

# Introductory Chemistry: A 3-Lab BioFuels Teaching Unit

## Week 1



Ecotoxicity Assay:

- Dose-Response  $LD_{50}$
- Standard Dilution
- Concentration nomenclature
- Data Analysis



## Week 2



Biodiesel Synthesis:

- Balancing reactions
- Density
- Separations

## Week 3



Fuel Calorimetry:

- Heat of Combustion
- Efficiency
- Energy Density
- Mixtures



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Green Chemistry Teaching Postcard



DTCS

This series of three labs can be used at multiple points during the introductory chemistry lab course. The three labs work well to bring a life-cycle perspective to the production, consumption, and environmental impacts of fuel consumption.

### Dose Makes the Poison

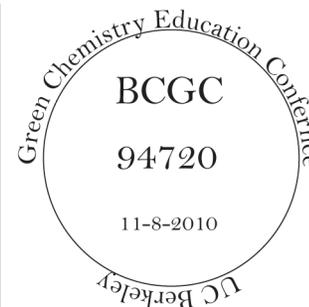
Week one students make solutions of various potential biofuels including ethanol, biodiesel (suspension), glycerol, and dimethyl furan. Radish or Lettuce seeds are then exposed to these solutions and allowed to germinate over the course of 5-7 days. During the second week, after starting the biodiesel separation, students collect germination and taproot length data, which can be shared with the class. This data can be used to create a dose-response curve.

### Biodiesel Synthesis

The second week of lab students run the transesterification of vegetable oil using NaOH and methanol, to obtain the methyl ester. After setting up and running the reaction during the first half of lab, the second half is spent collecting data from the germination assay. The biodiesel synthesis and separation allows the student to practice stoichiometry concepts, and introduces the concepts of density and viscosity.

### Biodiesel Combustion

During the third and final week of the lab, students use a simple soda-can calorimeter and an oil lamp to determine heats of combustion. Students will compare biodiesel to vegetable oil, ethanol, and an biodiesel/ethanol blend. Students will then be able to discuss both the heats of combustion, efficiency of combustion, and heat transfer.



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A copy can be found at:  
<http://bie.berkeley.edu/cgc/home>

### Further Reading:

Howard Wolinsky, "The Economics of Biofuels,"  
*European Molecular Biology  
Organization Reports*, 10, 551-553.

Melinda Wenner, "The next Generation of  
Biofuels," *Scientific American*, March  
2009, 46-51.