Bioenergy Engineering and Science Activities for K12 Education

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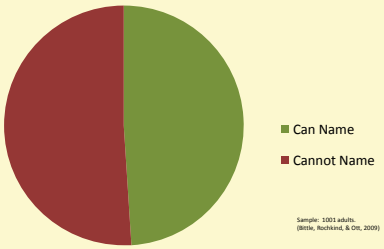
Summary

The goal of our bioenergy initiative is to not only study bioenergy, but to also educate K12 students on ways to convert plants to fuel. We have developed a series of bioenergy activities that can be used at the middle school or high school level. Each activity is designed to allow students to investigate an aspect of the bioenergy field. Students have an opportunity to engage in the larger social debate as well as understand the current economic, science, and engineering challenges of bioenergy. The activities are designed using the research-based 5E learning cycle model This year's activities emphasized engineering in the learning process. The activities included design of a gasifier, wood to electricity plant, and algae bioreactor. Bioenergy provides a compelling context for students to learn about engineering and science. Our goal is to interest and educate students so they are prepared to join the bioenergy field.

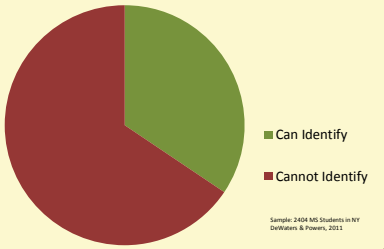
Background

Bioenergy is largely unknown to the general population and K12 students. Bioenergy is not typically included in the US K12 curriculum. This effort uses bioenergy to teach engineering and science practices while integrating STEM curriculum.

Adults Able to Name One Alternative Energy Source

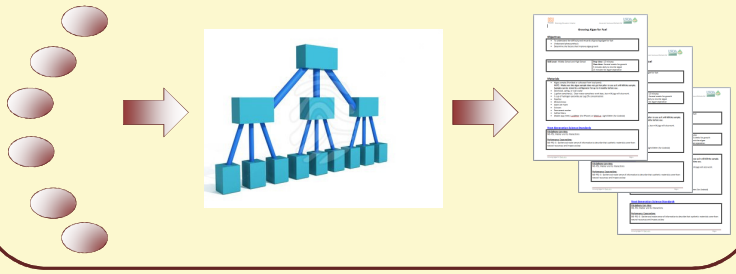


MS Students Able to Differentiate Biofuels from Petroleum Fuels



Bioenergy Curriculum Strategy (in process)

Delphi Expert Study → **Curriculum Framework** → **Activities**



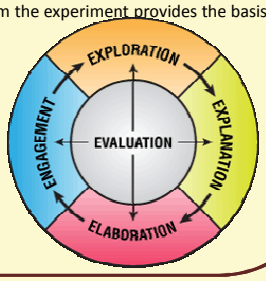
Curriculum Status

Item	Description	Status
Delphi Expert Study	Bioenergy expert panel	80% complete
Curriculum Framework	Convening educator panel to develop grade-banded topics	2015
Activities in Pilot	Teachers trained to employ activities in after school club.	10 in pilot
Activities ready for Publication		11 prepared
Activities Published	Activities are published on the AHB web site for national teacher use.	9 Complete

Activity Format: 5E Learning Cycle Model

The 5E Learning Cycle is a constructivist science learning model developed to help students learn more deeply. Hands-on activities are integrated into the learning of new material. The model has been shown to increase student learning (Akar, 2005) and attitudes toward science (Ebrahim, 2004). The model integrates with the 2013 Next Generation Science Standards (NGSS Lead States, 2013) and provides a framework teaching engineering and science practices.

- **Engage**
  Interest and curiosity is generated for the topic at hand. Students are encouraged to describe what they already know about the concept.
- **Explore**
  Students investigate the science concept through a hands-on activity. Students puzzle over the results of the experiment. Their prior concepts of science may be challenged.
- **Explain**
  Student begin to explain the concepts they experienced. Evidence from the experiment provides the basis for discussion. The teacher provides formal definitions as needed.
- **Elaborate (Engineer)**
  Student apply and extend concepts learning earlier. Engineering provides a platform to extend science learning.
  Science becomes the basis for engineering design.
- **Evaluate**
  Teachers evaluate students at each step so they receive feedback on their learning.



Discussion

Alternate Energy and bioenergy receive very little coverage in the K12 curriculum. If we are to expect our students to make informed choices and be prepared for bioenergy-related jobs, they need to learn about bioenergy at each grade level. Standards (NGSS) are encouraging teachers to integrate STEM content as well as to teach both science and engineering practices. Bioenergy is an ideal way to integrate the STEM curriculum, teach science practices, and connect students to larger societal issues.

References

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United States Department of Agriculture
National Institute of Food and Agriculture