



Solar, Wind or Biomass: Who Will Be the Next Alternative Energy Star for Agriculture?

Middle School Food and Agricultural Literacy Curriculum

Precepts

- A. Action
- A3. Plan Effectively

National Standards

- PST.01.01.01.a. Identify renewable and non-renewable energy sources and pathways of delivery.
- BS.01.01.02.a. Investigate current applications of biotechnology in agriculture.
- CS.01.01.03.c. Implement an effective project plan.
- NL-ENG.K-12.12 – Applying Language Skills
- NS.5-8.5 – Science and Technology

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 ...
- Describe how alternative energy sources are used in agriculture.

Content Outline

Objective 1. Describe how alternative energy sources are used in agriculture.

I. Types of alternative energy used in agriculture

- A. Solar energy can be used in agriculture to save money by cutting a farm's electricity and heating bills and reduce pollution.
 - 1. Solar panels (photovoltaic cells) provide power for farm operations such as remote electric fences, gate openers, water pumps, lights, and water tank de-icers.
 - 2. Solar greenhouses collect and store solar energy as heat.
 - 3. Solar heat collectors warm livestock buildings and greenhouses.

Time

Instruction time for this lesson: 45 minutes.

Resources

Arms, K. (2004). Environmental Science. Austin, TX: Holt, Rinehart and Winston. — Merriam-Webster Dictionary Thesaurus. (2009). Merriam-Webster Dictionary. Retrieved August 25, 2009, from <http://www.merriam-webster.com/> — National FFA Organization. (2003). LifeKnowledge Precepts and signs of success. — National Renewable Energy. (2008). Learning about renewable energy. Retrieved August 24, 2009, from http://www.nrel.gov/learning/re_basics.html — National Association of Agricultural Educators. (2009). Renewable Fuels Lesson Plans. Retrieved August 10, 2009, from <http://aged.learn.com/learncenter.asp?sessionid=3-AD1ED755-C7E4-4C55-AC16-8D6DB18B6720&DCT=1&id=178410&page=32> — National Association of Agricultural Educators. (2009). Biomass as a fuel lesson plan. Retrieved August 23, 2009, from <http://www.naae.org/> — Texas State Energy Conservation Office. (2005). Biomass: Nature's Most Flexible Energy Resource. Retrieved August 24, 2009, from <http://www.infinitepower.org/pdf/No7%2096-812B.pdf> — 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.6.2.TM.A – one per teacher
MS.NR.6.2.AS.A – one per student (notes page)
MS.NR.6.2.AS.B – one per teacher (copy and cut apart to distribute for Go Get It e-Moment®)
Two pieces of paper balled up
MS.NR.6.2.ASSESS.A – one per student

Key Terms

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

ethanol

biodiesel

methane

- B. Wind energy among the cows and crops, farmers have a new income as huge towers with propellers turn and change the energy from the wind into electricity.
 - 1. Wind turbines allow farmers to collect land use fees from electric companies and still use the land for agricultural purposes.
 - 2. Windmills pump water for animal drinking tanks.



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C. Biomass (plants and organic waste) produced from plants and organic wastes – When crops such as cotton, rice, peanuts, and sugar cane are harvested, there are large amounts of waste materials that are left behind. Items such as crop residue and effluent from confined animal feeding operations (CAFO) can be used for fuel. Small biomass energy projects can provide many needed benefits in rural areas that are involved in agriculture. Example: a biomass generator that uses manure as its energy source is installed on a feedlot. This would solve the feedlot's problem of manure disposal, reduce odors, and provide jobs for the community.

1. **Ethanol** – an alternative fuel; a liquid alcohol fuel with vapor heavier than air; produced from agricultural products such as corn, grain, sorghum, and sugar cane
2. **Biodiesel** – a fuel that is similar to diesel fuel and is derived from vegetable sources such as soybeans
3. **Methane** – an odorless gas produced by the decomposition of organic matter from bio-waste (human, plant, or animal material) such as pig manure. Anaerobic bacteria break down the waste giving off **methane** in a **methane** digester. Sludge from the **methane** digester is used for fertilizer.

This lesson will continue to build information about the alternative energy sources that were introduced in the last lesson. The focus today will be on applications of alternative energy in agriculture. Before class ball up two pieces of paper and have two students in mind who will follow instructions enthusiastically for the interest approach activity.

As these two students enter, have them come to the front of the room. Also, before class, designate a starting line and a finish line (next to the trash can). In addition you will need to prepare the information from **MS.NR.6.2.AS.B** on individual papers and post them randomly around the room so that students can find them and get their information. Also, distribute a copy of **MS.NR.6.2.AS.B** to each student. In addition, pre-assign student groups of two for a review activity at the end of class.

Interest Approach

Today we have two pieces of paper crushed into balls on the floor, but these are not normal wads of trash paper – they have a purpose! When I say GO, we will have a race between insert student name and insert other student's name to get a paper wad from the starting line to the trash can. Before

we begin, there is one major rule we must follow: no physical contact of any kind can be made with the paper! No contact with anything! What questions do you have? GO

Students will either fan or blow the ball to the finish line.

Great!! Way to go getting those paper wads to the finish line! Let's give our racers a round of applause for being such good sports!

Lead class in applause.

Now, let's consider what just happened here. What would have been the obvious first choice to get the paper wad to the trash can if we did not have the "no physical contact" rule?

Allow volunteers to suggest answers. Expect answers such as, walking up to the trash can and dropping it in and throwing the paper wad into the trash can.

Yes, those are good suggestions and they would have been our first choice to get the job done but today these students were challenged to be creative and model another way that is not commonly used to get paper to the trash can. Thinking back to our lesson yesterday, who will share what type of choice they had to make?

If the lessons are not being taught in sequence, the teacher can just ask, "Who will tell us the term used when we are making a choice that is not the most common method used for a task?"

Allow students to volunteer answers making sure that during the discussion, they connect the idea that blowing or fanning the paper was an alternative choice to move the paper wad.

As we know, wind energy is just one of the six alternative forms of energy we were introduced to in yesterday's lesson. If you can name all six of the alternative forms of energy we discussed yesterday, give a thumbs up.

If the previous lesson on wind energy was not taught, the teacher should review the six forms of alternative energy listed below at this time.

Call on students to name all of the sources covered in yesterday's lesson. Then have them do a choral response and say all of the forms of alternative energy together.

Utilize the Choral Response e-Moment



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Exactly right. Now everyone repeat those forms of alternative energy one more time together. Solar, Wind, Biomass, Geothermal, Hydroelectric, and Tidal/Wave power.

Encourage students to respond in unison.

Great responses! Today we are going to learn more about alternative energy. This is important because the United States currently relies heavily on coal, oil, and natural gas for its energy. These fossil fuels are nonrenewable; that is, they draw on finite resources that will eventually decrease, becoming too expensive or too environmentally damaging to get. However, renewable energy resources – such as wind and solar energy – are constantly renewed and will never run out. Let's put our brains in exploratory mode as we explore how alternative energy is used in agriculture.

Summary of Content and Teaching Strategies

Objective 1. Describe how alternative energy sources are used in agriculture.

I. Types of alternative energy used in agriculture

Ask students if they can think of any ways alternative energy would be used by agriculture. Then have the students write the title statement from **MS.NR.6.2.TM.A** as a title for the notes they will be taking on their notes page **MS.NR.6.2.AS.A**. Use a Go Get It e-Moment to complete the rest of the information presented on **MS.NR.6.2.TM.A**.

Think of a way that alternative energy would be used by some part of the agriculture industry, then raise your hand.

Allow several students to volunteer their ideas. Display the first item from **MS.NR.6.2.TM.A** and distribute **MS.NR.6.2.AS.A**.

Those are some interesting suggestions and we will look back after we finish our explorations today to see how many were discovered. Today we are taking a closer look at the three forms of alternative energy widely used by the agricultural industry. Let's begin by writing the following statement at the top of your notes handout as the title: Agricultural Uses for Alternative Energy.

Allow time to write the title on the handout.

Utilize the Go-Get-It e-Moment

Around the room there are 15 facts to help us learn more about alternative energy used in agriculture. When I say EXPLORE, we will have 10 minutes to stand up, take our notes page, and inspect the room for facts. When a fact is found, find the corresponding section and number and write it down on the notes page. After finding all 15 facts and writing them on the notes page, return to your seat and review the facts. What questions do you have? EXPLORE.

As students finish, remind them to go back to their seat and review what they have just written. When everyone is done, display the rest of **MS.NR.6.2.TM.A** and have the students make sure they captured all 15 facts correctly.

Awesome! In our exploration we should have found these 15 facts. Take a minute and make sure you captured all the facts correctly. If facts are missing from your sheet, add them as we review.

- A. Solar energy can be used in agriculture to save money by cutting a farm's electricity and heating bills and reduce pollution.
 - 1. Solar panels (photovoltaic cells) provide power for farm operations such as remote electric fences, gate openers, water pumps, lights, and water tank de-icers.
 - 2. Solar greenhouses collect and store solar energy as heat.
 - 3. Solar heat collectors warm livestock buildings and greenhouses.
- SE1. Solar energy can be used in agriculture to save money by cutting a farm's electricity and heating bills and reduce pollution.

Examples of agricultural uses of solar energy include:

- SE2. Solar panels (photovoltaic cells) provide power for farm operations such as remote electric fences, gate openers, water pumps, lights, and water tank deicers.
 - 2. Solar greenhouses
- SE3. Solar greenhouses collect and store solar energy as heat.
 - 3. Solar heat collectors
- SE4. Solar heat collectors warm livestock buildings and greenhouses.



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Solar, Wind or Biomass: Who Will Be the Next Alternative Energy Star for Agriculture?

B. Wind energy among the cows and crops, farmers have a new income as huge towers with propellers turn and change the energy from the wind into electricity.

1. Wind turbines allow farmers to collect land use fees from electric companies and still use the land for agricultural purposes.
2. Windmills pump water for animal drinking tanks.

WE1. Among the cows and crops, farmers have a new income as huge towers with propellers turn and change the energy from the wind into electricity. Farmers collect land use fees from electric companies and still use the land for agricultural purposes.

Examples of wind energy used in agriculture include:

1. Wind turbines
 2. Windmills
- WE2. Windmills to pump water for animal drinking tanks.
- C. Biomass (plants and organic waste) produced from plants and organic wastes: When crops such as cotton, rice, peanuts, and sugar cane are harvested, there are large amounts of waste material that are left behind. Items such as crop residue and effluent from confined animal feeding operations (CAFO) can be used for fuel. Small biomass energy projects can provide many needed benefits in rural areas that are involved in agriculture. Example: a biomass generator that uses manure as its energy source is installed on a feedlot. This would solve the feedlot's problem of manure disposal, reduce odors, and provide jobs for the community.
1. **Ethanol** – an alternative fuel; a liquid alcohol fuel with vapor heavier than air; produced from agricultural products such as corn, grain, sorghum, and sugar cane
 2. **Biodiesel** – a fuel that is similar to diesel fuel and is derived from vegetable sources such as soybeans
 3. **Methane** – an odorless gas produced by the decomposition of organic matter from bio-waste (human, plant, or animal material) such as pig manure. Anaerobic bacteria break down the waste giving off **methane** in a **methane** digester. Sludge from the **methane** digester is used for fertilizer.

Biomass

1. **Ethanol** – an alternative fuel; a liquid alcohol fuel with vapor heavier than air; produced from agricultural products such as corn, grain, and sugar cane

BE1. Biomass energy is produced from plants and organic wastes: When crops like cotton, rice, peanuts, and sugar cane are harvested, there are large amounts of waste material that are left behind. Items such as crop wastes, manure from feedlots and dairies, and stalks are left behind. All of these items can be used for fuel.

BE2. Corn is currently the top biomass energy crop (56 pounds yields about 2.5 U.S. gallons of **ethanol**) but switch grass (1 ton of switch grass = about 75-100 U.S. gallons of **ethanol**) and fast-growing trees (willow and poplar) are also important sources.

Examples of biomass energy used in agriculture include:

- BE3. Biomass can be converted into fuels, such as **ethanol**, to power cars or make electricity to heat the dairy barn or family home.
- BE4. Residue from producing **ethanol** is used as a feed that increases feed efficiency for livestock by 15-30%.
2. **Biodiesel** – a fuel that is similar to diesel fuel and is derived from vegetable sources such as soybeans
- BE5. **Biodiesel** can also be created from canola oils.
3. **Methane** – an odorless gas produced by the decomposition of organic matter
- BE6. **Methane** is produced from bio-waste (human, plant or animal material) such as pig manure.
- BE7. Anaerobic bacteria break down the waste (such as pig manure) giving off **methane** in a **methane** digester. Sludge from the **methane** digester is used for fertilizer.
- BE8. Farmers can use **methane** digesters to dispose of livestock wastes and produce heat for the production of alcohol from grain.
- BE9. Small biomass energy projects can provide many needed benefits in rural areas that are involved in agriculture. Example: a biomass generator that uses manure as its energy source is installed on a feedlot. This would solve the feedlot's problem of manure disposal, reduce odors, and provide jobs for the community.



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What questions do you have about the facts?

Allow students to ask any questions they have for clarification.

Great job getting those facts on your notes page! Now consider, just as the United States has met the challenge to be innovative and create multiple methods to cope with our diminishing fossil fuel resources, we must also think in innovative ways as agriculture students and search out innovative SAEs. When considering your SAE, be open to opportunities and look in innovative places that you may not have considered to create a new SAE or to expand the scope of a current SAE.

This is an opportunity to discuss examples of innovative SAE with your students, such as making **biodiesel**. Encourage students to take their SAE to another level and challenge them to see how they can make their SAE more innovative.

Wow, an SAE that focuses on alternative energy sure is a great idea! We all are looking forward to seeing what results from this SAE opportunity. Today we have learned how alternative energy can be used in the agricultural industry and have some good examples. Now it is time to put that information to use. Continue to be focused, curious, and creative as we take the next step and use these facts to create and present them in the form of a weather report.

Review/Summary

The Meteorologist e-Moment helps students break down and summarize the information by creating a short "weather forecast" using today's lesson. The class will brainstorm about the characteristics of a weather report (temperature highs and lows, cold fronts, low pressure areas, high pressure areas, winds, overcast, precipitation, humidity, rain, snow, regions, Doppler radar, and phrases such as "by mid-day we will expect ...," "we will have partly cloudy skies this morning followed by a 30% chance for scattered showers in the evening," etc.).

You will then instruct each group to write a 30-second "weather report" about the uses of alternative energy in agriculture. The students will practice their "weather report" and share the reports with the class. It can be helpful if you write an example weather report and model it for the class before they create their own weather reports.

Example: Good morning! Our weather report has great news on the alternative farm power issue this morning. There is a cold front rapidly approaching from the west so all those wind turbines out there on the wind farms will be cranking out lots more energy as the winds increase to 10 miles per hour on the leading edge of the front. Further to the south, partly cloudy skies will be causing a lack of power generation as solar panels produce at minimum levels due to a lack of sunlight.

We have seen weather reports on television or heard weather reports on the radio. The weather reporters have a short amount of time to convey a lot of important information. Today, we are going to take on the role of a weatherperson. What weather terms would you hear a weatherperson say?

Allow responses. Write the suggestions on the board. Discuss the way a weather report is conducted and model some of the terminology in a sharp, crisp "forecaster" fashion for the students. Each group will then create their "weather forecast" using the information from today's lesson.

Wow, we are starting to sound like weathercasters. Now that we have a good list of weather terms, let's think about how the important information we considered earlier could be put into a weather report. When I say GO, we will break into our predetermined teams to develop a 30-second to one-minute weather report that combines the information about agriculture's use of alternative energy with the weather terms. Then, we will share our weather reports with the rest of the class. What questions are there? GO

Allow students to get in their groups.

OK, let's go over our directions one more time to be sure that we understand our task. Who will remind us what we need to do to create our weather reports?

Allow volunteers to respond and clarify any misunderstood instructions.

Awesome! We are almost ready to start reporting. When I say REPORT, we will take about five minutes to create and rehearse our weather reports. All members of the group should be prepared to present the weather report to the class. What questions are there before we get started? Okay, REPORT!



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Circulate around the room to assist students in putting together weather reports. Additionally, the instructor should monitor time to adjust for allowing more or less time as necessary for groups to prepare and rehearse. Then choose a member from each group to present their "weather reports" to the class.

As I was walking through the room, I heard some awesome weather reports developing! Let's show what we have created. In a moment, we will hear each group's weather report. Listen, as each report is given, for connections made between the alternative fuel content and the weather terms. Think about the relationships between the items on your handout. Let's have our first group present!

Allow time for each group to present. Show appreciation through applause after each person presents.

Wow! Those were some amazing weather reports! You have truly shown in a creative way that you know how agriculture uses alternative energy. This information will be very important as we continue our exploration of alternative energy tomorrow when we search for what the future holds for the use of alternative energy. Come to class tomorrow as eager learners ready to look into the future!

Application

Extended classroom activity:

Groups will research, design, and build their own alternative energy generating system.

FFA activity:

Invite a representative from the electric company to talk about fuel sources in the area and possible careers in the energy industry.

SAE activity:

Do a home, farm, or community improvement project by researching and installing an alternative energy system to reduce energy costs for a Home and Community Development or Agricultural Energy Systems SAE.

Evaluation

MS.NR.6.2.ASSESS.A

Answers to Evaluation

1. A
2. (in no particular order – require only one example but all possible are listed)
 - A. solar energy – solar greenhouses, solar heaters, or electricity from solar panels
 - B. wind energy – wind turbines to generate electricity or windmills to pump water
 - C. biomass – any explanation that uses crops, wastes, or wood to produce alcohols, **methane**, or biodiesel



Alternative Energy Sources Used In Agriculture

Solar Energy

- SE1.** Solar energy can be used in agriculture to save money by cutting a farm's electricity and heating bills and reduce pollution.

Examples of agricultural uses of solar energy include:

- SE2.** Solar panels (photovoltaic cells) provide power for farm operations such as remote electric fences, gate openers, water pumps, lights, and water tank de-icers.
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Wind Energy

- WE1.** Among the cows and crops, farmers have a new income as huge towers with propellers turn and change the energy from the wind into electricity. Farmers collect land use fees from electric companies and still use the land for agricultural purposes.

Examples of wind energy used in agriculture include:

- WE2.** Windmills to pump water for animal drinking tanks.

Biomass

- BE1.** Biomass energy is produced from plants and organic wastes: When crops like cotton, rice, peanuts, and sugar cane are harvested, there are large amounts of waste material that are left behind. Items such as crop residue and effluent from confined animal feeding operations (CAFO) are left behind. All of these items can be used for fuel.
- BE2.** Corn is currently the top biomass energy crop (56 pounds yields about 2.5 U.S. gallons of ethanol) but switch grass (1 ton of switch grass = about 75-100 U.S. gallons of ethanol) and fast-growing trees (willow and poplar) are also important sources.

Examples of biomass energy used in agriculture include:

- BE6.** Another form of energy from biomass is the production of methane from bio-waste (human, plant, or animal material) such as pig manure.
- BE7.** Anaerobic bacteria break down the waste (such as pig manure) giving off methane in a methane digester. Sludge from the methane digester is used for fertilizer.
- BE8.** Farmers can use methane digesters to dispose of livestock wastes and produce heat for the production of alcohol from grain.
- BE9.** Small biomass energy projects can provide many needed benefits in rural areas that are involved in agriculture. Example: a biomass generator that uses manure as its energy source is installed on a feedlot. This would solve the feedlot's problem of manure disposal, reduce odors, and provide jobs for the community.



Alternative Energy Sources Used In Agriculture

Solar Energy

SE1. _____

Examples of agricultural uses of solar energy include:

SE2. _____

SE3. _____

SE4. _____

Wind Energy

WE1. _____

Examples of wind energy used in agriculture include:

WE2. _____

Biomass

BE1. _____

BE2. _____

Examples of biomass energy used in agriculture include:

BE3. _____

BE4. _____

BE5. _____

BE6. _____

BE7. _____

BE8. _____

BE9. _____



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Name _____

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

1. _____ Farmers can grow crops which can be used for energy.

- A. True
- B. False

2. List three forms of alternative energy used by agriculture and include an example of each.

- A. _____
- B. _____
- C. _____