



Plants in Your Gas Tank... Farmers Fueling Our Future!

Middle School Food and Agricultural Literacy Curriculum

Precepts

- D. Character
- D4. Respect others

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.01.04.04.c. Demonstrate respect for others.
- NL-ENG.K-12.3 – Evaluation Strategies
- 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 ...
- Explore agriculture's role in the production of alternative energy.

Content Outline

Objective 1. Explore agriculture's role in the production of alternative energy.

- I. **Alternative energy sources produced by agriculture**
 - A. Wind Energy
 - B. Biofuel – a fuel composed of or produced from biological raw materials.
 - 1. Biodiesel
 - 2. Ethanol
 - 3. Methane

Time

Instruction time for this lesson: 45 minutes.

Resources

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. — 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 — 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 — U.S. Department of Energy. (2009). Energy Sources Wind. Retrieved July 25, 2009, from <http://www.energy.gov/energysources/wind.htm> — 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

Piece of fruit
Overhead projector/transparencies
MS.NR.6.4.AS.A – Cut out and ready to be taped on students' backs
MS.NR.6.4.AS.B – one per student
MS.NR.6.4.TM.A– one per teacher
MS.NR.6.4.TM.B– one per teacher Tape
Self-adhesive chart paper or large roll paper – one per group
Assorted markers – 4-6 per group
Pencils – one per student
MS.NR.6.4.ASSESS.A – one per student

Key Terms

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

Biofuel



Plants in Your Gas Tank... Farmers Fueling Our Future!

This lesson builds on the students' prior knowledge of alternative energy to allow them to learn how agriculture can contribute to the production of alternative energy. Before class, cut **MS.NR.6.4.AS.A** into strips. Each strip should have one section of information on it designated by one of the numbers 1-20. Also have handout **MS.NR.6.4.AS.B** ready to distribute to each student. You should also have pre-assigned groups of three or four students with at least one strong reader in each group. At the beginning of class, you will walk to the front of the class with a half eaten piece of fruit (apple, banana, etc.) that you have apparently been enjoying very much.

Interest Approach

Thank you for showing up today. Before we start class, I just have to tell you that this fruit is so good but I am so full!

Walk toward the trash pretending to want to throw it away. Hopefully, some of your students will say, "Don't throw it away...I will take it." If they don't, simply turn to the class and ask,

What else could we do with this type of trash besides put it in a landfill?

Allow students to answer. Guide them to suggest using it to produce biomass fuels or biofuels.

Yesterday we learned about how alternative fuels will be a very important fuel source as we move toward the future. Many of the alternative fuel sources we have been discussing come from agricultural sources such as wood, crops, and even manure! Those types of fuels are called **biofuels**. That is important to us because today we will continue our journey to explore alternative fuels as we learn about agriculture's role in the production of alternative energy. Be attentive learners as we begin our explorations today.

Summary of Content and Teaching Strategies

Objective 1. Explore agriculture's role in the production of alternative energy.

I. Alternative energy sources produced by agriculture

- A. Wind Energy
- B. Biofuel – a fuel composed of or produced from biological raw materials.
 - 1. Biodiesel
 - 2. Ethanol
 - 3. Methane

This activity is a type of *Go Get It e-Moment®*. You will randomly distribute the cut strips from the information from **MS.NR.6.4.AS.A** to the students along with a piece of tape. Also, provide students with a copy of **MS.NR.6.4.AS.A** and a pencil. Students will place their strip of paper over their shoulder, on their back, being sure it is not upside down. Students will search the strips on their classmates' backs for the information they need to fill in the blanks on **MS.NR.6.4.AS.B**. When the student has finished filling in all of the blanks, they may go back to their seat, remove the strip from their back, stick the sticker to the front of their desk and fill in the information provided on their own strip onto their worksheet. Putting the strip on the desk allows students who have not gotten all of the information the opportunity to get that information as well. If there are not 20 students in the class, the teacher could also have a strip and/or strips could also be stuck to walls or locations around the room instead of on the students' backs. Also, if there are more than 20 in the class, large pieces of information can be separated into two pieces so that everyone has a strip with information.

We will begin today with an activity that requires us to go get the information that we will need. This activity requires us to be respectful of the needs of everyone in the room. We will be working not only for ourselves but also for our classmates to help everyone get the assignment completed. Just as in life, we will be more successful if we respect others.

We will all be more successful with this assignment if we consider and respect everyone in this classroom. When I say SEARCH, we will pick up the strip of paper and tape on our desks and place it on our backs.

To do this correctly, we will reach over our shoulder and be sure it is right side up because everyone will need to come capture the information to complete the activity sheet. What questions do you have? SEARCH

Allow students to place the strips of paper on their backs.



Lesson Number: MS.NR.6.4

Middle School Food and Agricultural Literacy Curriculum

Plants in Your Gas Tank... Farmers Fueling Our Future!

The activity today will allow us to learn about how agriculture is answering the call for more effective and environmentally friendly alternatives to fossil fuels! We must be informed about these choices so we can become more informed citizens for ourselves, agriculture, and our planet.

Let's be attentive and engaged learners as we put our brains in exploratory mode in order to discover information about the alternative fuels produced by agriculture! OK, now when I say GO, we will have 10 minutes to quietly and quickly go get the information we need to fill out the worksheet.

Remember to be courteous. Everyone should get all of the information. When the worksheet is complete except for one blank, sit down, remove your strip of paper, add that information to the worksheet and place the sticker on the front of your desk for others to use. When seated, read over the information on the worksheet, as we will be using it to complete another assignment. What questions are there? GO

Allow students to move around the room collecting the information. Watch out for students who are speeding around gathering everyone else's information and not allowing others to get the information on his/her sticker.

Wow! That was amazing. Excellent effort collecting all that information! Take a deep breath, turn to someone and say, "Way to go!"

Allow students to respond.

Now that we have the facts, it is important to check and make sure we have captured them correctly. When I say MOVE, we will go quickly and quietly to our pre-assigned groups. Take your completed handout and writing utensil with you. What questions do you have? MOVE

Allow students to move to groups.

We will start reading with the group farthest from the door and move around the room in a clockwise motion. When we get to each group, a volunteer from the group will read the next statement on the handout. Everyone will read along silently and check our information to make sure we have written it correctly. This information will be used in another activity today so it is important that we all listen carefully and understand all of the facts.

Begin with the first group and continue allowing groups around the room to read the information until the entire handout is completed.

Great job, readers! Thanks for your excellent cooperation and listening so intently. We will be using some chart paper and markers for the next phase of our lesson today.

Project **MS.NR.6.4.TM.A**. This activity uses a version of the Cartographer e-Moment to help the students organize and represent the information they have just learned in a visual manner by making a graphic organizer with the information. Help students to ask themselves these questions:

How do the parts of this information relate to one another? Do they cluster around a central theme to branch out in greater detail from major headings?

Students will also be using a Hieroglyphics e-Moment to create a picture or icon for each major type of alternative energy produced by agriculture on their bubble map. Distribute the chart paper and markers to the groups after delivering the directions.

Review/Summary

We've just learned about the opportunities for the agricultural industry to produce alternative energy and how the production of those crops, use of wind turbines, and the use of agricultural byproducts can reduce our dependence on fossil fuels.

Let's continue to be engaged as we build on what we know by putting this information into a graphic organizer, which is simply a helpful way to organize our information visually by creating a map or diagram that represents the relationships among the information.

The chart paper and markers are for a graphic organizer to be completed by the group. The title of your map is "Alternative Energy from Agriculture." This activity requires the group to work together to create a graphic organizer that helps us organize the information and see the connections in a visual manner. The group will use the information on the handouts we completed today to supply the information for the organizers. Projected is an example of how the group could start their graphic organizer.

Explain **MS.NR.6.4.TM.A**



Lesson Number: MS.NR.6.4

Middle School Food and Agricultural Literacy Curriculum

Plants in Your Gas Tank... Farmers Fueling Our Future!

There are many possible correct combinations. This is just an example to get us started. Pay close attention so that we will use the circles connecting to our center circle for the main concepts and the circles that connect to them should have the main information that pertains to each of those concepts. Show a thumb up if you understand how to create a this type of map, a thumb horizontal if you are not sure, and a thumb down if you are totally confused.

Check for understanding. If this is a new concept, there may be some students who need more clarification. Having a simple bubble map of some topic the students are familiar with to display before starting. This activity is a good strategy for students who have not used graphic organizers before.

Now that we understand how the bubble map is going to be constructed, we need to learn the process we will follow to create the map. When I say WRITE, the groups will have five minutes to complete this phase of the activity. Beginning with the student farthest from the door, that person will quickly draw a connecting circle and write a word or phrase that fits the topic in the circle. Pass the paper to the team member on the left. The paper will continue to go around and around the group until time is called or all of the information on the handout has been included. If you understand these instructions, please raise your hand.

Call on a student with their hand up to repeat the directions. Check for understanding.

Excellent! What questions do you have? WRITE

Circulate among the groups to encourage and clarify questions.

Wow! We certainly are some creative thinkers. Those are some incredible graphic organizers! Turn to somebody and say, "Great work!" Let's continue to be creative as we create a symbol to represent the main concepts of our organizer. What pictures or icons will help you remember these parts of the information?

Allow students to respond. Project **MS.NR.6.4.TM.B** as an example and have a couple of students with good examples come up to the board and draw their symbol.

Thanks for those super examples! Now when I say DRAW, each group will have three minutes to sketch the symbols that will help you remember the main concepts represented in the group's organizer. What questions do you have? DRAW

Allow the teams to draw their symbols. Circulate among the groups to ensure understanding and encourage students.

Amazing symbols! What great representations of agriculture's contributions to producing alternative fuels. Let's listen carefully for the information as each team shares their graphic organizers and symbols with the class.

Allow teams to share. Celebrate their success with applause.

Great job, teams. Way to go! We learned all of the options agriculture has for providing alternative energy for our nation. This will be especially important tomorrow as we apply math concepts to alternative energy sources. Thanks for your creative work today. Come to class tomorrow with sharp pencils and good attitudes as we crave to learn more about alternative energy.



Lesson Number: MS.NR.6.4

Middle School Food and Agricultural Literacy Curriculum

**Plants in Your Gas Tank...
Farmers Fueling Our Future!**

Application

Extended classroom activity:

1. Tour a farm that produces crops used for alternative fuels.
2. Students can further research the benefits and limitations of renewable alternative energy sources at the U.S. Department of Energy's Energy Efficiency and Renewable Energy Network site. This site lays out the different types of renewable energy in a short but succinct style that will appeal to many students. An alternative would be to use a search engine such as www.google.com or www.ping.com and research the topic on their own.
3. Draw a map of a farm that produces all of the alternative energy sources taught in this lesson.

FFA activity:

Invite a university expert on biofuel or a farmer who grows crops used for biofuel to present to a FFA meeting about their job and career possibilities in the alternative fuels area.

SAE activity:

Research new crops used for producing biofuel and grow some of them for a specialty crop or oil crop SAE.

Evaluation

MS.NR.6.4.ASSESS.A

Answers to Evaluation

1. B
2. D
3. C
4. B
5. B



Alternative Energy from Agriculture

1. Renewable energy and agriculture are a winning combination. Wind, solar, and biomass energy can be harvested forever, providing farmers with a long-term source of income.

Farming the Wind

2. Wind energy alone could provide \$1.2 billion in new income for farmers and rural landowners by 2020, as well as 80,000 new jobs.
3. Farmers can benefit from wind energy in many ways, including generating their own power, leasing land to wind developers, and becoming wind developers themselves.
4. One wind turbine uses only one-quarter acre of land, including access roads, so farmers can continue to plant crops and graze livestock right up to the base of the turbines and can earn royalties up to \$2,000 per year.
5. Until recently, wind power was concentrated in California. Now it can be found in most states. Farming regions in the Midwest, Great Plains, and West have emerged as major growth areas.
6. Net metering allows farmers to get the most out of their wind turbines. When a turbine produces more power than the farm needs at that moment, the extra power flows back into the electrical system for others to use and the farmer is paid by the electric company.
7. A farmer or group of farmers can become a wind developer who produces power to sell to others. Electric companies increasingly buy their power from independent power producers rather than generating it themselves.

Biodiesel

8. Biodiesel is an alternative fuel that can be made from any vegetable oils, animal fats, or greases. It can be used in any diesel engine with few or no modifications.
9. Biodiesel delivers similar torque, horsepower and miles per gallon. Biodiesel is safe, biodegradable, and reduces the emissions of most air pollutants.
10. Pacific Biodiesel produces biodiesel from used restaurant fryer oil. One of the main components for fryer oil is soybeans, a major crop produced by almost 400,000 farmers in 29 states.



Alternative Energy from Agriculture

Ethanol

11. Ethanol is an alcohol fuel made from the sugars found in grains, such as corn, sorghum, and wheat, as well as potato skins, rice, sugar cane, sugar beets, and yard clippings. Corn is the major crop for ethanol in the U.S.; however, sugar cane and sugar beets are the most common ingredients for ethanol in other parts of the world.
12. Since alcohol is created by fermenting sugar, sugar crops are the easiest ingredients to convert into ethanol.
13. Scientists are working on cheaper ways to make ethanol by using all parts of plants and trees.
14. Farmers are experimenting with “woody crops,” mostly small poplar trees and switchgrass, to see if they can grow them cheaply and abundantly for methanol production.
15. Someday, you may find yourself driving by huge farms that are not producing food or animal feed, but feedstock for ethanol. Feedstock is the raw material used to make a product.
16. Switchgrass produces high yields and can be harvested annually for several years before replanting. Some fast-growing trees make excellent energy crops, since they grow back repeatedly after being cut off close to the ground.

Methane

17. Many farmers used to burn or plow under farm wastes when crops like cotton, rice, peanuts, and sugar cane are harvested. The advent of new technologies that convert biomass material from plants or animals into valuable energy (fuel) may give farmers and ranchers moneymaking alternatives to such practices.
18. Small biomass energy projects can provide many needed benefits in rural areas that are involved in agriculture. For example, a biomass generator could be installed on a feedlot or dairy that uses manure as its energy source. This would solve the feedlot's problem of manure disposal, reduce odors, and provide jobs for the community.
19. Methane is created through a process called anaerobic digestion. This is the process through which waste (such as leaves, manure, etc.) is broken down in an oxygen-free environment by bacteria. The bacteria give off the greenhouse gases, methane, and carbon dioxide, as a consequence. The methane biogas can then be burned to produce renewable energy in the form of electrical and thermal energy. Some dairy farmers collect biogas from tanks called “digesters” where they put all of the muck and manure from their barns. Digesters convert the manure to methane.
20. On June 2, 2009, Stahlbush Island Farms, a prominent vegetable canner, unveiled their very own Biogas Plant that converts vegetable waste into electrical and thermal energy. The BioGas plant utilizes anaerobic digestion to capture methane and other greenhouse gases. The methane biogas produced is then converted into green energy and used to power the farm. In the event that Stahlbush Island Farms creates more renewable energy than is needed, it is sold back to the grid.



Alternative Energy from Agriculture

1. Renewable energy and agriculture are a winning combination. _____, _____, and _____ energy can be harvested forever, providing farmers with a long-term source of income.

Farming the Wind

2. Wind energy alone could provide \$1.2 billion in new income for _____ and _____ by 2020, as well as 80,000 new jobs.
3. Farmers can benefit from wind energy in many ways, including _____ their own power, _____ land to wind developers, and becoming wind _____ themselves.
4. One _____ uses only _____ acre of land, including access roads, so farmers can continue to plant crops and graze livestock right up to the base of the turbines and can earn royalties up to \$2,000 per year.
5. Until recently, wind power was concentrated in California. Now it can be found in _____. Farming regions in the Midwest, Great Plains, and West have emerged as major growth areas.
6. Net metering allows farmers to get the most out of their _____. When a turbine produces more power than the farm needs at that moment, the extra power flows _____ into the electricity system for others to use and the farmer is _____ by the electric company.
7. A _____ or group of farmers can become a wind developer who produces power to _____ to others. Electric companies increasingly buy their power from independent power producers rather than generating it themselves

Biodiesel

8. Biodiesel is an alternative fuel that can be made from any _____, _____, or _____. It can be used in any diesel engine with few or _____ modifications.
9. Biodiesel delivers similar torque, horsepower, and _____ per gallon. Biodiesel is _____, biodegradable, and reduces the emissions of most air pollutants.
10. Pacific Biodiesel produces biodiesel from used restaurant _____. One of the main components for fryer oil is _____, a major crop produced by almost 400,000 farmers in 29 states.



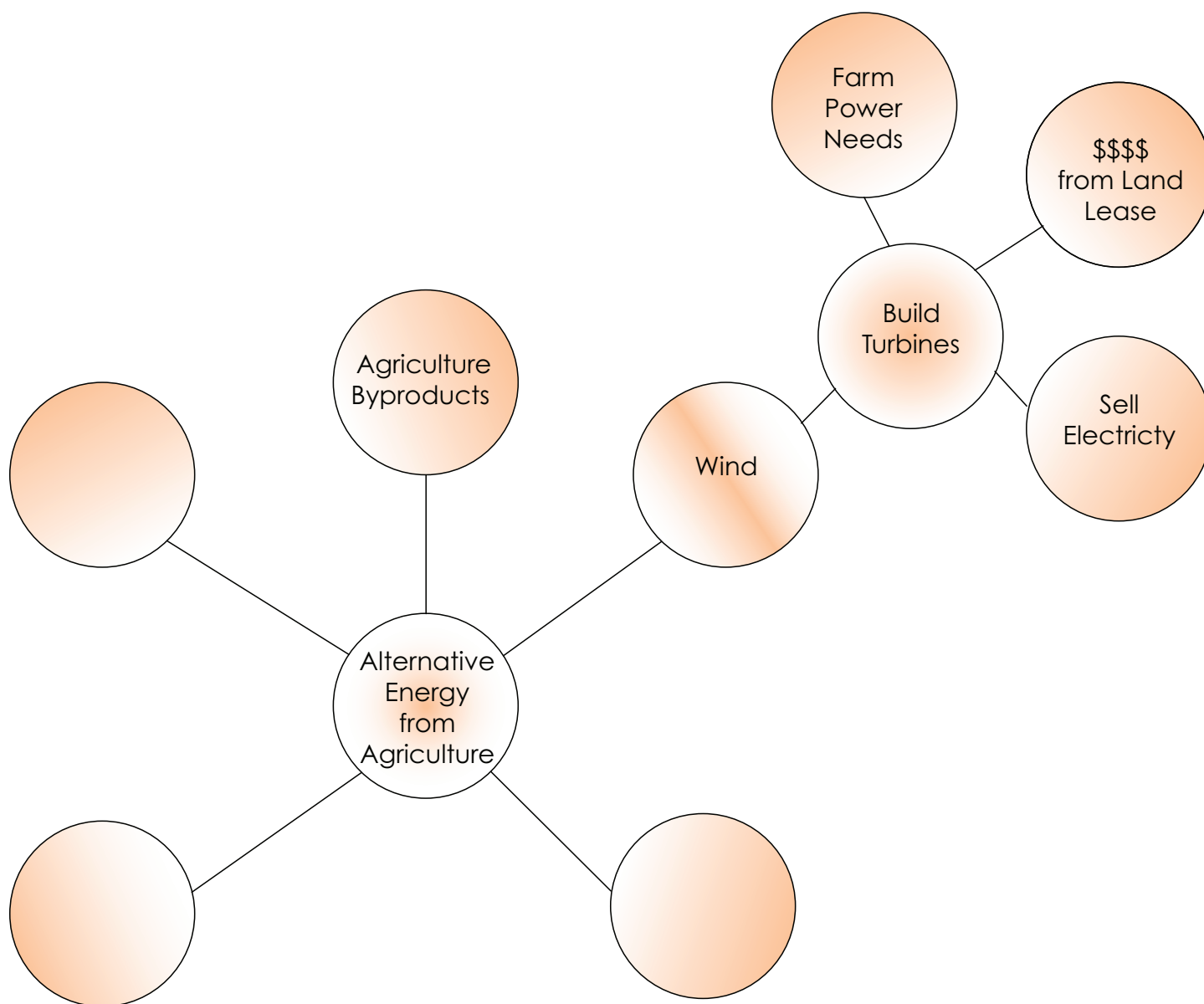
Alternative Energy from Agriculture

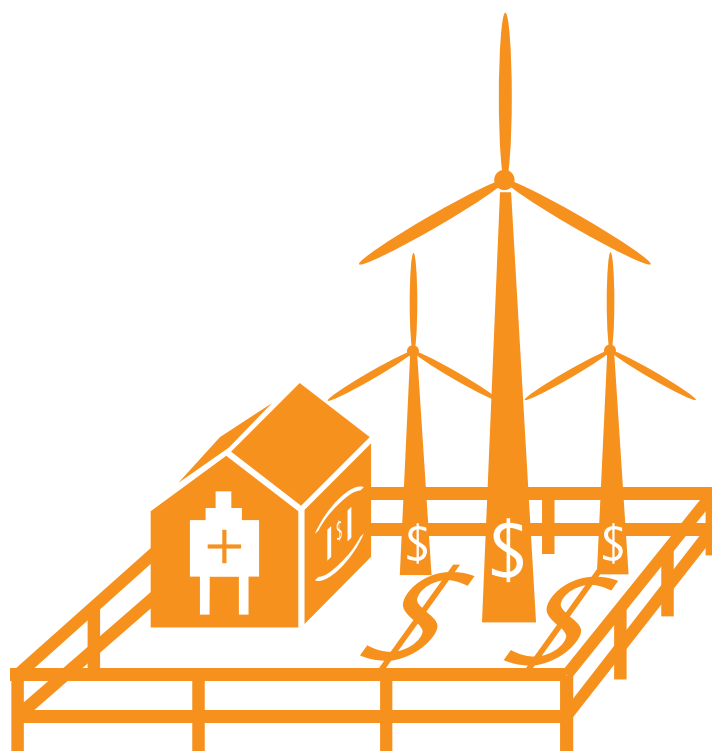
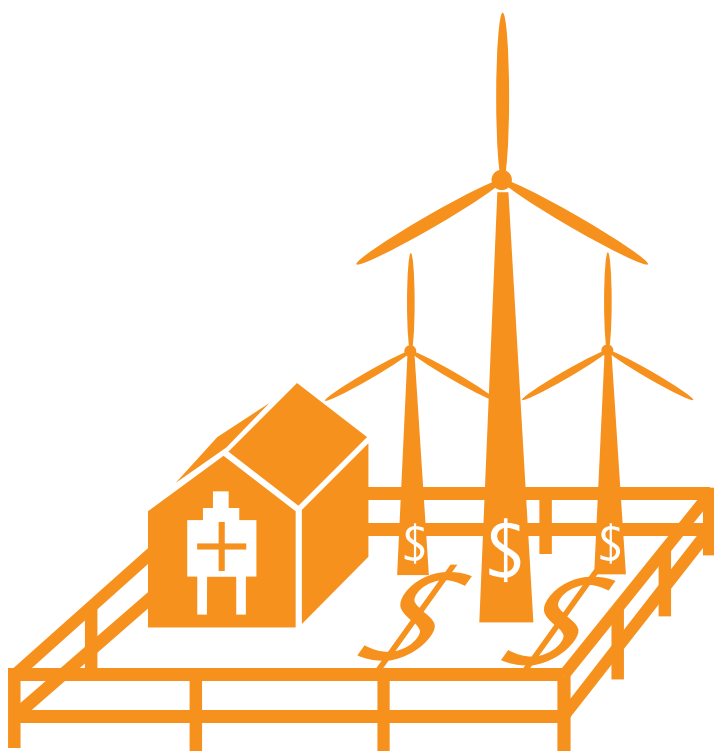
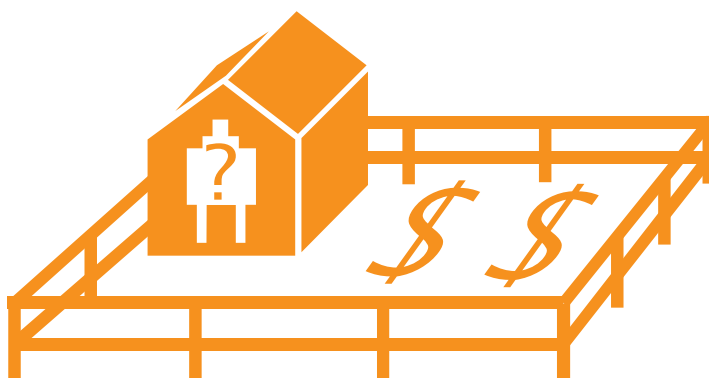
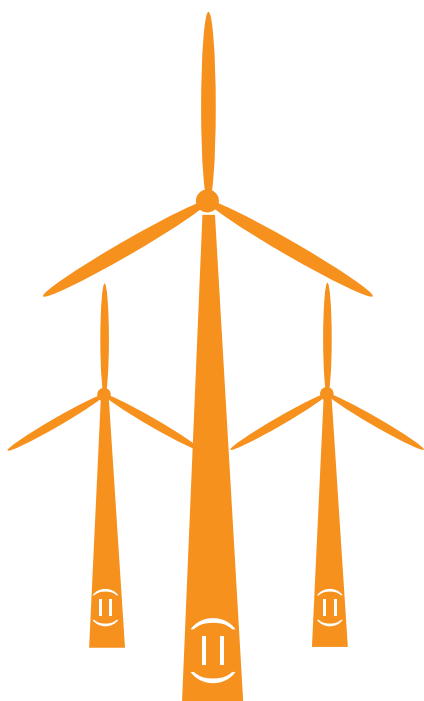
Ethanol

11. Ethanol is an alcohol fuel made from the _____ found in grains, such as corn, sorghum, and wheat, as well as potato skins, rice, sugar cane, sugar beets, and yard clippings. _____ is the major crop for ethanol in the U.S.; however, sugar cane and sugar beets are the most common ingredients for ethanol in other parts of the world.
12. Since alcohol is created by fermenting sugar, _____ crops are the easiest ingredients to convert into _____.
13. Scientists are working on cheaper ways to make ethanol by using _____ of plants and trees.
14. Farmers are experimenting with “woody crops,” mostly small poplar _____ and _____, to see if they can grow them cheaply and abundantly.
15. Someday, you may find yourself driving by huge farms that are not producing food or animal feed, but feedstock for _____. Feedstock is the raw material used to make a product.
16. Switchgrass produces high yields and can be harvested annually for several years before _____. Some fast-growing trees make excellent energy crops, since they _____ back repeatedly after being cut off close to the ground.

Methane

17. Many farmers used to _____ or _____ farm wastes when crops like cotton, rice, peanuts, and sugar cane are harvested. The advent of new technologies that convert biomass material from plants or animals into valuable energy (fuel) may give farmers and ranchers _____ alternatives to such practices.
18. Small biomass energy projects can provide many needed benefits in rural areas that are involved in agriculture. For example, a _____ could be installed on a feedlot or dairy that uses manure as its energy source. This would solve the feedlot’s problem of _____, reduce odors, and provide jobs for the community.
19. Methane is created through a process called _____. This is the process through which waste (such as leaves, manure, etc.) is broken down in an oxygen-free environment by bacteria. The bacteria give off the greenhouse gases, methane, and carbon dioxide, as a consequence. The methane biogas can then be burned to produce renewable energy in the form of electrical and thermal energy. Some dairy farmers collect biogas from tanks called _____ where they put all of the muck and manure from their barns. Digesters convert the _____ to _____.
20. On June 2, 2009, Stahlbush Island Farms, a prominent vegetable canner, unveiled their very own Biogas Plant that converts _____ into electrical and thermal energy. The BioGas plant utilizes anaerobic digestion to capture methane and other greenhouse gases. The methane biogas produced is then converted into green _____ and used to power the farm. In the event that Stahlbush Island Farms creates more renewable energy than is needed, it is sold back to the grid.







Name _____

Directions: Read each statement and decide which statement best completes the sentence.

1. **Renewable energy and agriculture are a winning combination. _____, solar, and biomass energy can be harvested forever, providing farmers with a long-term source of income.**
 - A. Ice
 - B. Wind
 - C. Rain
 - D. Cloud
2. **Farmers can benefit from wind energy in many ways, including generating their own power, _____ land to wind developers, and becoming wind developers themselves.**
 - A. loaning
 - B. selling
 - C. giving
 - D. leasing
3. **_____ is an alternative fuel that can be made from any vegetable oils, animal fats, or greases. It can be used in any diesel engine with few or no modifications.**
 - A. gasohol
 - B. methane
 - C. biodiesel
 - D. ethanol
4. **_____ is the major crop for ethanol in the U.S.; however, sugar cane and sugar beets are the most common ingredients for ethanol in other parts of the world.**
 - A. Soybeans
 - B. Corn
 - C. Trees
 - D. Sunflowers
5. **_____ is created through a process called anaerobic digestion. This is the process through which waste (such as leaves, manure, etc.) is broken down in an oxygen-free environment by bacteria.**
 - A. gasohol
 - B. methane
 - C. biodiesel
 - D. ethanol