

## Educational Materials List



The following is a list of classroom educational materials available from GLBRC Education and Outreach. ([www.glbrc.org/education/educational-materials](http://www.glbrc.org/education/educational-materials)).

### Fermentation Activities

Fermentation In A Bag A simple fermentation activity that GLBRC has done at family-style outreach events. Younger students can observe fermentation in a single bag, while older students can create multiple set-ups to compare how yeast reacts with different feedstocks. Prep time is minimal and students can carry their portable experiment if desired. Easily adapted for classroom use.

Fermentation challenge: Making ethanol from cellulose An inquiry-style activity designed for high school students. Includes a fermentation demonstration and opportunity for students to experiment with various cellulosic feedstocks and pretreatment methods. An activity from Michigan Technological University titled "Biofuels from forest resources: Handouts and procedures: Cellulosic ethanol from forest resources" is also available on the website and outlines a multi-day college-level procedure to create ethanol from woody biomass.

Mini-Fermenter A less expensive version of a true lab fermenter. Appropriate for technical college or college-level experiments or demonstrations. Adapted from the Madison Area Technical College Biotechnology Program.

### Sustainability Activities

Global energy flows and bioenergy: A systems thinking problem space This activity focuses on global energy that is related to human activities. It steps through where this energy comes from (sources); how it is used; how it flows from these sources to uses; and what the corresponding losses are. An emphasis is placed on student development of questions in regards to these energy flows. The target audience is high school students and undergraduates.

Life Cycle Assessment of Biofuels 101 A high school/introductory college-level activity that considers the sustainability of different transportation fuels. Students are introduced to the concept of a life cycle assessment (LCA), focusing on energy and carbon cycling for corn and cellulosic ethanol and gasoline production systems. Supporting materials include energy and carbon LCA PowerPoint files, videos on life cycle analysis, scripts of the videos, active walkthrough of LCA and process tools.

Carbon dioxide production in soil microbial communities An understanding of soil carbon is extremely important in the discussion of the overall sustainability of biofuels production. This lab activity measures and compares the amount of microbial activity occurring in different soil types. The activity provides instructions for using a titration method or CO<sub>2</sub> probe to measure CO<sub>2</sub> production. Supporting materials include a soil microbe PowerPoint file, sample data and carbon sequestration pdf.

# EDUCATION AND OUTREACH

## General Informational Handouts

Why is it so difficult to create cellulosic ethanol? A four-page handout that discusses the challenges of creating ethanol from cellulosic biomass.

Carbon sequestration in soils A short reading on carbon cycling, sequestration, and the relationship between agricultural practices for growing fuels and climate change. Adapted from the Ecological Society of America.

Video: What is cellulose and how is it used to make ethanol? A short, fun video introduction.

Bioenergy bibliography with annotations A list of web links and readings created for educators.

Bioenergy 101 – Common vocabulary Definitions of words commonly heard about bioenergy.

## Activities in progress (not yet posted)

Search for cellulases in the environment Students collect environmental samples where they believe symbiotic relationships with cellulose-degraders may occur. Using a series of plating techniques, they isolate cellulose-degraders and test for cellulase activity.

Quantitative life cycle assessment of cellulosic biofuels Students use Microsoft Excel™ spreadsheets to conduct a comparison of energy life cycle needs of producing ethanol from corn stover, switchgrass, and diverse prairie. A manual of data and templates are provided for students to run their own spreadsheet models.

Carbon cycling in biofuel field plots Students monitor soil microbial activity, root primary productivity and above ground biomass productivity on different vegetative plots. Vernier CO2 probes are used for microbial activity monitoring in situ.

Insect diversity and ecosystem services monitoring in biofuels plots A suite of activities including insect counts, pollination observations, predation rates of insects and seeds to be used in different ecosystems.