**FAB Bio-Fuel Project**

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**Sonoma State University Dr. Michael Cohen**

**The Fuel from Aquatic Biomass (FAB) project: You will be working on a great research project with Dr. Michael Cohen from Sonoma State University. Your research project will collect data about the production of methane gas from wastewater-cultivated vegetation and other organic materials, which can be converted into electricity. You will analyze your results and prepare a presentation about your research project working in a lab group.**

**Please look at the three links below to learn about this fantastic project.**

Project website <http://cohenlab.pbworks.com/> (see the *Documents & Presentations* link for files of this document and today’s presentation).

This KQED program is pretty good in its description of the potential for anaerobic digestion: <http://www.kqed.org/quest/television/view/415>

This EPA site has some good links: <http://www.epa.gov/region9/waste/organics/ad/resources.html>

A video tour of the FAB project site given by one of Dr. Cohen’s graduate students:

<http://www.youtube.com/watch?v=mwFkwWZAxNE>

**California STAR Test Standards covered by this Inquiry Investigation:**

* **Stability in an ecosystem is a balance between competing effects.**
* **Students know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.**
* **Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.**
* **Students know how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigrations, emigration, and death.**
* **Students know how water carbon, nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.**
* **Students know a vital part of an ecosystem is the stability of its producers and decomposers.**
* **Students know at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be representing in an energy pyramid.**

**Schedule for Time on FAB Project**

1. **Introduction to the FAB project, guest lecture with PowerPoint, 1 hour.**
2. **Students given handouts that they read and answer oral questions, 1 hour.**
3. **Homework for students: visit the websites listed above and answer questions that they turn in to class.**
4. **Students work in lab group to design their lab protocol and to design their experiment equipment. Students purchase and bring to class: bottles, tubes and valves, 1 hour.**
5. **Set up the experiment with different variables in different lab groups, 1 hour.**
6. **Run the experiment for 3 weeks or longer. Have students collect data 3 times per week. Data collection takes about 15 minutes or less each day.**
7. **After 3 weeks of data, have all lab groups share their results with the entire class. Students will ask questions and discuss potential errors and also discuss their conclusions, 1 hour.**
8. **Students work in class on their formal lab report on the FAB project, 1 hour.**
9. **Each lab group makes a short oral presentation about their results and conclusions and also discusses potential expansion of further inquiry on the FAB project, 90 minutes.**

**Biogas Production Laboratory: Setup and procedures[[1]](#footnote-1)†**

***Instructor* preparation of microbial inoculum:**

* Obtain microbial inoculum. A good source would be from an active anaerobic digester or start your own from pond sediment mixed with substrate.
* Pass the inoculum through a tea strainer into a large receptacle for class use.

Necessary materials for each culture set up –

* 250-ml wide-mouth Erlenmeyer flask
* single-holed rubber stopper with inserted glass tubing bent horizontally on the top side
* ~50 cm tygon tubing that attaches snugly to the glass tubing
* a J-shaped bent glass tube inserted into the other end of the tygon tubing
* a 64 oz cranberry juice container cut to ~15 cm height
* ~600 ml straight-sided water bottle
* measuring ruler for reading 10-ml increments on the water bottle

***Student* preparation of anaerobic digestion cultures:**

* determine the dry weight of your feedstock components
* add 100 ml of the microbial inoculum to the Erlenmeyer flask
* add organic feedstock to the Erlenmeyer flask (1 to 2 g dry weight equivalent)
* bring the volume of the culture up to 200 ml with tap water
* seal the rubber stopper onto the Erlenmeyer flask
* fill the water bottle with tap water and half-fill the cut cranberry juice container with tap water
* cap the water bottle and immerse the bottle opening under the level of water in the cranberry juice container
* remove the cap and insert the gas tubing outlet into the water bottle opening
* lower the level of the water in the cranberry juice container to ~4-5 cm by use of a turkey baster or large pipette
* insert the entire device into an incubator
* monitor gas production several times weekly and empty or add water to the cranberry juice container to maintain a ~4 cm water level

Tips and things to keep in mind –

* double check to confirm that students opened the tubing valves
* depending on the feedstock the collection bottle may need to be refilled with water
* compare biogas production from substrates on a dry weight basis
* as gas production slows down students may actual observe that the gas volume in their collection bottle decreases; this is due to the fact that the biogas is typically about 35% CO2, which is soluble in water
* optional: cut the tygon tubing approximately 15 cm from the Erlenmeyer flask and insert an on-off valve (sold for use in sprinkler drip systems)
1. † For guidance see photos in presentation found under “For Instructors” at the website: http://cohenlab.pbworks.com/w/page/8882679/Document-Repository [↑](#footnote-ref-1)