



Upper Level Lesson 3: In the Environment

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Standards:

These lesson tools meet the following Common CORE and PA educational standards.

Science: (PA Standards)

S8.D.1.2; S8.B.3.3; S8.A.2.1;
Common CORE: MS-LS2-3, MS-LS2-4, MS-ESS3-3, MS-ESS3-4; MS-LS2-3, MS-LS2-4, MS-ESS3-3, MS-ESS3-4; MS-LS2-3, MS-LS2-4, MS-ESS3-3, MS-ESS3-4

Reading: (Common CORE):

CCSS.ELA-LITERACY.RI.6.4, CCSS.ELA-LITERACY.RI.6.10, CCSS.ELA-LITERACY.W.6.1, CCSS.ELA-LITERACY.SL.6.1, CCSS.ELA-LITERACY.L.6.3, CCSS.ELA-LITERACY.L.6.4; CCSS.ELA-LITERACY.RI.7.4, CCSS.ELA-LITERACY.RI.7.10, CCSS.ELA-LITERACY.W.7.1, CCSS.ELA-LITERACY.SL.7.1, CCSS.ELA-LITERACY.L.7.3, CCSS.ELA-LITERACY.L.4; CCSS.ELA-LITERACY.RI.8.4, CCSS.ELA-LITERACY.RI.8.10, CCSS.ELA-LITERACY.W.8.1, CCSS.ELA-LITERACY.SL.8.1, CCSS.ELA-LITERACY.L.8.3, CCSS.ELA-LITERACY.8.4, LITERACY.L.8.1, CCSS.ELA-LITERACY.L.8.3, CCSS.ELA-LITERACY.L.8.4

Environment & Ecology (PA Standards): 4.2.6.C, 4.2.7.A, 4.3.8.A, 4.4.6.B



Essential Question:

How does a dairy farm influence our environment?

Approximate Length:

This lesson has two parts. Teacher can choose to teach one part or both parts of lesson. Lessons and parts can be taught during one large block or divided into periods over 2 - 4 days. Each part should take about 60 - 70 minutes of class time, with these segments:

Segment	Responsible	Segment	Responsible
1) Lesson Overview — 5 min	Teacher	4) Lab Exercise — 20 min*	Students
2) Reading Passage — 10 min	Students	5) Lesson Review — 10 min	Class
3) Classroom Discussion — 10 min	Teacher/Class	6) Lesson Evaluation — 10 min	Teacher

Material List:

To complete the lesson and lab activities, you will need the following items:

- “Discover Dairy... In The Environment” Reading Passage (Copy for Each Student)
- “Discover Dairy ... In The Environment” Lab Handout (Copy for Each Student)
- “Discover Dairy ... In The Environment” UL Video Motivator (available to download or stream from www.discoverdairy.com or on the Discover Dairy Ipad Application)
- “Discover Dairy ... In The Environment” transparency or graphics to project
- Projector or White Board to Show Motivating Video and graphics
- For Part II Lab: (*consider grouping students in groups of four and having these materials for each group*)
 - ⇒ Plastic 1-liter bottle (empty)
 - ⇒ Bowl of hot (not boiling) water
 - ⇒ Freezer to cool bottle and balloon
- Pencil or pen for each student

Activating Strategy:

The activating strategy should take about 10 minutes of classroom time, with four minute video included, to set stage for lesson. Teacher should explain that two of the world’s biggest challenges are producing enough food for a rapidly growing population, and taking care of our planet. While some would argue that the two conflict with one another, today’s farmers work hard to protect our air, water and soil while producing an abundant supply of food. This lesson will explain why it is important farmers care for the environment and how they do that. **Show video motivator.**

PART ONE — The Dairy Farmer’s Role in the Environment

Essential question:

“How does a dairy farm influence our environment?”

Key to answering essential question:

- ♦ Explain why a healthy environment is important to dairy farmers.
- ♦ Analyze how dairy farms use natural resources to produce quality products.
- ♦ List the steps dairy farms take to ensure that they are protecting our natural resources for future generations.

Reading Passage: (Give students 10 minutes to read over Page 1 of Reading Passage.)



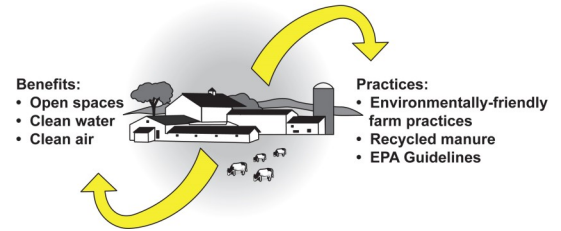
Discover Dairy is an initiative of the American Dairy Association North East, Center for Dairy Excellence, Midwest Dairy Council and the Pennsylvania Dairy Promotion Program, and, funded in part by the Center for Dairy Excellence Foundation of Pennsylvania.



Classroom Discussion:

Protecting our environment is critical to our future existence. We need clean water and air to sustain life.

- ♦ Ask students why we need a healthy environment. (*We need clean air and water to sustain life on earth.*)
- ♦ Why do each of us have to play a role in protecting our environment? (*Because the environment depends on us to use environmentally-friendly practices to care for it.*)



- ♦ Why do farmers take responsibility for caring for the environment? How do they care for the environment? (*They live on the farms where they work, and their livelihood depends on the quality of the land they farm and the water their cows drink. They take care of the environment in how they care for their cows, how they handle animal waste, and how they recycle resources on their farms.*)
- ♦ What farming practices does the farmer use to protect the land for future generations? (*Farmers use no-till farming and rotational cropping. No-till farming protects the soil from erosion, and rotational cropping replenishes the soil with needed nutrients.*)
- ♦ Why is a healthy environment essential for farmers? If the soil is not healthy, what will happen to the farmer's crops? (*They won't grow or be productive.*) If the water is polluted, what will happen to his cows? (*They could get sick or wouldn't be able to produce milk.*)
- ♦ What do cows produce from their bodies that can provide nutrients to the soil? How can farmers recycle their manure? Why is it important that they recycle it properly? (*Cows produce waste or manure, which if not handled properly could be a pollutant. Farmers recycle their manure on fields to replenish nutrients and moisture in the soil.*)
- ♦ What is the name of the agency that has guidelines farmers must follow to protect the environment? (*The Environmental Protection Agency or EPA*)

Remind students that, just like in milk safety and quality, dairy farmers work hard to meet and exceed environmental regulations established to ensure the quality of the soil, water and air. It is their responsibility, just like it is our responsibility to care for the world around us.

Lab Exercise:

Teachers should prepare copies of the Environment Lab Worksheet,. Lab can be completed in groups of two or four, with classroom discussion at the end.

Materials needed for lab (per group):

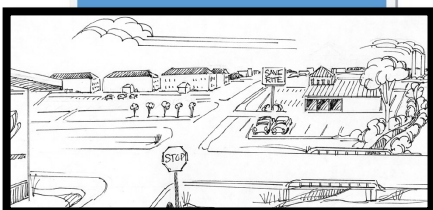
No other materials besides the lab handout and a pencil are needed for this lab. The teacher should use the lab handout to facilitate classroom discussion around the exercise.

- In what ways does the farm have a positive impact on the environment?
- What practices has the farmer put into place to protect the environment?
- What things in the residential and industrial community could affect the environment?
- How can we ensure that we protect the environment from those aspects?

To review appropriate responses to lab questions, see answer key found on www.discoverdairy.com or in Discover Dairy Ipad app.



Dairy farms work to meet or exceed guidelines established by the Environmental Protection Agency.





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Part I Lesson Review:

Teachers can ask the following questions to evaluate whether students understand the steps that go into ensuring milk is safe to drink.

1. Why do we depend on a healthy environment? *Our food, air and water supply all depend on a healthy environment.*
2. Why must dairy farmers take precautions to protect the environment? *Cows produce waste, which can be a pollutant if it is not handled properly, and farmers know land is a valuable resource that they take care of.*
3. How do farmers protect their environment? *They recycle their manure and other resources, such as water, on the farm to replenish the soil. They also use environmentally-friendly practices to farm the land and produce crops.*
4. What agency develops guidelines and regulations that farmers must follow to protect the environment? *The Environmental Protection Agency (EPA)*

Part I Lesson Evaluation: If desired, teachers can use the **Lesson 3 Part 1** section of the Discover Dairy post-test to evaluate students' ability to grasp lesson concepts. *This test can also be used at unit end.*

PART TWO — Energy on the Dairy Farm

Essential question:

What sources of energy exist on the dairy farm?

Keys to answering essential question:

- Understand how dairy farmers recycle waste on their farms.
- Understand the different sources of energy that exist on a dairy farm.
- Understand how some dairy farmers capture energy to produce electricity.

Reading Passage: *(Give students 10 minutes to read over Page 2 of Reading Passage.)*

Classroom Discussion: *(Use Transparency to walk through Reading Passage)*

Explain to the students that 18 percent of our global energy consumption comes from renewable energy sources. As concerns about the environment increase, more and more people are looking at renewable energy as the way of the future.

- ♦ Why is renewable energy important? *(It reduces pollution, global warming and U.S. dependence on imported fuels.)*
- ♦ What sources of renewable energy exist on the farm? *(Renewable energy on the farm comes from wind, solar and biomass energy sources.)*
- ♦ How can renewable energy benefit the farm and community? *(They can be used on the farm to replace other fuels or sold to the local community as electricity. By capturing these sources of renewable energy, dairy farms can lower their own energy costs while becoming a source of renewable energy for their local community.)*

Essential Question:

What sources of energy exist on a dairy farm?

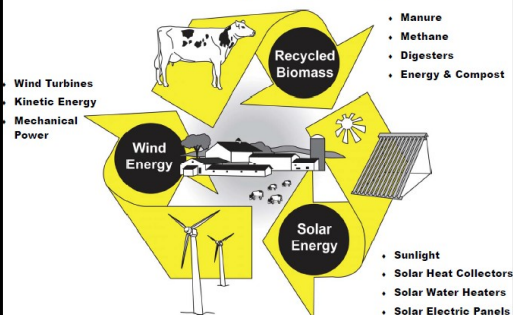


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PART TWO — Energy Sources on a Dairy Farm (*continued*)

Sources of Energy on the Dairy Farm



- ♦ What is biomass energy produced from? (*An anaerobic digester converts organic matter, such as cow manure, into a biogas called methane, which is combusted into energy.*)
- ♦ How does converting manure to energy help the farm? (*It takes something that could be problematic and converts it into renewable commodities — energy, compost and fertilizer.*)
- ♦ How do farmers collect wind energy? (*Through giant wind turbines that turn the kinetic energy in the wind into mechanical power.*)
- ♦ How many days of sunlight would it take to produce the amount of energy stored in the Earth's reserves of coal, oil and natural gas? (*20 days of sunlight.*)
- ♦ How are farmers collecting solar energy on the farm? (*Through solar heat collectors, solar water heaters, and solar electric panels.*)

Remind students that renewable energy on the farm can come from biogas, sunlight or the wind. Producing energy from biogas can turn waste products, like cow manure, into renewable commodities, like energy. By capturing energy from wind or sunlight, farmers can cut down on energy-related costs while offering a valuable commodity to the local community.

Lab Exercise:

Teachers should prepare copies of the Dairy in the Environment Lab 3.2 Worksheet to distribute to the class to prepare for this exercise. Students should complete experiment in groups of 2 or 4. Teacher should lead class discussion and facilitate exercise.

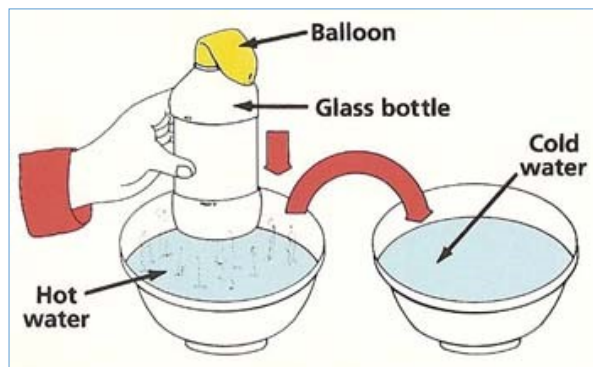
The following items are needed for exercise (per group):

- ⇒ Plastic 1 liter bottle (empty)
- ⇒ Large balloon
- ⇒ Bowl of hot (not boiling) water
- ⇒ Bowl of ice water
- ⇒ Rock
- ⇒ Freezer to cool balloon and bottle

Lab Explanation: In this activity, students will be determining whether thermal energy, which is energy produced from heat, can be made to do useful work. Before beginning the experiment, ask the students what they think will happen. Have them write their hypotheses in the space on the lab worksheet.

The teacher should facilitate classroom discussion around the experiment and what happened.

- Where you able to make a device that performed useful work?
- Can you think of devices that convert thermal energy into motion?
- How could thermal energy be converted into electrical energy?
- How do you think sunlight and solar energy produced on the farm relates to thermal energy?





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Food for Thought:

Ask Students to Describe Other Sources of Renewable Energy That Can Be Produced by Other Industries Outside of Agriculture.

Evaluate Comprehension!



PART TWO — Energy Sources on the Dairy Farm (*continued*)

Follow the directions outlined on the **Lab 3.2 Energy Sources Worksheet** to complete the experiment. Record what happens and answer questions on lab handout. *For appropriate responses to lab questions, see answer key found on www.discoverdairy.com or in Discover Dairy Ipad app.*

Lesson Review:

Teachers can asked the following questions to evaluate whether students understand the sources of energy that exist on the dairy farm.

1. What are three forms of renewable energy that can be produced on a dairy farm?
Wind Energy, Solar Energy, Biomass Energy
2. How can the dairy farmer use renewable energy to benefit his farm and the community?
He can cut down on energy costs for his farm and replace non-renewable sources of energy for the community.
3. How is biomass energy produced on the farm? *The manure cows produce is converted to methane, which is combusted into an energy source.*
4. How is wind energy collected on the farm? *Giant wind turbines turn the kinetic energy produced by the wind into mechanical energy.*
5. How is solar energy collected on the farm? *Solar heat collectors, solar water heaters and solar electrical panels are all used to collect energy from the sunlight.*

Part 2 Lesson Evaluation: If desired, teachers can use the **Lesson 3 Part 2** section of the cover Dairy post-test to evaluate students' ability to grasp lesson concepts. *This test can be used at unit end.*

Summarizing Lesson:

Remind students that it is everyone's responsibility to take good care of our planet and our natural resources. Dairy farmers work to protect our air, water and soil while producing an abundant supply of food. Several sources of energy can also be produced on the dairy farm.

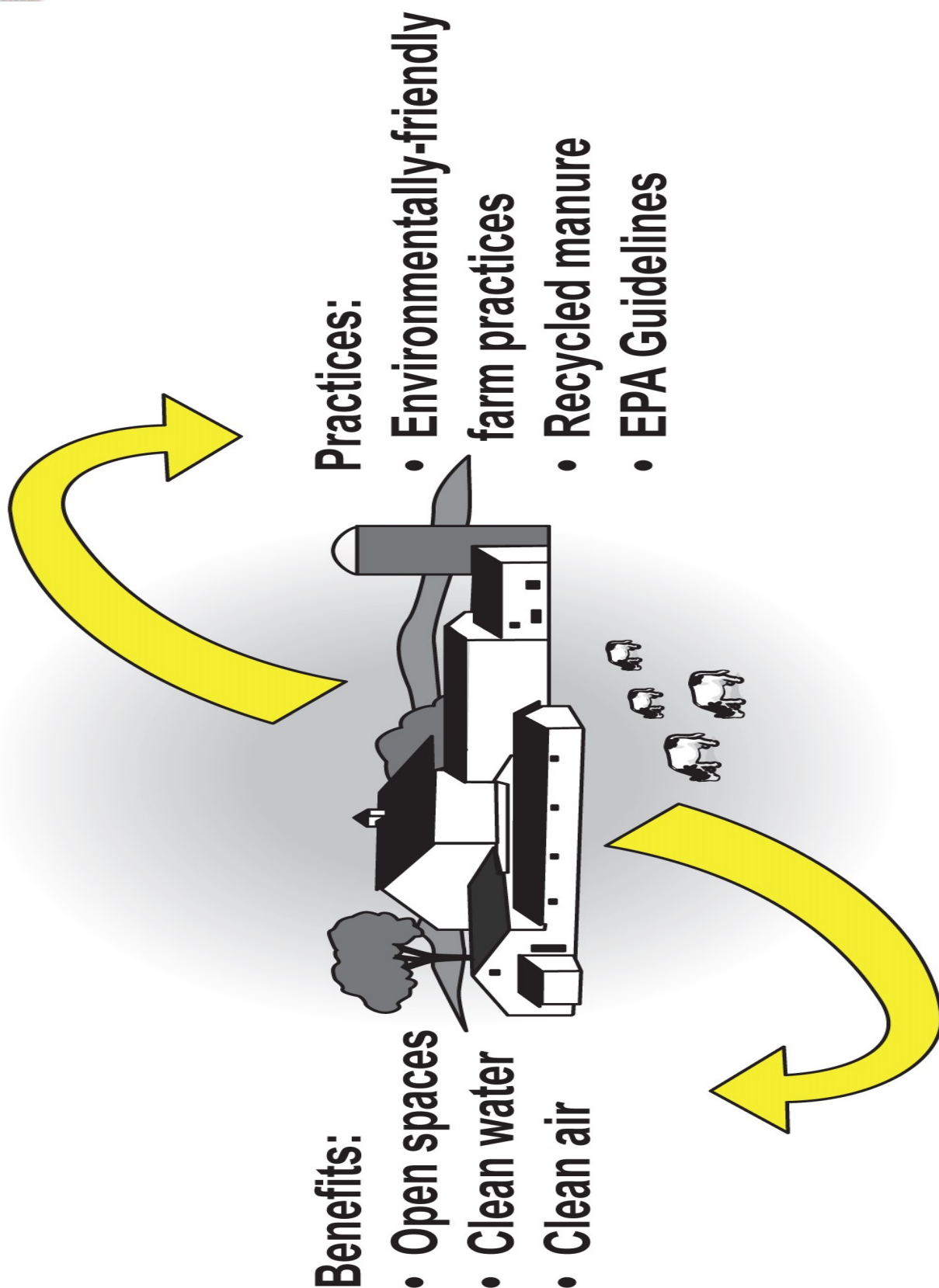
Summarize concepts identified in labs:

- Dairy farmers must ensure that their farm and farming practices have a positive effect on the environment. *Dairy farmers work hard to meet and exceed environmental regulations established to ensure the quality of the soil, water and air.*
- Along with producing food, many dairy farmers also produce renewable forms of energy on the farm. *Producing energy from biogas can turn waste products, like cow manure, into renewable commodities, like energy. By capturing energy from wind or sunlight, farmers can cut down on energy-related costs while offering a valuable commodity to the local community*

Evaluation:

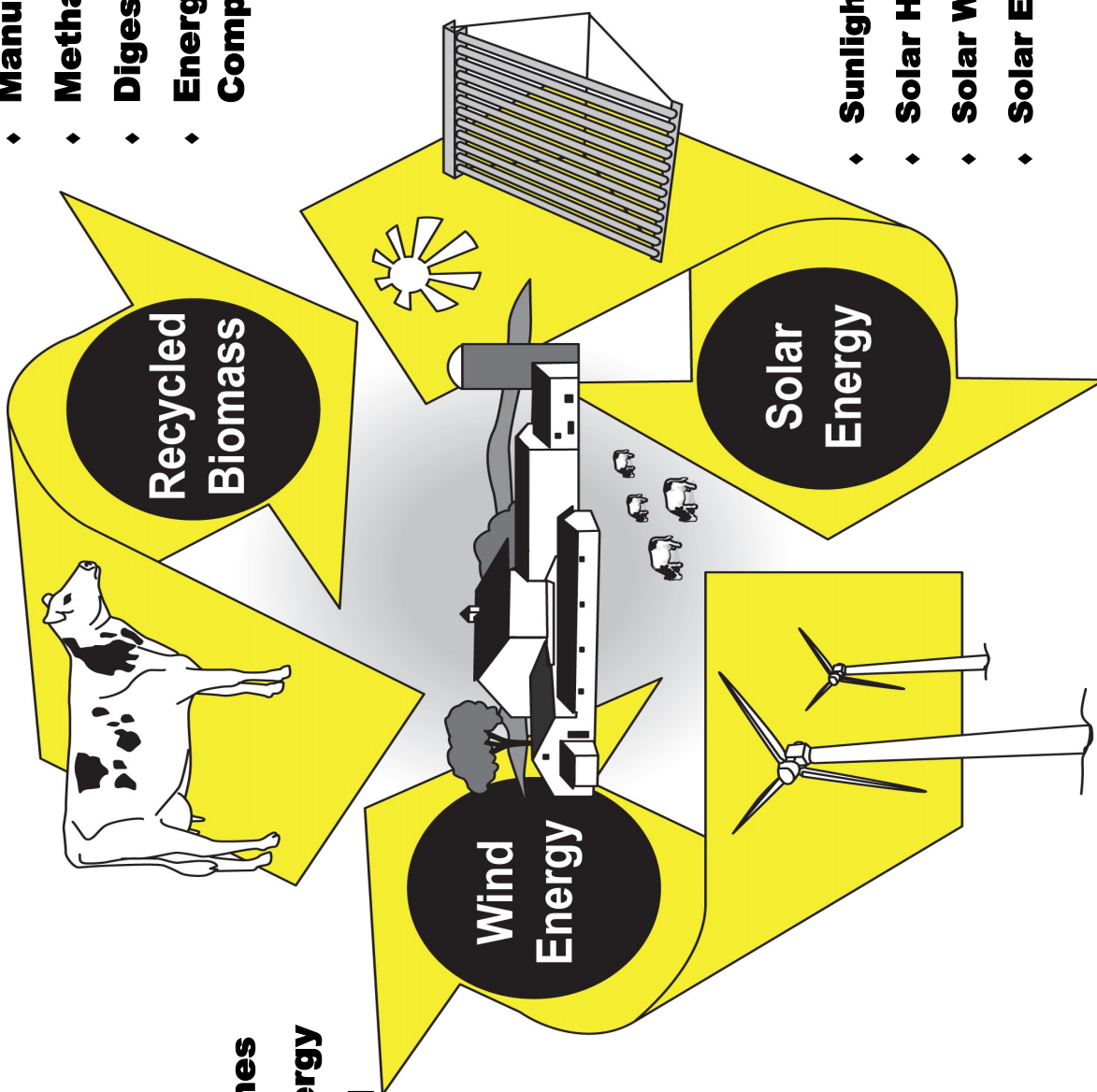
To test comprehension of lesson content, use the “**Discover Dairy Upper Level Post Assessment**” available online at www.discoverdairy.com or in the iPad application. For a writing assessment, have the students research an article on the Internet that discusses sources of energy that come from a farm.

A Dairy Farm's Role in the Environment



Sources of Energy on the Dairy Farm

- ♦ **Manure**
- ♦ **Methane**
- ♦ **Digesters**
- ♦ **Energy & Compost**



- ♦ **Sunlight**
- ♦ **Solar Heat Collectors**
- ♦ **Solar Water Heaters**
- ♦ **Solar Electric Panels**

- ♦ **Wind Turbines**
- ♦ **Kinetic Energy**
- ♦ **Mechanical Power**



Lab 3.1: A Dairy's Role in the Environment

Name: _____

Each of us plays an important role in protecting our environment, whether we live on a dairy farm or in a residential community. Dairy farms have a positive effect on the environment because dairy farmers continue to apply environmentally-friendly practices. Use the two sketches on the back of this page to compare and contrast the two communities and their impact on the environment.

What aspects of the farm have a positive effect on the environment? What should the farmer do to make sure he or she protects the environment from any harmful effects? What aspects of the residential and industrial community could negatively impact the environment? What can we do to protect the environment from those negative effects?

Farm Community Attribute	Positive or Negative	Residential and Industrial Community Attribute	Positive or Negative

1. List 3-5 attributes of each community that could affect the environment: _____

2. List ways the farmer can make all of the attributes have a positive impact on the environment:

3. List ways we can ensure the residential community has a positive impact on the environment:

4. Explain ways the dairy farm in the sketch benefits the environment around it:

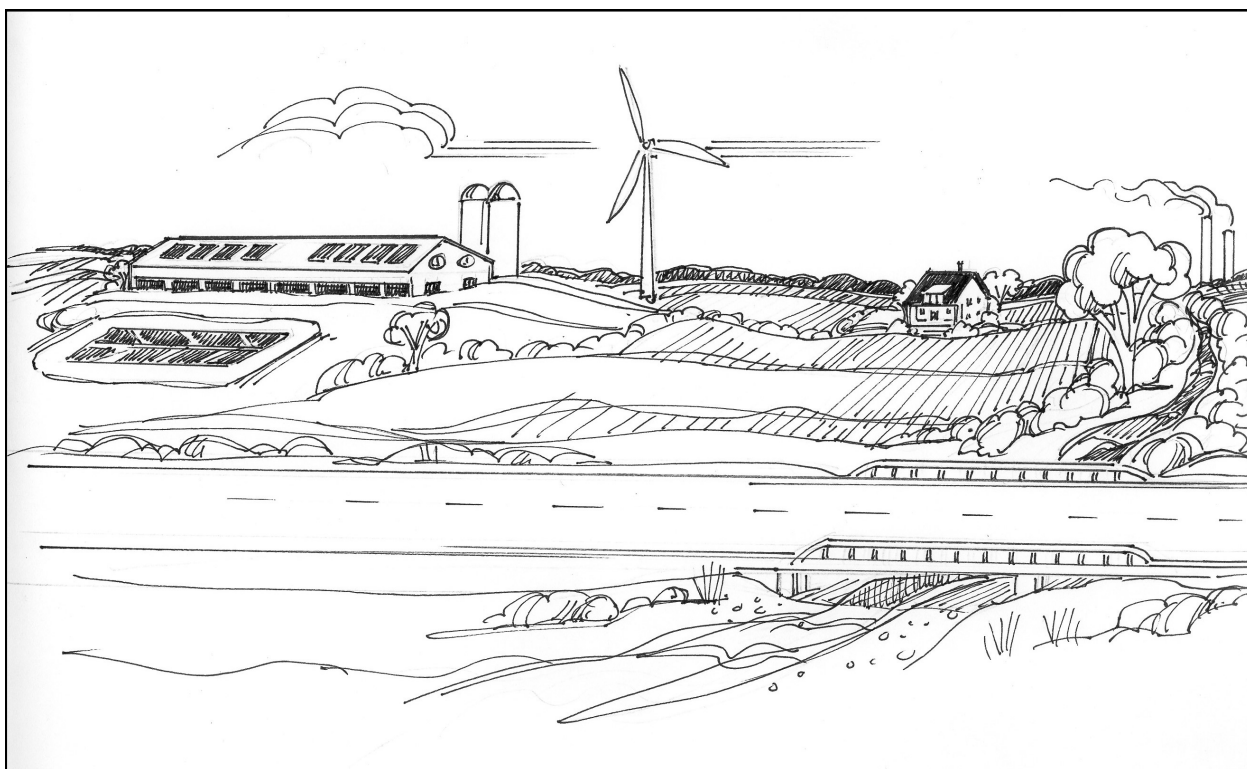
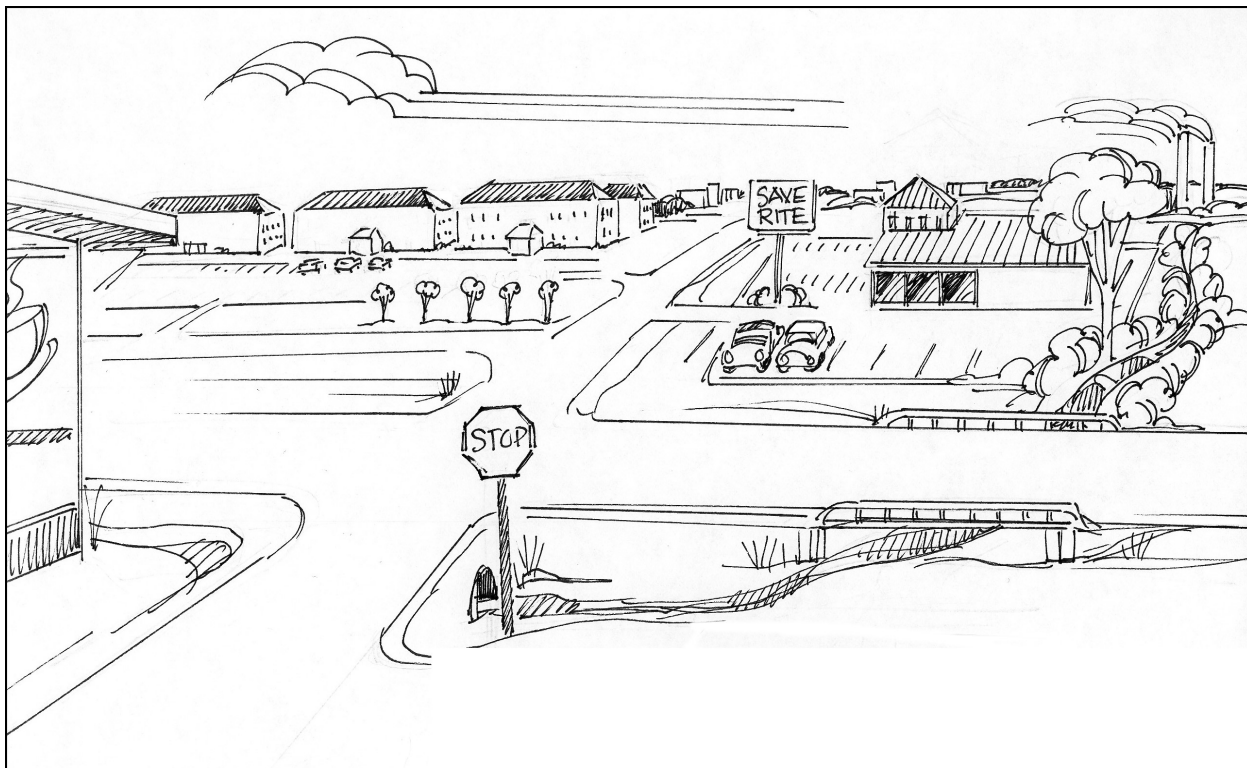


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Lab 3.1: A Dairy's Role in the Environment





Lab 3.2: Sources of Energy on the Farm

Name: _____

In this activity, you will be determining whether thermal energy, which is energy produced from heat, can be made to do useful work. Before you begin the experiment, circle the hypotheses you believe is true and write it below.

Hypotheses: *Thermal Energy can / can not be made to do useful work.*

Rewrite Your Hypotheses: _____

What you will need: *Plastic 1-liter bottle (empty) Large balloon*
Bowl of hot (not boiling) water Bowl of ice water
Small rock Freezer to cool bottle and balloon

Steps:

1. Cool the balloon and the bottle in a freezer for 5 minutes.
2. Fill the bowl with hot, not boiling, water.
3. Put the balloon over the mouth of the bottle, making sure the air has been squeezed from the bottle.
4. Place the bottle into the bowl of hot water.
5. The air inside the bottle should expand and inflate the balloon.
6. After it is inflated, put the bottle with the balloon in the bowl of ice water and observe what happens.
7. Put the rock on top of the balloon to observe how the expansion and contraction can be converted into useable work.

Questions:

1. What happened when you put the bottle in the warm water? _____

Why? _____

2. What happened when you put the bottle in cold water? _____

Why? _____

3. Were you able to create a device that performed useful work? YES or NO

How? _____

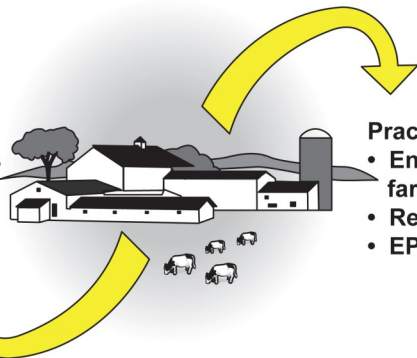
4. What other devices can you think of that use thermal energy to do work? _____

5. How do you think sunlight and solar energy relate to thermal energy? _____



Benefits:

- Open spaces
- Clean water
- Clean air



Practices:

- Environmentally-friendly farm practices
- Recycled manure
- EPA Guidelines

Two of the world's biggest challenges are producing enough food for a rapidly growing population, and taking care of our planet. Some would argue that producing food and caring for our world are indirect competition with each other. However, today's farmers work hard to protect our air, water and soil. They understand the importance of protecting the environment for future generations, and they depend on the land for their businesses.

All dairy farmers must follow stringent regulations to protect the air, land and water on their farms, and they take great pride in exceeding those requirements. They are responsible users of water in their milking parlors, barns and dairy waste storage areas. They recycle both water and manure, and take measures to improve the quality of our water supplies. Some farms produce electricity from alternative energy sources on the farm, including the sun, wind and waste products.

The Dairy Farm's Role in the Environment

How do you think a dairy farm influence our environment?

Protecting our environment is critical to our future existence. We need clean water and air to sustain life. Our food, water and air supply are all dependent on a healthy environment. We all need to play a role in protecting our natural resources.

Dairy farms provide wide open spaces for local communities. They also play an important role in caring for the environment. The dairy farmer is one of many individuals who must take responsibility for using environmentally friendly

A healthy environment is essential to farmers because their livelihood depends on the quality of the land they farm and the water their cows drink.

To protect the land for future generations, farmers use environmentally safe farming practices such as no-till farming and rotational cropping. No-till farming is a way of growing crops from year to year without disturbing the ground

through tillage to prevent top soil losses. Rotational cropping allows a farmer to rotate crops to continually replenish nutrients to the soil.

Cows eat about 90 pounds of food and drink about 40 gallons of water every day. In addition to producing milk from all that food, their bodies produce waste, known as cow manure. Each cow produces about 30 pounds of cow manure every day. This waste must be properly handled to protect the environment.



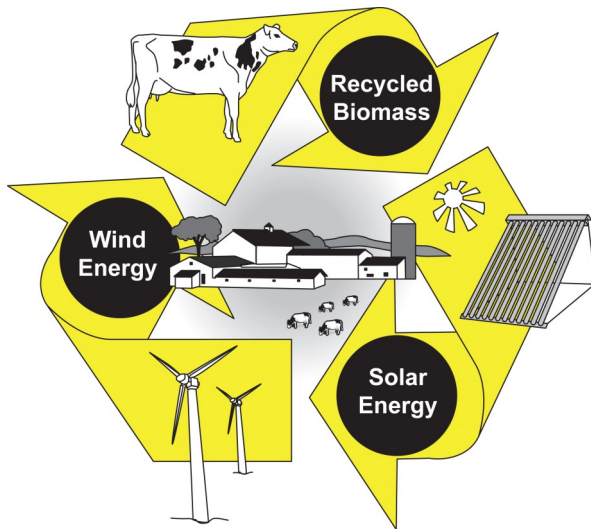
Manure is rich in soil-building nutrients. The farmer recycles this manure on nearby crop fields to replenish the nutrients in the soil. The manure is applied according to detailed nutrient management plans regulated by the federal, state and local government. This ensures the farmer abides by clean water laws and protects the water on and near his farm.

Organizations like the **Environmental Protection Agency (EPA)** have guidelines farmers must follow to protect the environment and handle their waste. Most farmers have a Nutrient Management Plan in place, which explains how they will meet or exceed those guidelines.



Dairy farms play a vital role in the local community because of the

wide open spaces they provide. Farmers have an important responsibility to care for the environment by using environmentally-friendly practices daily on their dairy operations.

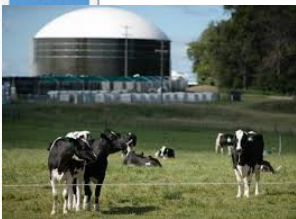


Energy Sources on the Farm

What sources of energy exist on the dairy farm?

About 18 percent of our global energy consumption comes from renewable energy sources. As concerns about the environment increase, more and more people are looking at renewable energy as the way of the future. A dairy farm can be a valuable source of this renewable energy, which helps to reduce pollution, global warming and U.S. dependence on imported fuels.

Renewable energy on the farm comes from wind, solar and biomass energy sources. They can be used on the farm to replace other fuels or sold to the local community as electricity. By capturing these sources of renewable energy, dairy farms can lower their own energy costs while becoming a source of renewable energy for their local community.



Biomass energy is produced from plants and organic waste, everything from crops, trees and crop residues to manure. On several dairy farms across the country, anaerobic digesters are used to convert the energy stored in the organic materials in cow manure into a useable source of energy.

The anaerobic digester converts the energy stored in manure to a biogas called methane, which can be combusted into energy to use to produce electricity for the farm or local community. The material remaining after methane is removed from the manure

can often be used as compost or fertilizer.

Manure is a nutrient-dense substance that, if not managed properly, has the potential to pollute streams and water supplies. More and more farmers are using the process of methane digestion to turn this cow waste into new renewable commodities – energy, compost and fertilizer.

Other dairy farmers have installed giant wind turbines on their farms to collect energy from the wind. Farms have long used wind power to pump water and generate electricity through windmills. Giant wind turbines convert the kinetic energy in the wind into mechanical power. That energy is then used for tasks (such as grinding grain) or made into energy by a generator.

Solar Energy is Utilized By:

- ◆ **Solar heat collectors** dry crops & warm buildings.
- ◆ **Solar water heaters** provide hot water for the farm.
- ◆ **Solar electric panels** turn sunlight into electricity to power the farm or sell to the community.

Another source of renewable energy on the farm is the sunlight, which holds an enormous amount of energy. All of the energy stored in Earth's reserves of coal, oil and natural gas is equal to the energy from only 20 days of sunlight.

Lesson Vocabulary:

Cow manure — a nutrient-dense substance produced as a waste product from the cow.

No-Till Farming — Growing crops without disturbing the soil through the use of tillage (breaking ground) practices.

Rotational Cropping — Rotating the crops planted year after year to replenish nutrients in the soil.

Environmental Protection Agency (EPA) — A federal agency with the mission to protect human health and to safeguard the natural environment -- air, water and land -- upon which life depends.

Renewable Energy — Energy that comes from natural resources, such as sunlight, wind, rain or biomass, that can be naturally replenished.

Biomass Energy — Energy produced from plants and organic waste, everything from crop residues to manure.

Anaerobic Digester — A machine that limits oxygen to compost or digest organic waste to produce methane.

Methane — a biogas that can produce energy.

Kinetic energy — Energy from an object in motion.

Mechanical energy — Energy used to do work.