology skills needed in the workplace.
SC.68.CS-PC.2.8	Identify interdisciplinary careers that are enhanced by computer science.
SC.68.CS-CS.6.1	Explain why some tasks can be accomplished more easily by computers.
SC.68.CS-CS.6.2	Describe how humans and machines interact to accomplish tasks that cannot be accomplished by either alone.
SC.68.CS-CS.6.3	Identify novel ways humans interact with computers, including software, probes, sensors, and handheld devices.
SC.68.CS-CS.6.4	Describe ways in which computers use models of intelligent behavior (e.g., robot motion, speech and language understanding, and computer vision).
SC.68.CS-CS.6.6	Design and demonstrate the use of a device (e.g., robot, e-textile) to accomplish a task, individually and collaboratively.

Science Standards

SC.68.N.1.3	Explain the difference between an experiment and other types of scientific investigation, and explain the relative benefits and limitations of each. Content Complexity: Level 3: Strategic Thinking & Complex Reasoning
SC.68.N.1.4	Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.
SC.68.N.1.5	Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.

Health Standards

HE.6.B.5.1	Investigate health-related situations that require the application of a thoughtful decision-making process.
HE.6.B.6.1	Use various methods to measure personal health status.
HE.6.B.6.3	Determine strategies and skills needed to attain a personal health goal.
HE.6.B.6.4	Monitor progress toward attaining a personal health goal.

ELA

ELA.68.C.1.3	Write and support a claim using logical reasoning, relevant evidence from sources, elaboration, and a logical organizational structure with varied transitions.
ELA.68.C.2.1	Present information orally, in a logical sequence, using nonverbal cues, appropriate volume, clear pronunciation, and appropriate pacing.
ELA.68.C.3.1	Follow the rules of standard English grammar, punctuation, capitalization, and spelling appropriate to grade level.
ELA.68.C.4.1	Conduct research to answer a question, drawing on multiple reliable and valid sources, and refocusing the inquiry when appropriate.
ELA.68.V.1.1	Integrate academic vocabulary appropriate to grade level in speaking and writing.

Enhancement Activities

1. Have the students present their paragraphs from part 2 to the class.

2. Split the students into groups of 3 or 4 and research technology the students utilize in their lives that they think would also be useful on a modern farm. Examples: tablets, drones, virtual reality, apps, etc.

3. Ask a local dairy farmer for a list of somethings that cause them issues on their farm. Examples: Cows scratching their backs on fencing or other equipment and breaking it. Split the students into groups. Have them brainstorm, research, and design possible solutions for the issue you assigned them. They will present these to the class.

Activity 2 – Farm Biology

Science Standards

SC.68.N.1.3	Explain the difference between an experiment and other types of scientific investigation and explain the relative benefits and limitations of each.
SC.68.N.1.4	Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.
SC.68.N.1.5	Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.
SC.6.N.2.2	Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered.
SC.7.L.16.1	Understand and explain that every organism requires a set of instructions that specifies its traits, that this hereditary information (DNA) contains genes located in the chromosomes of each cell, and that heredity is the passage of these instructions from one generation to another.
SC.7.L.16.4	Recognize and explore the impact of biotechnology (cloning, genetic engineering, artificial selection) on the individual, society, and the environment.

Health Standards

HE.6.B.5.1	Investigate health-related situations that require the application of a thoughtful decision-making process.
HE.6.C.2.9	Identify the influence of personal values, attitudes, and beliefs about individual health practices and behaviors.
HE.6.P.8.2	State a health-enhancing position on a topic and support it with accurate information.

ELA.68.C.1.3	Write and support a claim using logical reasoning, relevant evidence from sources, elaboration, and a logical organizational structure with varied transitions.
ELA.68.C.2.1	Present information orally, in a logical sequence, using nonverbal cues, appropriate volume, clear pronunciation, and appropriate pacing.
ELA.68.C.3.1	Follow the rules of standard English grammar, punctuation, capitalization, and spelling appropriate to grade level.
ELA.68.C.4.1	Conduct research to answer a question, drawing on multiple reliable and valid sources, and refocusing the inquiry when appropriate.
ELA.68.V.1.1	Integrate academic vocabulary appropriate to grade level in speaking and writing.

Enhancement Activities

Create a poster for part 2 from the information you learned in the lesson. Hang the information PSA Posters around the school.

Health Standards

HE.68.P.8.2	State a health-enhancing position on a topic and support it with accurate information.
HE.68.P.8.3	Work cooperatively to advocate for healthy individuals, families, and schools.

Create a visual aid, or digital media project studying the history of genetic engineering (include the Punnett square and selective breeding vs. natural breeding). Put students into groups for this project. They will present to the class when completed.

Science

SC.7.L.16.2	Determine the probabilities for genotype and phenotype combinations using Punnett Squares and pedigrees.

Social Studies

SS.68.G.3.1	Explain how the physical landscape has affected the development of agriculture and industry in the ancient world.
SS.68.G.5.1	Identify the methods used to compensate for the scarcity of resources in the ancient world.
SS.6.W.2.2	Describe how the developments of agriculture and metallurgy related to settlement, population growth, and the emergence of civilization.
SS.8.A.1.1	Provide supporting details for an answer from text, interview for oral history, check validity of information from research/text, and identify strong vs. weak arguments.
SS.8.A.1.3	Analyze current events relevant to American History topics through a variety of electronic and print media resources.
SS.8.A.1.4	Differentiate fact from opinion, utilize appropriate historical research and fiction/nonfiction support materials.

ELA

ELA.68.C.5.1	Integrate diverse digital media to enhance audience engagement in oral or written tasks.
ELA.68.C.5.2	Use digital tools to produce writing.

Activity 3 – Farm Ecology

Science Standards

SC.68.N.1.3	Explain the difference between an experiment and other types of scientific investigation and explain the relative benefits and limitations of each.
SC.68.N.1.4	Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.
SC.68.N.1.5	Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.
SC.6.N.2.2	Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered.
SC.6.E.7.1	Differentiate among radiation, conduction, and convection, the three mechanisms by which heat is transferred through Earth's system.
SC.7.L.16.4	Recognize and explore the impact of biotechnology (cloning, genetic engineering, artificial selection) on the individual, society, and the environment.
SC.7.N.2.1	Identify an instance from the history of science in which scientific knowledge has changed when new evidence or new interpretations are encountered.
SC.7.P.11.1	Recognize that adding heat to or removing heat from a system may result in a temperature change and possibly a change of state.
SC.7.P.11.3	Cite evidence to explain that energy cannot be created nor destroyed, only changed from one form to another.
SC.7.L.17.2	Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.
SC.7.E.6.6	Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water.

ELA

ELA.68.C.1.3	Write and support a claim using logical reasoning, relevant evidence from sources, elaboration, and a logical organizational structure with varied transitions.
ELA.68.C.2.1	Present information orally, in a logical sequence, using nonverbal cues, appropriate volume, clear pronunciation, and appropriate pacing.
ELA.68.C.3.1	Follow the rules of standard English grammar, punctuation, capitalization, and spelling appropriate to grade level.
ELA.68.C.4.1	Conduct research to answer a question, drawing on multiple reliable and valid sources, and refocusing the inquiry when appropriate.
ELA.68.V.1.1	Integrate academic vocabulary appropriate to grade level in speaking and writing.

Enhancement Activities

Split students into groups of 3 or 4. Have them pick a current practice used on a dairy farm. Examples: the cooling of milk, methane digesters, milking machine, how cattle are moved around the operation, etc. Research and compare how that practice was done through different periods of time vs. how it is done now. Create a presentation to teach the class about the history of the practice you chose.

Social Studies

SS.6.W.2.2	Describe how the developments of agriculture and metallurgy related to settlement, population growth, and the emergence of civilization.
SS.8.A.1.1	Provide supporting details for an answer from text, interview for oral history, check validity of information from research/text, and identify strong vs. weak arguments.
SS.8.A.1.3	Analyze current events relevant to American History topics through a variety of electronic and print media resources.
SS.8.A.1.4	Differentiate fact from opinion, utilize appropriate historical research and fiction/nonfiction support materials.

ELA

ELA.68.C.5.1	Integrate diverse digital media to enhance audience engagement in oral or written tasks.
ELA.68.C.5.2	Use digital tools to produce writing.
ELA.68.C.2.1	Present information orally, in a logical sequence, using nonverbal cues, appropriate volume, clear pronunciation, and appropriate pacing.

Have students write a short essay on what they think the dairy industry will look like or practices/ technologies they will use in the year 2050. Doesn't have to be something that currently exists. They can use their imaginations and come up with some ideas of inventions that can be used on dairies. This is a fun creative writing activity!