Biomass to Biofuel

Enrichment Lab

Central Question:
- When combusting different biomass fuels, which will create the most energy?

Objectives:
- The student will understand and demonstrate energy acquisition through soybean plants and compare it with traditional energy sources.
- The student will identify how energy from soybean and other plants can be used for alternative fuel and other uses.
- The student will understand how agriculture is at the forefront of alternative fuel production.

Related NE Science Standards:
- SC12.3.3 Students will describe, on a molecular level, the cycling of matter and the flow of energy between organisms and their environment.

Anticipated Length:
90 Minutes

Lab Materials:
- "Biomass to Biofuel" student handouts
- Safety goggles
- Calculator
- Biomass to burn – soybeans, nuts, wood, etc.
- Alcohol lamps with liquid fuel – Optional – biodiesel, ethanol, diesel, etc.
- Colorimeter set-up
  - Ring stand, aluminum soda can, glass thermometer (°C), paperclip/wire
- Lab materials
  - .00 g Scale, 100 mL graduated cylinder, matches or lighter, digital timer, oven mitt, aluminum foil
- Water availability

Teacher Notes:
- A variety of combustible fuels can be tested and compared. Any solid (soybean, soybean stover/dead stalk and leaves, nuts, wood, etc.) should be lit and placed in a foil dish and liquids (ethanol, kerosene, diesel, biodiesel, etc.) could be tested in an alcohol lamp

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Biomass to Biofuel Lab

Student Name: _____

Plants as Fuel

Plants can be used for more than food! In the same way that we get energy from the food that we eat, the plant energy can also be used for other things – like alternative fuels. Soybeans are a cornerstone of the biodiesel production in the United States, and the energy derived from the small bean is powering trucks, buses, and even homes!

This lab will explore and compare the amount of energy which different fuels can produce. The basic unit of energy is a calorie, which is the amount of heat it takes to change 1 milliliter of water, 1 degree Centigrade. The energy released from the combustion (or burning of fuel) is measured in calories, much like we measure the calories we consume in our diet, because our body breaks down the molecules of food for its energy.

Use the next two pages to set up your lab and collect data. When complete return to the Analysis Questions and Consider This below.

Analysis

Reflection Questions

1. Which fuel was better? Why?

2. What were the pros and cons to each of the fuels?

3. What does the use of soybeans as a fuel allow us to consider in the future? Think outside the box!

Consider This: Agriculture Fuels the Future

The lab activity demonstrated the ability of an agricultural product (soybeans) to produce energy. We know that soybeans are currently used to produce biodiesel, a rising star in the fuel industry, noted not only for its renewable source, but also for cleaner emissions. The issue of clean air is not just a health concern. It affects our industries and businesses, the greater economy, the laws written by Congress and even our foreign policy. But imagine if producers within agriculture could grow the majority of our own non-toxic, biodegradable, renewable fuel! How would things change? Use science to study the issue and think about changes you can make in your own community.

Biomass to Biofuel Lab

Student Name: _____

Calculated Calories in Soybeans and Other Biofuels when Combusted

	Initial Water Temperature	Final Water Temperature	Change in Water Temperature	Initial Fuel Weight	Final Fuel Weight	Change in Fuel Weight	Calories
Units	°C	°C	°C	g	g	g	cal
Notation	T_i	T_f	$T_f - T_i = \Delta T$	W_i	W_f	$W_i – W_f = \Delta W$	$\Delta W / \Delta T$ = Calories per Gram of fuel
Soybean							
Trial 1							
Trial 2							
Trial 3							
					Average Calories per Gram		
Name of other biofuel: _____							
Trial 1							
Trial 2							
Trial 3							
					Average Calories per Gram		

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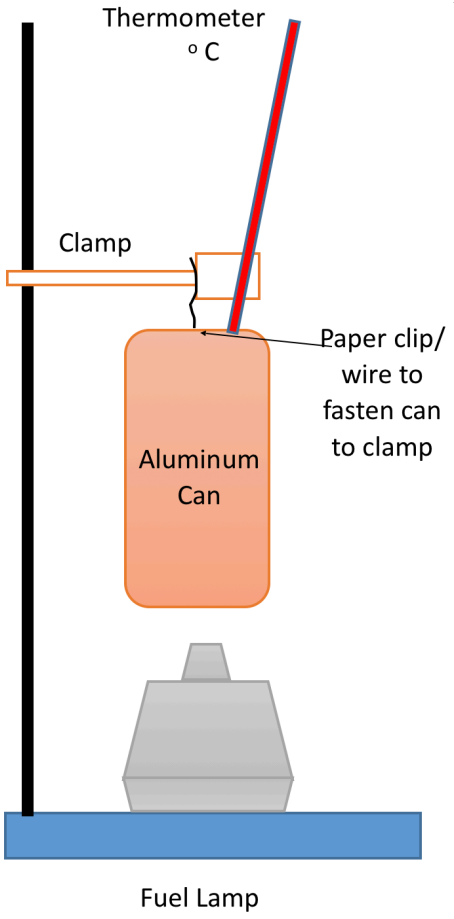
Measuring Calories in Biomass Instructions

1. Set up lab equipment like the image to the right.
2. If you are burning a liquid, you will have a fuel lamp like the image, if you are burning a solid, you will need to make an aluminum foil dish and place it under the can.
   SAFETY NOTE: Put on lab goggles and keep on entire lab.
3. Place 100 mL of water in the can.
4. Record Initial Water Temperature (T_i) in data chart.
5. Weigh the Fuel Lamp or Foil Dish with Biomass and record Initial Fuel Weight (W_i) in data chart.
6. Light fuel source and place immediately under the can.
7. Start timer at SAME time you light the fuel source.
8. Burn for 2 minutes, then blow out flame.
9. Record Final Water Temperature (T_f) in data chart.
10. Weigh the Fuel Burner or Foil Dish with Biomass and record Final Fuel Weight (W_f) in data chart.
11. Calculate Change in Water Temperature. (ΔT); $T_f - T_i = \Delta T$
12. Calculate Change in Fuel Weight. (ΔW); $W_i - W_f = \Delta W$
13. Calculate Calories. $\Delta W / \Delta T$ = Calories per Gram of fuel
14. Dump water out of can and place another 100 mL in can.
    SAFETY NOTE: Use hot hand protectors.
15. Repeat steps 1 to 13 for the remaining trials.
16. Once all trials are complete, calculate averages for kerosene and for diesel. (Add Trial 1, 2, and 3 Calories per gram of fuel and divide by 3)



Fuel Lamp