Lesson Number: MS.NR.6.3

Back to the Future… Agriculture Style!

Middle School Food and Agricultural Literacy Curriculum

Precepts

E. Awareness

E1. Address issues important to the community

National Standards

PST.01.01.01.c. Compare the efficiency of energy production from various sources.

BS.01.01.03.a. Examine potential future applications of biotechnology in agriculture and compare them with alternative approaches to improving agriculture.

CS.01.05.01.a. Discuss trends and issues important to the community.

NL-ENG.K-12.12 – Applying Language Skills

NS.K-4.6 – Science in Personal and Social Perspectives

NS5-8.2 – Physical Science

Student Learning Objectives

As a result of this **unit** the students will…

Describe alternative energy sources utilized in the United States.

As a result of this **lesson** the students will …

Explore future applications of alternative energy sources.

Content Outline

Objective 1. Explore future applications of alternative energy sources.

I. Apply alternative energy sources for future agricultural use

A. Wind Energy

1. ***Wind turbines:*** a wind-driven turbine for generating electricity
2. Environmental Impacts

Time

Instruction time for this lesson: 45 minutes.

Resources

Arms, K. (2004). Environmental Science. Austin, TX: Holt, Rinehart and Winston. — Bearden, T. (2001). Blowin' in the wind. Retrieved July 25, 2009, from Online News Hour - http://www.pbs.org/newshour/bb/environment/jan-june01/blowing.html — National FFA Organization. (2003). LifeKnowledge Precepts and Signs of Success. — Prososki, L. (2009). Exploring alternative energy sources. Retrieved July 27, 2009, from News Hour Extra - http://www.pbs.org/newshour/extra/teachers/lessonplans/science/alternative_energy.html — National Renewable Energy Laboratory. (2008). Learning about renewable energy biomass energy basics. Retrieved July 26, 2009, from http://www.nrel.gov/learning/re_biomass.html — National Renewable Energy Laboratory. (2008). Learning about renewable energy solar energy basics. Retrieved July 26, 2009, from http://www.nrel.gov/learning/re_solar.html — National Renewable Energy Laboratory. (2008). Learning about renewable energy wind energy basics. Retrieved July 26, 2009, from http://www.nrel.gov/learning/re_wind.html — Merriam-Webster Dictionary Thesaurus. (2009). Merriam-Webster Dictionary. Retrieved August 25, 2009, from http://www.merriam-webster.com/ — U.S. Department of Energy (2009). Energy Sources Bioenergy. Retrieved July 25, 2009, from http://www.energy.gov/energysources/bioenergy.htm — U.S. Department of Energy. (2009). Energy Sources Solar. Retrieved July 25, 2009, from http://www.energy.gov/energysources/solar.htm — Texas State Energy Conservation Office. (2005). Rural Renewable Applications. Retrieved August 24, 2009, from http://www.infinitepower.org/pdf/No7%2096-812B.pdf

Tools, Equipment, and Supplies

Overhead projector/transparencies
MS.NR.6.3.TM.A – one per teacher (headings for Interest Approach)
Sheet of clean copy paper – one per group
MS.NR.6.3.AS.A – D —one per group
Solar Energy Conference sign
Wind Energy Conference sign
Biomass Energy Conference sign
Self-adhesive chart paper – one per group
Assorted markers – several per group
Colored index cards – one per student
MS.NR.6.3.TM.A – one per student
MS.NR.6.3.ASSESS.A – one per student

Key Terms

The following terms are presented in this lesson and appear in ***bold italics:***

Wind turbines
Passive solar water heater
Passive solar design
Photovoltaic cells
Methane
Ethanol
Biodiesel

B. Solar Energy

1. ***Passive solar water heating:*** a water heater that uses the sun's energy to heat water and that requires no moving parts and no external energy except the sun.
2. ***Passive solar design:*** the use of sunlight to heat and cool buildings
3. Solar ***photovoltaic cells:*** convert sunlight into electricity: made from layers of semiconductor materials (silicon).
4. Advantages of photovoltaics
5. Disadvantages of solar energy

C. Biomass Energy

1. How biomass works
2. ***Methane:*** an odorless gas produced by the decomposition of organic matter.
3. ***Ethanol:*** an alternative fuel; a liquid alcohol fuel with vapor heavier than air; produced from agricultural products such as corn, grain, and sugar cane.
4. ***Biodiesel:*** a fuel that is similar to diesel fuel and is derived from usually vegetable sources (as soybean oil).
5. Environmental impact

Interest Approach

Students will be completing a group activity that requires you to have pre-assigned groups of three. You will be giving them a problem situation and asking them to assess how that situation would affect their lives. They will also be asked to provide an idea for a possible solution to the situation.

After the groups come up with their ideas, they will share them with the class. Each group will need a plain sheet of copy paper on which to write their team's responses. Students will follow the directions below to complete this activity. You should display **MS.NR.6.3.TM.A** before this activity starts.

Imagine, you wake up tomorrow and you discover there is no gasoline or gas for heating! Everything is in chaos!!! You get to school and your teacher tells you to keep on your jacket because the classroom will only have heat for an hour today. Also, the field trip planned for tomorrow that you have been looking forward to all semester is cancelled because there is not enough fuel to get there! In your pre-assigned teams of four, take the piece of paper each group was given and fold it hot dog style.

Allow students to fold their papers.

When I say GO, beginning with the team member closest to the door, each student in the team will have 30 seconds to write two statements. On the left side of the paper we will write a statement about how this situation would impact our daily life. On the right side of the paper, we will write an idea about how this problem should be dealt with so it doesn't happen in the future.

Choose a student and ask for a repeat of the directions to this point to check for understanding.

Each student in the group will have 30 seconds to write their short responses and then the paper will be passed to the left and the next student will respond until the entire team has written their ideas. You may build on the ideas of your team members or introduce new ideas. Your list will be shared with the class. What questions do you have? GO

Allow students to write their ideas, indicating each 30-second interval by prompting them to pass the paper to the left.

Excellent team work! We are all looking forward to hearing how this situation can be dealt with so let's start with the team closest to the door and have a volunteer from that team read their list.

Call on the teams to share their thoughts from the team list. Continue around the room until all teams have shared.

Those are some pretty amazing ideas! Thank you for being so creative. Let's continue to think creatively and be engaged as we consider the future, but not just anything in the future. We will be exploring the future of alternative energy in agriculture! Last time we learned about how solar energy, wind energy, and biomass are currently being put to use to serve the agricultural industry.

Today we will take a journey to the next level and apply what we learned to contemplate where future energy needs will lead us. This is very important because as we move to a future less dependent on fossil fuels, agriculture will be relied upon to step up and produce many of the alternative energy sources that will be needed to provide our nation's energy! So get those creative thinking caps on and let's begin our journey back to the future!

In this first activity, students will assume the role of an alternative energy consulting firm. A farmer/rancher has hired them to help him bring energy using alternative sources to power everything at his ranch/farm. This is a "Jigsaw-type" activity that uses peer group team to organize research and presentations on a topic. In this lesson, each student on the team becomes an "expert" on one topic by breaking out to a research topic group.

Through working and sharing with members from the other teams who are assigned the same expert topic, students become "experts" on their topic. The topics are Wind Energy, Solar Energy, and Biomass Energy. Upon returning to their teams, each one in turn teaches the group about his/her expert topic and then the group will decide on what types of energy they will use for their client, create a drawing to represent their choices, and present their choices to the class.

Have one copy of **MS.NR.6.3.AS.A-D** for each group. Also a large piece of self sticking chart paper and assorted markers will be needed by each group for this activity. You will also need to designate three sections of the room with the labels; Solar Energy Conference, Wind Energy Conference, and Biomass Energy Conference.

Summary of Content and Teaching Strategies

Objective 1. Explore future applications of ***alternative energy*** sources.

Deliver with emotion!

Did you know that at this time there is not a single energy source that can supply all of the needs of all of the people in the United States! In fact, not all alternative energy sources are available in all parts of the United States. Most of the time, there is not enough wind to consistently turn a windmill in the southeastern U.S. and if you live in the northern states, you know that there are days during the winter with no sun! Who knows what the limits will be for our energy needs and uses in the future as our population continues to rapidly expand?

According to some experts, if the consumption continues at the present rate, our fossil fuel supply could be gone before the end of this century! Although technology is advancing at an exponential pace, research efforts have not given us a new energy source that can meet all of our needs! Sources of energy from nuclear fusion, hydrogen fuel cells, and even algae are showing promise to some but currently are not generally available.

Adapting to alternative energy sources will be more important as the availability, economics, and environmental issues of traditional fossil fuel energy continue in the years to come. We need to be innovative thinkers as we consider how we will meet the energy challenges of the future for our community and our nation. Let's be engaged and creative learners as we explore the alternative energy sources that will have a huge impact on our future energy needs in agriculture!

Pass out **MS.NR.6.3.AS.A-D** to each group. Instruct the students to leave them face down on the table until instructed. Read the situation from **MS.NR.6.3.AS.D** to the class.

I. Apply alternative energy sources for future agricultural use

A. Wind Energy

1. ***Wind turbines:*** a wind-driven turbine for generating electricity
2. Environmental Impacts

B. Solar Energy

1. ***Passive solar water heating:*** a water heater that uses the sun's energy to heat water and that requires no moving parts and no external energy except the sun
2. ***Passive solar design:*** the use of sunlight to heat and cool buildings
3. Solar ***photovoltaic cells:*** convert sunlight into electricity; made from layers of semiconductor materials (silicon)
4. Advantages of ***photovoltaics***
5. Disadvantages of solar energy

C. Biomass Energy

1. How biomass works
2. ***Methane:*** an odorless gas produced by the decomposition of organic matter
3. ***Ethanol:*** an alternative fuel; a liquid alcohol fuel with vapor heavier than air; produced from agricultural products such as corn, grain, and sugar cane
4. ***Biodiesel:*** a fuel that is similar to diesel fuel and is derived from usually vegetable sources (as soybean oil)
5. Environmental impact

Back to the Future…Agriculture Style!

Today we will assume the role of an alternative energy consulting firm. Our firm helps people to consider the future and assists them in making wise alternative energy choices.

A new customer has hired the firm to help with a problem. This customer is planning the future of some new property he has just purchased for the purpose of starting his dream farm/ranch. He is very environmentally conscious and knows that in the future there will probably be more stringent rules for the use of fossil fuels. He also realizes that as fossil fuels become scarce, their price will probably go up. Because his new farm/ranch is over a hundred miles from the closest source of electricity this farmer/rancher is coming to your alternative energy consulting group to ask for assistance in finding alternative energy sources that will meet his concerns and also save him the thousands of dollars it will cost him to have the utility grid extended to his property.

He would also like to be totally independent including not being dependent on driving over two hundred miles round trip to get fuel from the gas station for his tractors and vehicles. He is asking your consultant group to come up with answers for all of his energy needs including those for his family, vehicles, crops, and livestock. What questions do you have?

Allow time for questions. Then instruct the groups to turn the handouts over and distribute one each of **MS.NR.6.3.AS.A-C** to different group members. The other handout, **MS.NR.6.3.AS.D**, is for the group to use together when they begin their group plan. Then continue reading from **MS.NR.6.3.AS.D**.

Each group will put together an energy plan and then present the plan to the customer (class). The plan should include an artistic drawing that will help the farmer/rancher better understand the energy sources suggested. The drawing should indicate where the group suggests the utilization of different types of alternative energy on the farm/ranch. In the presentation, the group will explain what types of alternative energy were chosen, what they were chosen to provide energy for, and why the group chose them.

The following is a list of buildings he will build and the livestock/crops he wants to produce:

Family home

2 family vehicles

Large barn for livestock, feed and hay storage and miscellaneous storage

100 head hog production barn

Small hobby greenhouse

Four large 100-acre pastures for livestock with multiple gates into each one (2 of the pastures are over 30 miles from the main house and barn area); each pasture must have a water source as there are no lakes or ponds in them

2 large tractors

Various pieces of farm equipment

2 ATVs

200 head of beef cattle

Four very large fields for the production of various crops; the four fields total 1,200 acres

200 acres of managed forest

*Important Note: For this activity, consider the location to be conducive as a source for all forms of alternative energy.

If you understand the directions to this point for this activity please show a thumb up. If you do not understand please show a thumb down.

Clarify and restate the instructions if necessary.

In order to complete this assignment, we must have experts on different types of alternative energy in our consulting firm. To achieve this, our experts go to conferences. Before the firm can put together a plan for this client, the experts must get together and consider where and how their type of alternative energy would best serve the client's purposes. When I say GO, we will move quickly and silently to form three expert conference groups.

Wind energy experts will meet at the sign that says Wind Energy Conference, solar energy experts will meet next to the sign that says Solar Energy Conference and biomass energy experts will move to the sign that says Biomass Energy Conference. Take your activity sheet and a pencil with you. Remain silent when you get to your group. What questions do you have? GO

Allow students to move to their designated expert groups.

When I say CONFERENCE, expert groups will have five minutes to choose a volunteer to read the handout and decide where their type of alternative energy could supply energy for the clients' needs. Each expert must write the choices on the back of their own handout. What questions do you have? CONFERENCE

Allow students to read the handout and work through the list of points on the farm that will need power. Circulate between the groups to answer any questions. Make sure each student is writing the group recommendations because they will be bring those back to their group.

Amazing conferences! Now when I say RETURN, we will go back quickly and silently to our original consulting firm and await further instruction. RETURN

Allow students to return to their original groups of three.

Wow! That was a lot of brain power at work. We have just become experts on one of the types of alternative energy. Continue to be focused learners as we develop the energy use plans. Turn to someone next to you and say, "What will our plan be?"

Allow students to comment to other students.

OK! When I say DECIDE, each group will have 10 minutes each for their experts to explain their topic and choose a plan to submit to the client. Following the presentations, time will be given to complete group drawings. Be aware that more than one type of alternative energy may be suggested by the different experts for the same power need.

The group must come to a decision about which one is the best to use for that situation and report only the one they choose. Remember to consider all of the client's potential energy needs. Your drawing should indicate all of the items listed on the client's farm/ranch list and what your plan is to provide the needed energy. What questions do you have? DECIDE

Allow students to come up with their plan and make their drawing. Circulate between the groups to answer any questions. Make sure each team is writing the group recommendations down so they can use them for their presentation when their drawings are complete.

Incredible! Those are some very creative drawings! Now is the time to hear from the consulting firms about how they would help this client with his energy needs. The group should stand, display their drawing and explain how they laid out the farm, what energy sources they have chosen for each need, and why that was the choice. We will start with the group closest to the door. What questions do you have?

Allow each group to display their drawing and explain their plan. As each group finishes, attach their drawing to the wall around the room. After all of the presentations are given, the drawings will be displayed and we will have a gallery walk for closer inspection of the effectiveness of future uses of alternative energy in this particular agricultural setting. Each consulting firm should examine all of the drawings/plans and vote for the "Alternative Energy Consulting Firm of the Year" according to which firm they believe had the most complete and effective plan.

Review/Summary

Thanks for working so hard. Now we have one last task. At the front of the room are colored index cards. When I say WALK, each group will pick up one card. We are going to take a gallery walk and decide which firm's plan and drawing did the most effective job of using alternative energy sources to supply all of this client's needs. Each group gets one vote to decide on the "Alternative Energy Consulting Firm of the Year." Vote by placing your index card next to the plan the group chooses. Then return silently to your seat and wait for the vote count! What questions do you have? WALK

Allow students to take their gallery walk and choose a plan by leaving the index card next to their choice. When all groups are seated, count the votes and congratulate the winning firm with a round of applause. Then have a round of applause for all of the teams and their plans.

Wow! We did it! We actually created some amazing alternative energy plans to bring energy to this client's farm using wind, solar, and biomass energy. We are certainly all winners for having completed this challenging activity today! This knowledge will be especially important to us as we answer tomorrow's question, "What is agriculture's role in the production of alternative energy?" Thanks for being so creative and working so hard. Come to class tomorrow focused and ready to learn as we continue on the rest of our alternative energy journey.

Application

Extended classroom activity:

1) Teams research solar cooler designs on the Internet and build their own. 2) Contact an expert with the U.S. Government's Energy Information Administration with specific questions about alternative energy. http://www.eia.doe.gov/contacts/renew.html

3) Use this website to get diagrams and instructions to make ***methane*** and ***ethanol*** in class or use a search engine such as www.google.com or www.ping.com and search for instructions to produce ***methane*** or ***ethanol***. (http://www.tvakids.com/teachers/pdf/jrhigh_ch4.pdf)

FFA activity:

Invite a biomass expert to come to a chapter meeting and speak about the future of biomass as an alternative fuel source and about careers in the industry.

SAE activity:

Grow soybeans or some other crop to make alternative fuels for an Oil Crop or Specialty Crop SAE.

Evaluation

MS.NR.6.3.ASSESS.A

Answers to Evaluation

1. B
2. B
3. A
4. A
5. B

Impact on our daily lives!	What can we do to keep this from happening in the future?

WIND ENERGY

We have been harnessing the wind's energy for hundreds of years. From old Holland to farms in the United States, windmills have been used for pumping water or grinding grain. Today, the windmill's modern equivalent – a wind turbine – can use the wind's energy to generate electricity.

Wind is a clean fuel; wind turbines produce no air or water pollution because no fuel is burned. It is one of our nation's fastest-growing sources of energy. Taking advantage of this abundant domestic resource to generate electricity helps meet America's growing energy demands while improving our energy security and protecting our environment.

On some of the distant mesas in Texas, a new source of energy is emerging – one that proponents think could be even more abundant than the oil that made a lot of Texans rich. Two hundred and forty two giant new wind turbines made in Denmark are being constructed south of Midland, Texas. Hundreds more are already operating nearby, feeding the statewide power grid – an impressive demonstration of wind's new status in the energy business. When their plant in West Texas is done, it'll generate 160 megawatts, enough to power 48,000 homes.

According to ROBERT I. MORRISON, the primary change that has gone in the last 20 years in this industry has been the machines have gotten very much larger. These are probably seven or eight times larger than the original machines that were installed in California. That makes them much more efficient, and the energy that comes out of them less expensive.

Wind turbines, like windmills, are mounted on a tower to capture the most energy. At 100 feet (30 meters) or more aboveground, they can take advantage of the faster and less turbulent wind. Turbines catch the wind's energy with their propeller-like blades. Usually, two or three blades are mounted on a shaft to form a rotor. The rotor spins like a propeller, and the turning shaft spins a generator to make electricity.

Stand-alone wind turbines are typically used for water pumping or communications. However, homeowners, farmers, and ranchers in windy areas can also use wind turbines as a way to cut their electric bills.

Operating a wind power plant is not as simple as just building a windmill in a windy place. Wind plant owners must carefully plan where to locate their machines. One important thing to consider is how fast and how much the wind blows. As a rule, wind speed increases with altitude and over open areas with no windbreaks. Good sites for wind plants are the tops of smooth, rounded hills, open plains or shorelines, and mountain gaps that produce wind funneling.

The most serious environmental drawbacks to wind machines may be their negative effect on wild bird populations and the visual impact on the landscape. To some, the glistening blades of windmills on the horizon are an eyesore; to others, they're a beautiful alternative to conventional power plants.

SOLAR ENERGY

Developing technologies that take advantage of the clean abundant energy of the sun is important to reducing greenhouse gases and helps stimulate the economy. The most commonly used solar technologies for homes and businesses are solar water heating, passive solar design for space heating and cooling, and solar photovoltaics for electricity.

Solar energy can be converted to thermal (or heat) energy and used for:

- Solar water heating – for use in homes, buildings, or swimming pools, or
- Heat spaces – inside greenhouses, homes, and other buildings.

Photovoltaic (PV devices) or "solar cells" – change sunlight directly into electricity and are made of semiconductors such as crystalline silicon, a special type of melted sand.

PV systems are often used in remote locations that are not connected to the electric grid. The simplest photovoltaic systems power many of the small calculators and wrist watches used every day. More complicated systems provide electricity to pump water, power communications equipment, and even provide electricity to our homes.

Individual solar cells are arranged together in a PV module and the modules are grouped together in an array. Some of the arrays are set on special tracking devices to follow sunlight all day long. The electrical energy from solar cells can then be used directly. It can be used in a home for lights and appliances. It can be used in a business. Solar energy can be stored in batteries to light a roadside billboard at night. Or the energy can be stored in a battery for an emergency roadside cellular telephone when no telephone wires are around. Some experimental cars also use PV cells. They convert sunlight directly into energy to power electric motors on the car.

Some advantages of photovoltaic systems are:

- Conversion from sunlight to electricity is direct, so that bulky mechanical generator systems are unnecessary.
- PV arrays can be installed quickly and in any size required or allowed.
- The environmental impact is minimal, requiring no water for system cooling and generating no byproducts.

The major disadvantages of solar energy are:

- The amount of sunlight that arrives at the earth's surface is not constant. It depends on location, time of day, time of year, and weather conditions.
- Because the sun doesn't deliver that much energy to any one place at any one time, a large surface area is required to collect the energy at a useful rate.

BIOMASS

The term "biomass" means any plant-derived organic matter available on a renewable basis, including dedicated energy crops and trees, agricultural food and feed crops, agricultural crop wastes and residues, wood wastes and residues, aquatic plants, animal wastes, municipal wastes, and other waste materials. The use of biomass can reduce dependence on foreign oil because biofuels are the only renewable liquid transportation fuels available.

How biomass works is very simple. The waste wood, tree branches, and other scraps are gathered together in big trucks. The trucks bring the waste from factories and from farms to a biomass power plant. Here the biomass is dumped into huge hoppers. This is then fed into a furnace where it is burned. The heat is used to boil water in the boiler, and the energy in the steam is used to turn turbines and generators

Burning biomass is not the only way to release its energy. Biomass can be converted to other usable forms of energy like methane gas or transportation fuels like ethanol and biodiesel.

Methane gas is the main ingredient of natural gas. Smelly stuff, like rotting garbage, and agricultural and human waste, releases methane gas – also called "landfill gas" or "biogas." In places where lots of animals are raised, the animals – like cattle, pigs and even chickens – produce manure. When manure decomposes, it also gives off methane gas similar to garbage. This gas can be burned right at the farm to make energy to run the farm.

Ethanol: Crops like corn and sugar cane can be fermented to produce a liquid alcohol transportation fuel called ethanol. Ethanol can be used in special types of cars that are made for using alcohol fuel instead of gasoline. The alcohol can also be combined with gasoline. This reduces our dependence on oil – a non-renewable fossil fuel. Future ethanol will be produced increasingly from cellulose found in crop residues (e.g., stalks, hulls), forestry residues (e.g., forest thinning, wood byproducts), energy crops (e.g., switchgrass, sorghum), and sorted municipal wastes. Some promising energy crops grow on marginal soils not suited for traditional agriculture. A high-protein animal feed, known as Distiller's Dried Grains with Solubles (DDGS), is produced in the process of making ethanol from corn.

Biodiesel, another transportation fuel, is a fuel made with vegetable oils, fats, or greases – such as recycled restaurant grease. Biodiesel fuels can be used in diesel engines without changing them. It is the fastest growing alternative fuel in the United States. Biodiesel, a renewable fuel, is safe, biodegradable, and reduces the emissions of most air pollutants.

Biomass can pollute the air when it is burned, though not as much as fossil fuels. Burning biomass fuels does not produce pollutants like sulfur that can cause acid rain. When burned, biomass does release carbon dioxide, a greenhouse gas. But when biomass crops are grown, a nearly equivalent amount of carbon dioxide is captured through photosynthesis.

Today we will assume the role of an alternative energy consulting firm. Our firm helps people to consider the future and helps them to make wise alternative energy choices. A new customer has hired the firm to help him with a problem. This customer is planning the future of some new property he has just purchased for the purpose of starting his dream farm/ranch. He is very environmentally conscious and knows that in the future there will probably be even stricter rules for the use of fossil fuels. He also realizes that as fossil fuels become scarcer, their price will probably go up. Because his new farm/ranch is over a hundred miles from the closest utility grid, this farmer/rancher is coming to your alternative energy consulting group to ask for assistance in finding alternative energy sources that will meet his concerns and also save him the thousands of dollars it will cost him to have the utility grid extended to his property. He would also like to be totally independent including not being dependent on driving over two hundred miles round trip to get fuel from the gas station for his tractors and vehicles. He is asking your consultant group to come up with answers for all of his energy needs including those for his family, vehicles, crops, and livestock. Your group will put together this energy plan and then present the plan to the customer (class). Your plan should include an artistic drawing that will help the farmer/rancher better understand the energy sources you have chosen. Your drawing should represent where you have chosen to use the different types of alternative energy on the farm/ranch and the group will explain what types of alternative energy were chosen, what they were chosen to provide energy for, and why the group chose them. After all of the presentations are given, the drawings will be displayed and we will have a gallery walk for closer inspection for the future uses of alternative energy in this agricultural setting.

The following is a list of buildings he will build and the livestock/crops he will produce:

Family home

2 family vehicles

Large barn for livestock, feed and hay storage and miscellaneous storage

100 head hog production barn

Small hobby greenhouse

Four large 100-acre pastures for livestock with multiple gates into each one (2 of the pastures are over 30 miles from the main house and barn area); each pasture must have a water source as there are no lakes or ponds in them

2 large tractors

Various pieces of farm equipment

2 ATVs

200 head of beef cattle

Four very large fields for the production of various crops – the four fields total 1,200 acres

200 acres of managed forest

For this activity, consider the location to be conducive as a source for all forms of alternative energy sources.

Name _____

Directions: Read each statement and choose the answer that best completes the statement.

1. _____**Photovoltaic cells utilize the energy from the wind.**
   A. True
   B. False

2. _____**Turbines capture solar energy.**
   A. True
   B. False

3. _____**Trees and even manure are considered biomass.**
   A. True
   B. False

4. _____**Corn is a source for producing ethanol.**
   A. True
   B. False

5. _____**Biodiesel is produced from fossil fuels.**
   A. True
   B. False