

Biomass: The Energy of the Future

Objective

Students will learn about biomass, biofuels, and biogas.

Background

Biomass is any organic material made from plants or animals. Biomass contains stored energy from the sun. Plants absorb the sun's energy in a process called "photosynthesis." The chemical energy in plants gets passed on to animals and people that eat them. Unlike fossil fuel, it is a renewable energy source.

Domestic biomass resources include:

- Agricultural residues—leftover material from crops, such as the stalks, leaves, and husks of corn plants
- Forestry wastes—chips and sawdust from lumber mills, dead trees, and tree branches
- Municipal solid waste—household garbage and paper products
- Food processing and other industrial wastes—black liquor, a paper manufacturing by-product
- energy crops—fast-growing trees and grasses developed just for this purpose

Biofuels are fuels derived from biomass. One such fuel is ethanol.

Many agricultural products, through current technology, can be converted to ethanol. Agricultural products specifically grown for conversion to biofuels include corn, wheat, and soybeans. The conversion of non-grain crops to biofuels is also being researched. One non-grain crop being researched is switchgrass, a perennial grass that grows in abundance all across Oklahoma.

Biogas is any gas derived from biomass. Syngas is one type of biogas. It involves heating biomass with little to no oxygen present. Syngas may be burned in gas turbines to make electricity or mixed with chemical catalysts to make liquid fuels.

Biofuels produce the greenhouse gas carbon dioxide, just like fossil fuels. The difference is that the plants used in the production of biofuels remove carbon from the atmosphere as they grow. For this reason, if biofuel replaces fossil fuel, it reduces the net amount of carbon released to the atmosphere.

Background sources: Cleaner Energy Partnership; US Department of Energy; USDA Agricultural Research Service

Oklahoma Academic Standards

GRADE 6

Speaking and Listening:
R.1,2,3; W.1,2. Vocabulary:
R.1,3

Social Studies Content:
1.2,3,4,5; 2.1C; 5.2A, 5D

GRADE 7

Speaking and Listening:
R.1,2,3; W.1,2. Vocabulary:
R.1,3

Social Studies Content:
1.2,3,4,5

Vocabulary

biofuel—fuel made from living organisms

biogas—gas made from living organisms

biomass—any organic material made from plants and/or animals
domestic—made or produced in the home country

energy—usable power (as heat or electricity)

ethanol—a colorless, limpid, volatile, flammable, water-miscible liquid produced by the fermentation of sugars from certain grains and grasses

organic—of, relating to, or obtained from living things

photosynthesis—the formation of carbohydrates in living plants from water and carbon dioxide, by the action of sunlight on the chlorophyll

renewable—replanted and grown for a usable supply

residue—that which is left after part is taken away

Activities

1. Read and discuss the background information and vocabulary.
—Students will discuss their own knowledge about new fuel technologies.
—Students will discuss personal experiences with electric or hybrid cars, burning wood for heat or cooking, and other experiences with alternative fuels.
2. Read the story included with this lesson, or have a student read the story to the class.
—Discuss the different uses for biogas presented in the story.
3. Hand out the “Worksheet for Biomass Research.”
—Each student will select one of the areas for research listed on the worksheet.
—Review “How Reliable Are Your Sources?” in the “Resources” section.
—Students will conduct research in the area selected.
—As students complete their research, they will enter the information onto the worksheet.
4. Students will present their gathered information to the class.
—As students listen to the presentations, they will enter the new information from other categories on their own worksheets.
5. Students will discuss the likelihood that any of the different biomass sources might become usable fuels in the next 5-10 years.
—Students will share their own opinions of the different biomass sources.
—Students will discuss potential long range problems or concerns for each biomass source.
—Survey students to find which biomass source is most favorable.
6. Each student will write an advertisement promoting the biomass source researched.

Extra Reading

Armentrout, David, *Biofuels*, Rourke, 2010.

Horn, Geoffrey, *Biofuels* (energy Today), Chelsea Clubhouse, 2010.

Povey, Karen D., *Biofuels—Our Environment*, KidHaven, 2007.

A Biogas Story

Leah lives on a farm with her mother and father. They raise corn on their farm to feed their pigs. every morning and evening Leah helps her father and mother feed the pigs.

The pigs are extremely important to the family's livelihood. On Saturday, they pick out the biggest pig and butcher it. On Sunday, they go to the outdoor market in the village to sell the meat. They also buy things they need.

Leah's family lives on a farm in the country. There is no electricity in her house, but it has lights and a stove. The house is run on biogas. Leah's family makes the biogas on their farm.

every day, Leah and her parents gather corn stalks from the fields and corn cobs that the pigs don't eat.

They collect manure from the pig pens. They also save their own waste.

There is a large container in the back yard. All the waste is put into the container. The family is careful not to let in any air.

As the waste decays, it produces biogas. The biogas flows through a pipe into Leah's house. It supplies fuel for the lights. It also supplies fuel for the stove, which Leah's mother uses to cook food and keep the house warm. The biogas is clean and doesn't make any smoke.

Leah's father empties the container when the waste has decayed. The waste (residue) that is left makes a good fertilizer, which he spreads on his fields.

The corn grows tall to feed the pigs.

This story was modified from "The Energy Exchange," The NEED Project, March 2006.

Name _____

Worksheet for Biomass Research

BIOMASS	RESEARCH FACTS	CURRENT AVAILABILITY	ADVANTAGES OF USE	PROBLEMS WITH USE
Wood—forestry wastes				
Crops—corn, sorghum, wheat				
Woody crops—small poplar trees				
Perennial grasses—Switchgrass, Bermuda grass, bahia grass, napier grass				
Agricultural residues from crops				
Municipal waste—garbage				
Landfill gas				