



\* A Farming for Fuels participant compares and contrasts fuels made from different products in the Carbon Cycle Activity Center. Photo courtesy Creative Discovery Museum, Chattanooga, Tennessee

# Farming for Fuels

By *Wayne Robinson*

In 2008, Creative Discovery Museum ([www.cdmfun.org](http://www.cdmfun.org)) in Chattanooga, Tennessee, was presented with an opportunity to educate the public about a new innovation: growing nonfood source crops that can be used to produce biofuels.

With its longstanding interest in environmental education, the museum began a relationship with the U.S. Department of Energy's (DOE) BioEnergy Science Center (BESC, [bioenergycenter.org](http://bioenergycenter.org)), a national biofuels energy research project, headquartered at the Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee. BESC is one of three Bioenergy Research Centers established by DOE's Office of Science to accelerate research toward the development of cost-effective advanced biofuels. The partnership has enabled the museum and ORNL to create a national education and outreach program, Farming for Fuels.

The goal of Farming for Fuels is to educate upper elementary and middle school students, as well as the general public, about alternative, sustainable, inexpensive energy sources, including BESC's research focus: creating biofuels from nonfood source crops, such as switchgrass.

## **A SUSTAINABLE FUTURE**

DOE believes that biofuels made from switchgrass and other nonfood plant crops have many potential environmental and economic benefits. Switchgrass helps remove carbon dioxide from the air, uses water very efficiently, protects soil from erosion, restores nutrients to soil, and is remarkably adaptable to a

wide range of habitats and climates. Biofuels from switchgrass can reduce U.S. dependence on foreign oil and strengthen the U.S. farming economy.

The net energy output of switchgrass is significantly greater than that of corn because corn requires energy input from fertilizer and replanting in order to grow. However, producing ethanol from a non-food source material is very complex. Corn is already primarily a starch, which can easily be converted by micro-organisms to a fuel. Switchgrass is much more complex in its structure and difficult to break down for conversion. BESG scientists nationwide are conducting cutting-edge research on developing new plant varieties that are easier to break down into fermentable sugars, and understanding how plant cell walls can be modified to improve sugar release.

To learn more about biofuels from switchgrass, visit [bioenergy.ornl.gov/papers/misc/switgrs.html](http://bioenergy.ornl.gov/papers/misc/switgrs.html) and [www.learnbiofuels.org](http://www.learnbiofuels.org).

## FIVE COMPONENTS, FIVE QUESTIONS

The Farming for Fuels program includes five main components:

- 1. Classroom lessons:** An inquiry-based lesson introduces concepts connected with biofuels and the challenges in producing them. Lesson topics include the carbon cycle, the need to move closer to a carbon neutral state, and the scientific complexity associated with the production of ethanol from sustainable nonfood/feed source plants. Following a short introduction, students rotate through at least three hands-on activity centers, covering topics such as Annuals and Perennials, Sugar Testing, and Cell Wall Structure. The lesson concludes with a concept wrap-up and a question-and-answer session. Over 35,000 students have been served through classroom lessons during the program's first five years.
- 2. Family events:** During family events, students and their families can talk directly with scientists and rotate through 9 to 15 activity centers, covering the need for alternative energy fuels, the role that biofuels play in meeting that need, and the important role of research in finding renewable, sustainable energy solutions. Over 45,000 individuals have participated in biofuels family events across the country during the past five years. Parent teacher association/organization meetings, science nights, and community festivals are common venues.
- 3. Biofuels website:** A new biofuels website ([www.learnbiofuels.org](http://www.learnbiofuels.org)), with educational content for educators, children, and the general public, was launched in 2013. The website contains special sections, including Teachers Corner, Latest Bio News, and Explore Issues, as well as links to educational videos, lesson plans, and the BioEnergy Science Center.
- 4. Road Trip Challenge (RTC):** In this software program, users of all ages are challenged to make good environmental decisions about transportation and the use of electric, gasoline, and biofuels energy sources as they travel across the United States in geographical segments or "legs." Each leg also has a scientific theme such as "carbon and the carbon cycle" and "climate and weather." RTC software is used in biofuels kiosks at select museums and science centers. The software is also available as a free iPad app at [www.itunes.org](http://www.itunes.org).
- 5. Distance learning:** Over 1,000 students in four states (Georgia, Illinois, Oklahoma, and Tennessee) participated in 50-minute biofuels distance learning (DL) lessons during 2013, our initial year of providing this type of programming. Over 50 DL lessons are slated for delivery to an additional 1,500–2,000 students across the nation during 2014. We ship classroom kits, designed to promote interactive learning, to participants before they receive the DL lessons. Through instructional segments and hands-on activities, students participating in DL lessons learn about current transportation energy sources, the problems associated with them, and the challenges involved in creating renewable energy options.

Results from a 2013 independent evaluation indicated the program is very effective in educating the public and communicating the project's five "Big Questions":

- 1) What are alternative energy sources?
- 2) Why is using alternative energy sources for fuel important for the environment?
- 3) Why are all alternative energy sources not equally good?
- 4) Why is finding nonfood source items with which to create alternative energy important?

- 5) Why are nonfood source alternative energy sources hard for scientists to develop?

#### **NATIONAL REACH**

Farming for Fuels has grown into a program with a national presence. The program is currently being used in 20 science centers and museums in 12 states. Over 80,000 people across the United States have now participated in the Farming for Fuels program during its first five years. The program is on track to reach over 100,000 individuals through person-to-person contact with an educational message about environmentally friendly, alternative biofuels energy by 2015.

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In the Annuals and Perennials Activity Center, a student plants different varieties of seeds as a make it/take it activity. Photo courtesy Creative Discovery Museum, Chattanooga, Tennessee.