

Bioproducts

This bioenergy education curriculum was created through Ohio's 4-H Cloverbud program and the Ohio BioProducts Innovation Center (OBIC) to inform and educate future consumers and supporters of bio-based energy and its products. The curriculum was developed with support from the Northeast Regional Sun Grant Initiative, with a grant from the U.S. Department of Transportation: US DOT Assistance #DTOS59-07-G-00052.

The material consists of three bioenergy curriculum pieces in the content areas of 1) bioenergy sources, 2) bioenergy conversion, and 3) bioproducts. Each curriculum piece contains about nine educational activities.

Ohio State University Extension's 4-H Cloverbud program is designed to meet the developmentally appropriate needs of children ages 5 to 8, or in kindergarten through the second grade. However, this curriculum is **recommended for youth through fifth grade**. The Cloverbud youth development program emphasizes overall well-being by empowering young children with successful learning and positive social interaction through cooperative learning in non-competitive environments.

OBJECTIVES

- Becomes familiar with bioproducts
- Develops an interest in new bioproducts
- Fosters a responsible and caring attitude toward the utilization of bio-based products
- Develops an understanding that plants are a part of the bioenergy cycle and are used in the manufacturing of bioproducts

GROUP SIZE

6 to 8 children per adult volunteer

LIFE SKILL AREAS

- Develops social skills and decision making skills
- Enhances large motor skills
- Develops learning-to-learn skills
- Enhances eye-hand coordination and fine motor skills
- Builds self-confidence
- Improves the ability to make hypotheses about activity outcomes

VOLUNTEER TIPS

- Complete the first "Getting Started" activity for introductory purposes, and then choose one of the activities from each section.
- Create a fun, engaging atmosphere using pictures and video clips related to the activities.
- The length of time given to complete each activity is an estimate. Set a relaxed pace while completing each activity, allowing time for creativity and experimentation.
- For each section, choose a balance of activities, including movement, sitting down, and problem solving so that children are engaged in a variety of learning settings.
- Encourage children to make predictions or hypotheses (educated guesses) about what will happen as they complete the activities.

TIME FRAME

This lesson is designed for a group meeting between 30 and 60 minutes. Each activity takes 5 to 15 minutes to complete.

BACKGROUND

Bioproducts are supplies, energy, and chemicals derived from renewable bioenergy sources. Examples of these sources include soybeans, corn oil, animal waste, and sugar cane. Bioproducts come in many forms, from building materials to cleaning products to biodegradable plastics to fuels. Bioproducts derived from bioenergy sources can replace fuels, chemicals, and plastics currently made with petroleum.

NATIONAL SCIENCE STANDARDS

- Interdependence of organisms
- Organisms and environments
- Ability to do scientific inquiry
- Understand scientific inquiry
- Types of resources

SUCCESS INDICATORS

- Identifies a variety of bioproducts
- Learns the differences between bio-based and petroleum-based products
- Understands environmental sustainability



LEARNING ACTIVITIES

1. Getting Started

ACTIVITY “Guess the Bioenergy Product”

Materials: Bioenergy Elements Chart (included at the end of this activity) and scissors.

Print the Bioenergy Elements Chart. Cut out only the pictures (not the names or descriptor) from the bioproducts column. If possible, gather bioproducts (plastics, insulation, biofuel in safe container, etc.) in your area. Ask the group to look at the pictures or investigate the bioproducts. Ask for ideas about how they are used. [They're used for fuel, heating, cooking, or other purposes.]



Note to the volunteer: Collect and save pictures for use in 4. Bringing Closure, “Fueling Our Future with Bioenergy: Putting It All Together,” if completed. If you need additional images of bioproducts, conduct a Google image search for terms such as *bioenergy*, *bioproducts*, *biofuels*, and *bioplastics*. Be aware of any allergies in your group.

Application: Ask the group which of these products they or their parents have used. [Fuel with ethanol is common, packing peanuts, and green cleaning products are some examples.]

ACTIVITY “Biofuel Milestones”

Materials: Large space to draw a time line (black top/sidewalk or chalkboard), chalk, Biofuel Milestones (included at the end of this activity), scissors.

Draw a time line with one end labeled 1900 and the other labeled 2012. Print the Biofuel Milestones. Cut out only the pictures (not the captions) and share them with the children. As you share each picture, read its caption (but not the date). Ask the group to guess when each of the events occurred and to place the pictures near that point on the time line. Then, share the actual dates with the children.



Note to the volunteer: If you would like to add additional events to the time line, use the following.

2010—entire class of professional tractor pullers all used biodiesel

2008—first biodiesel boat travels around the world in 60 days

Application: Review when each of the biofuel milestones occurred. Ask the children whether the milestones are recent or if they happened a long time ago. [Answers will vary depending on milestone.] Then, ask them what other machines could use biofuel. [Buses, trains, or motorcycles.]

2. Digging Deeper

ACTIVITY “Bio-based Lubricants: Feels Slippery to Me”

Materials: A variety of bio-based items such as sunflower seeds, raw almonds, Brazil nuts (work well), pecans (work well); wax paper; rolling pin.

Take some of the bio-based items and place them between two sheets of wax paper. Then, use the rolling pin to extract some of the bio-based oil. Once some of the oil is pressed out onto the wax paper, ask the children to rub the oil between their fingers. Discuss which of the oils feels the most slippery. Talk about what the oils look like and how they smell. Be aware of any allergies in your group.

Note to the volunteer: Tell the children that bio-based lubricants such as Simply Soy from Nutek (www.nutekformulations.com) are becoming more common.

Application: Ask the group how mechanical oils are used, and where they typically come from. [Oils are lubricants that help bicycle chains, door knobs, and hinges work more smoothly. Lubricants are often made from petroleum/crude oil.]

ACTIVITY “Disappearing Act”

Materials: Bio-based packing peanuts, petroleum-based packing peanuts, chalkboard, chalk, two large bowls filled with warm tap water. (Bio-based packing peanuts are available at Staples, FedEx, Kinkos, U-Haul and the Container Store. They are sometimes called starch peanuts.)



Note to the volunteer: The bio-based and petroleum-based packing peanuts might look very similar. As such, it will be important for you to keep them separate so that you will always know which is which throughout the activity.

Ask the group to examine the two types of packing peanuts, and ask them what differences and similarities they observe. [Answers will vary.] Inquire about what they think the packing peanuts are made from. [Answers will vary.] Point out that bio-based peanuts are usually corn starch-based.

Tell the children that they are going to try to dissolve the packing peanuts. Ask them to predict which one will dissolve first. [The bio-based peanut should dissolve more quickly than the petroleum-based peanut.] Add 1 bio-based and 1 petroleum-based peanut to each bowl of warm tap water. You can also use packing peanuts with moist soil to simulate waste in landfills.

Application: Questions to consider:

- Why did the bio-based peanuts dissolve so quickly? [The bio-based product breaks down when exposed to water, but the petroleum-based one does not.]
- What would it mean for the environment if landfill waste consisted of bio-based waste material instead of material and plastics made from petroleum? [Bio-based waste dissolves and would not take up space in a landfill.]

3. Looking Within

ACTIVITY “Do They Clean Just as Well?”

Materials: Two similar cleaning products (one traditional and one bio-based); two identical, soiled surfaces (e.g., two windows marked with crayon, two trays soiled with a small amount of honey, or two scraps of fabric soiled with mud spots); two cleaning rags and a pair of gloves for each child.

Note to the volunteer: Be sure to check that the bio-based product is truly bio-based (that it is made from natural ingredients). One example of a bio-based product line is Clorox Green Works. Green Works products are available at Target, Walgreens, Meijer, Kroger, and other stores.

Display the two cleaning products. Explain that the bio-based product is made from plant extracts. Present the two soiled surfaces, and ask each child put on his or her pair of gloves. Then, give each child two rags: one with a small amount of traditional cleaner on it, and one with a small amount of bio-based cleaner on it. Ask the children to pay attention to how both products work as they clean the dirty surfaces.

Safety Note: Children should not come into direct contact with the cleaning products used in this activity. Therefore, an adult needs to dispense the products, and children need to wear gloves when cleaning.

Application: When both surfaces have been cleaned, ask the children if one product worked better than another. Does it matter if the product was bio-based? [Usually the bio-based product cleans just as well as the traditional product, but it is safer to use because there are fewer toxic chemicals and fumes.]

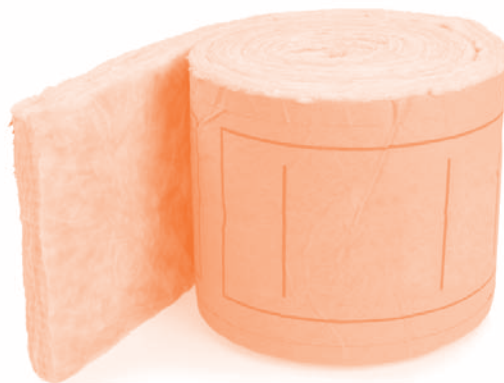
ACTIVITY “Bio-based Insulation”

Materials: Bio-based, recycled insulation (e.g., GreenFiber); fiberglass-based insulation; gloves. (Check with your local hardware store to see if samples are available.)

Safety Note: Use gloves when handling the insulation, especially the fiberglass-based insulation. Children should not touch either insulation.

Compare the products. Is one better than the other? How are they alike? How are they different? [The products should be similar in how they work and in their general appearance; however, the bio-based insulation is safer for touching and breathing than the fiberglass insulation. They also would cost about the same.]

Application: Ask the group how and where insulation is used, and why it is important to insulate homes. [Insulation is used in homes to conserve energy and reduce heating costs.]



4. Bringing Closure

ACTIVITY “Do We Have Enough?”

Materials: Objects to represent corn and garbage (e.g., corn kernels/popcorn for corn and orange peels and waste paper (or something similar) for garbage) in equal amounts.

Ask the children about the two bioenergy sources. Who uses corn? [People and livestock eat corn, and oil can be made from corn.] Who uses garbage? [Some types can be changed into biogas.]

Ask the group to divide the corn into three equal piles: one for the people, one for the animals, and one for bioproducts. Do the same with the garbage, but since people and animals (usually) don't eat garbage, put it all into one pile for bioproducts.

Share with the children that this activity is only an illustration and is more complicated in that corn, for example, can be broken down into parts such as protein, oil, and starch. As a result, a bushel of corn can be used for multiple purposes as its components are separated.

Application: Compare the amount of each bioenergy source that is available for making bioproducts. Ask the group which has the most and which has the least? [Garbage is produced every day.] Ask the children why it is important for the long-term development of bioproducts to have bioenergy sources that are available just for that purpose. [Cost can be controlled when there is less demand for a bioenergy source.]

ACTIVITY “Fueling Our Future with Bioenergy: Putting It All Together”

Materials: Bioenergy Elements Chart (included at the end of this activity), scissors.

Use the pictures from the Bioenergy Elements Chart. Ask the group to sort out the pictures by category: bioenergy sources, bioenergy conversions, and bioproducts.

Application: Once the pictures have been sorted, discuss the links between bioenergy sources and bioenergy conversions that result in bioenergy products. Explore these connections with the pictures. That is, bioenergy sources are linked to bioenergy conversion processes to become bioproducts. (Note that there are multiple ways to link the bioenergy sources, bioenergy conversions, and bioenergy products. For example, when corn is fermented, it produces biofuel.) Explain that bioenergy products can be made from different bioenergy sources. Then, ask the group why bioenergy is so important for environmental sustainability. [It reduces dependency on foreign energy, and it helps protect the environment.]



5. Going Beyond

ACTIVITY “Fueling the Future”

Materials: Paper, crayons, markers, pencils.

Share with the group that more vehicles in the future will run on different types of fuel. Explain that gas stations will sell more biofuels such as biodiesel and ethanol. Tell the children that there might also be other forms of energy such as electricity (electrical plugs) or hydrogen cells (liquid hydrogen fuel) that motor vehicles can use. Allow the children time to illustrate what they think a gas station will look like in the future.

Note to the volunteer: Allow plenty of time and encouragement for creativity.

Application: Ask the children to discuss their pictures with the entire group. Ask them which fuels will be available at their gas station of the future. [Answers will vary.]





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Authors: Scott D. Scheer, Professor, Agricultural Communication, Education, and Leadership, State Specialist, Ohio State University Extension; Barbara Fox, Undergraduate Student, The Ohio State University
 Curriculum Content Specialist: Dennis Hall, Assistant Director, Ohio BioProducts Innovation Center, The Ohio State University
 Curriculum Production: Jane Wright, Curriculum Manager, Ohio State University Extension, 4-H Youth Development
 Reviewers: Rhonda Williams, Extension Educator, Ohio State University Extension, 4-H Youth Development; Demetria Woods, Extension Educator, Ohio State University Extension, 4-H Youth Development
 Illustrator: Patrick O'Toole (<http://otoons.net>)
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Reading Adventures

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Web Links

- www.eia.gov/kids/energy.cfm?page=biomass_home-basics
- www.eia.gov/kids/energy.cfm?page=biofuel_home-basics
- www.sciencenewsforkids.org/2006/04/microbes-at-the-gas-pump-3
- www.alliantenergykids.com/EnergyandTheEnvironment/RenewableEnergy/022398

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BIOFUEL MILESTONES



Airplane

First airplane powered by biofuels on a passenger flight from Houston to Chicago: 2011



Indy Car

First Indy Car series to use 100% ethanol: 2007



Tractor

First tractor fueled with biodiesel produced by John Deere: 2005



Model T

Henry Ford's Model T runs on ethanol or gasoline or both: 1908

BIOENERGY ELEMENTS CHART

Bioenergy Sources

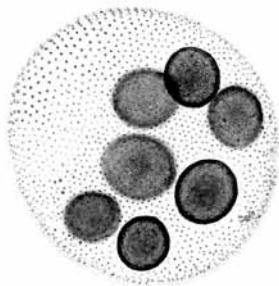
CORN



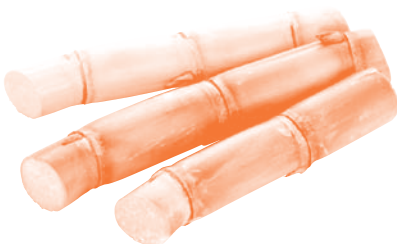
SOYBEANS



ALGAE

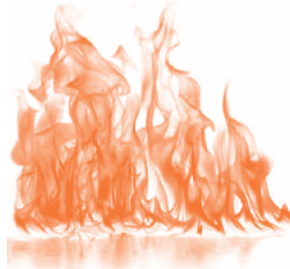


SUGAR CANE

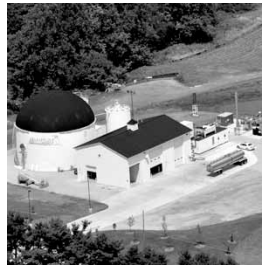


Bioenergy Conversions

COMBUSTION



BIODIGESTER



ESTERIFICATION



FERMENTATION



Bioproducts

INSULATION



BIOFUEL



PACKAGING



CLEANING PRODUCTS

