

# COMBUSTION

## LAB OVERVIEW

Level: Grades 9-16

Estimated Time to Completion: 90 Minutes

Prior Knowledge: Background Provided

In this lab investigation, students will employ the methods of calorimetry to approximate the amount of energy contained in a selection of biomass types and other food items.

The heat given off from the reaction will be absorbed by water that is suspended above the burning sample. This method indirectly measures the amount of heat given off by combustion through observing the changing temperature of the water.

Upon completion, students will be able to:

- Understand and employ the techniques of calorimetry.
- Calculate how many calories of energy/g for several biomass/biofuel items and compare these values to established literature values.
- Determine ash content and its impact on energy.
- Understand the impact of moisture on biomass energy content.
- Discuss how this experiment can be improved to provide more accurate results.

## MATERIALS REQUIRED

Lab Balance

Test Tube

Test Tube Holder

Ring Stand

Thermometer and Thermometer Clamp

Source of Distilled Water

Evaporating Dish

Wire Screen

Lighter or Matches

Heat Resistant Gloves or Tongs

## NOTES TO INSTRUCTOR

- It is recommended that safety protocols are discussed before the lab, including the importance of safety equipment to avoid burns or other fire hazards. Additionally, experiments should be conducted in a well-ventilated area such as a hood.
- Provide a variety of biomass types for the students to choose from. Have the % moisture recorded from the biomass along with the literature value for the biomass.
- A food item with a "calories" content makes for an interesting biomass sample. Note calories are really kilocalories and food calories are related to, but not the same as, calories measured through bomb calorimetry.
- Have the students burn both a relatively dry (<10% moisture) and wet (20 – 30% moisture) sample to determine the double impact of moisture (change in mass content and decreased net energy content).
- If you have done the biodiesel and ethanol labs, the fuel obtained may be burned instead of a solid biomass. In this case, it works best to replace the wire mesh with a kerosene lamp wick. A spirit burner is a convenient method to burn liquid biofuels such as ethanol or biodiesel and can be weighed pre- and post-experiment to determine the mass of the biofuel combusted.
- Dense biomass such as wood chips or biomass pellets can be used but are difficult to fully combust.