

## Introduction to Bioenergy: Farm-Based Fuels

### Goals:

1. Youth will determine both positive and negative impacts of energy consumption on their lives.
2. Youth will understand that energy from the sun is transformed through photosynthesis to be stored in plants and algae.
3. Youth will recognize that biofuels are a potentially renewable source of energy and a market for farmers.
4. Youth will debate the tradeoffs involved in biofuel use and production.

**Amount of Time:** seven to ten 90-minute sessions. Time can easily be extended using the variations and virtual fun activities.

Lesson (Section and Title)	Objectives	Activities	Life Skills
<p>Lesson 1: Energy Today and Tomorrow</p> <p>(1 to 2 90-minute sessions)</p>	<p>Youth will:</p> <ul style="list-style-type: none"> <li>● Trace how energy from the sun is transformed during photosynthesis.</li> <li>● Identify major energy sources.</li> <li>● Compare and contrast renewable and nonrenewable sources of energy.</li> <li>● Create an action plan in groups to save energy.</li> </ul> <p><i>Optional:</i> Youth will process and analyze information about a man-made ecological disaster and its consequences.</p>	<p>After a brief introduction to energy, youth complete three main activities.</p> <ol style="list-style-type: none"> <li>1. Trace matter and energy transformations through photosynthesis.</li> <li>2. Calculate their own carbon footprints and develop action plans to reduce carbon.</li> <li>3. Grow feedstocks, including duckweed, corn, and algae.</li> </ol> <p><i>Note: There is an optional fourth activity in which youth investigate the effects of the Deepwater Horizon oil spill.</i></p>	<ul style="list-style-type: none"> <li>● Decision-making</li> <li>● Keeping records</li> <li>● Teamwork</li> </ul>

<p>Lesson 2: Plant Power (1 90 minute session, with options to extend)</p>	<p>Youth will:</p> <ul style="list-style-type: none"> <li>● Recognize materials used to make biomass.</li> <li>● Understand the basics of the ethanol production process by extracting starch from a potato.</li> <li>● Recognize that different organic substances contain different amounts of stored energy</li> </ul>	<p>After reviewing different types of biomass, youth complete three main activities.</p> <ol style="list-style-type: none"> <li>1. Extract liquid from sweet potatoes and regular potatoes. They compare the amounts and test for iodine.</li> <li>2. Follow the same process as in Lesson 1 to model combustion.</li> <li>3. Use a coffee can calorimeter to calculate the energy value of different feedstocks.</li> </ol> <p><i>Note: There is an optional demonstration where youth test for starch in plant leaves that have been grown under different light conditions.</i></p>	<ul style="list-style-type: none"> <li>● Learning to learn</li> <li>● Planning &amp; organizing</li> <li>● Communications</li> <li>● Cooperation</li> <li>● Teamwork</li> <li>● Personal Safety</li> </ul>
<p>Lesson 3: Green Gasoline and New Fuels for Machines  (2 90-minute sessions with homework)</p>	<p>Youth will:</p> <ul style="list-style-type: none"> <li>● Explore how ethanol is produced from feedstocks.</li> <li>● Study the variety of vehicles that use biofuels and consider how much corn is required to fuel a car.</li> <li>● Determine whether an Internet source is reliable.</li> </ul>	<p>Following an introduction to chemical reactions, youth will complete the following activities:</p> <ol style="list-style-type: none"> <li>1. Follow the same process as in Lesson 1 to model starches, cellulose, and the fermentation process.</li> <li>2. Complete fermentation experiments using plastic bags and various feedstocks.</li> <li>3. Watch a brief video and take notes</li> </ol>	<ul style="list-style-type: none"> <li>● Critical thinking</li> <li>● Planning &amp; organizing</li> <li>● Keeping records</li> <li>● Problem solving</li> <li>● Communications</li> <li>● Teamwork</li> </ul>

	<ul style="list-style-type: none"> <li>• Collaborate with peers to deliver a presentation on a vehicle that uses a renewable source of energy.</li> </ul>	<p>on ethanol production.</p> <ol style="list-style-type: none"> <li>4. Solve a series of math problems involving E10 and E85 fuels.</li> <li>5. Learn to evaluate and cite Internet sources.</li> <li>6. Research, develop, and present a sales pitch for a flexible fuel vehicle.</li> </ol>	
<p>Lesson 4: The Biofuels Market (2 90-minute sessions)</p>	<p>Youth will:</p> <ul style="list-style-type: none"> <li>• Identify where biofuel crops and facilities are located in North Carolina and throughout the country.</li> <li>• Explain the economic factors that influence biofuel markets.</li> <li>• Respond thoughtfully to the challenging ethical questions related to biofuel production amid global population growth.</li> </ul>	<p>Following a brief introduction to economics, youth will complete three major activities:</p> <ol style="list-style-type: none"> <li>1. Research and map the types of biomass available in different regions of the United States.</li> <li>2. Play at least two versions of a classic market simulation game.</li> <li>3. Discuss the ethical issues surrounding questions of food versus fuel.</li> </ol>	<ul style="list-style-type: none"> <li>• Critical thinking</li> <li>• Wise use of resources</li> <li>• Communications</li> <li>• Concern for others</li> <li>• Contribution to group effort</li> <li>• Character</li> </ul>
<p>Lesson 5: Planning for the Future (1 to 2 90-minute sessions)</p>	<p>Youth will:</p> <p>Apply knowledge gained throughout the course on bioenergy to make thoughtful land-use decisions</p>	<p>This lesson is the culmination of all of the work done to date. Youth will:</p> <ol style="list-style-type: none"> <li>1. Role play a specific character in a fictional land-use debate.</li> <li>2. Research issues surrounding biofuels and develop a presentation</li> </ol>	<ul style="list-style-type: none"> <li>• Decision-making</li> <li>• Critical Thinking</li> <li>• Record Keeping</li> </ul>

		<p>from their character's perspective.</p> <p>3. Participate in a mock Board of County Commissioners meeting.</p> <p><i>Optional: Youth may play a Jeopardy! game if time and interest permit.</i></p>	<ul style="list-style-type: none"><li>● Planning &amp; Organizing</li><li>● Communications</li><li>● Responsible Citizenship</li><li>● Leadership</li></ul>
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