Developing future leaders who will determine the bioenergy landscape of tomorrow

BioenergizeME Virtual Toolkit

Virtual Science Fair 2015 (Fall of 2014)

"Bioenergy—Building on the Shoulders of Giants"

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1 INTRODUCTION

Bioenergy has come a long way since dried plant material was first burned for light and heat by early human civilization. Bioenergy comes from biomass, or plant material, that collects and stores energy from the sun as chemicals within its cells. There are many ways to harvest bioenergy from plant material, and technologies have been developed over time to use the energy in biomass more efficiently and cleanly.[a]

In the United States, biomass provides just a portion of the variety of resources used to meet America's energy needs. As our awareness increases about the diminishing availability of energy resources and the environmental effects of producing and using them, it is more important than ever for the young people of today to understand the following:

- Basic energy principles
- Energy resource and technology options available
- Benefits and challenges of various energy resources
- How they and their peers can play an important role in shaping America's energy future.

Many young people haven't thought much about bioenergy as an option for power, transportation fuels, and other products. That's understandable, because the variety of information available about bioenergy, its challenges, and its promise can be confusing. The OPERATION BioenergizeME[b] Virtual Science Fair is designed to help young people and educators get a handle on this important energy resource.

The BioenergizeME Virtual Science Fair is adapted for both classroom and independent educational use, and follows the Global Literacy XPRIZE model[c] to "rethink learning by harnessing innovation and technology and by placing the capability and desire to become educated into the hands of the learner."

In the competition, teams present their virtual science fair project in the form of an infographic, which is a great way to communicate ideas and educate others in a way that is interesting and quick to understand. For this challenge, infographics should convey a message that is predominantly image-led and that a general audience can understand in just a few minutes.

[a] For a good introduction to exciting things related to bioenergy production, see the short video *Bioenergy: America's Energy Future* (full version: http://youtu.be/GU0Cu45cLT4 or short version: http://youtu.be/VskQZAvbjGE).

[b] OPERATION BioenergizeME is the U.S. Department of Energy Bioenergy Technologies Office's educational base camp, providing resources and activities to help engage younger stakeholders in bioenergy. OPERATION BioenergizeME supports the Energy Department's Energy Literacy Framework (see http://energy.gov/eere/education/energy-literacy-essential-principles-and-fundamental-concepts-energy-education)—an initiative to increase the public's understanding of the role of energy in the world and in their daily lives, and to help them apply this understanding to answer questions and solve problems.

[b] http://www.xprize.org/prize-development/learning

2 CHALLENGE DETAILS

The BioenergizeME Virtual Science Fair takes place in both fall and spring school sessions. Students are welcome to participate in one or both sessions. Educators are encouraged to integrate the challenge into their curriculum as they see fit, while keeping in mind the submission deadlines and the national bioenergy media campaign week (see 2.1 Challenge Structure, Task 5).

An Energy Department-sponsored kick-off webinar for educators and students well be held in mid-September 2014 and mid-January 2015. This pre-recorded webinar will be available on the BioenergizeME Virtual Science Fair website and will provide submission dates, guidelines, themes, and information resources.

2.1 CHALLENGE STRUCTURE

The BioenergizeME Virtual Science Fair is designed for teams of two to four high school students. Educators can adjust this as needed for their teaching situation, but only four students from the winning infographic team will receive the grand prize. The student teams may choose to respond to one or more of the research topics and prompts provided, but they should make sure that the infographic communicates a well-focused thesis. The challenge is broken up into five main tasks:

Task 1 Students research a selected research topic and prompt (the Library of Congress provides possible subject headings and a resource library to get students started).

Task 2 Students communicate their research in the form of an infographic (See Section 8.3: Infographic Resources).

Task 3 Educator reviews infographics based on the provided rubric (Section 7), then submits those that meet challenge requirements as directed in Section 3: Entry Rules. Optional: Educator returns infographics not meeting challenge requirements to student teams with feedback and allows for revision and resubmission.

Task 4 Review board from the Bioenergy Technologies Office evaluates entries for objectivity and well-referenced content and makes a "go" or "no-go" determination.

Task 5 Students whose infographics receive a "go" participate in the national bioenergy media campaign week via their social media networks (resources for social media campaign planning and implementation provided to all teams receiving a "go").

2.2 ELIGIBILITY

The following eligibility requirements must be met in order for the infographic to be submitted into the bioenergy media campaign:

- All entrants must be U.S. citizens or legal residents.
- Each submission must have approval by at least one sponsoring educator.
- Entrants must be no older than 19 years of age.

3 ENTRY RULES

- Each infographic must be image-led, using illustrations and/or graphics to communicate the team's research findings.
- Each infographic must respond to at least one research prompt found in Section 6.
- Before submission, each infographic must be reviewed by a sponsoring educator and receive at least a "3" for the research content section of the rubric (provided in Section 7).
- Infographics must be suitable for general audiences (i.e., contain no explicit language, crude/suggestive humor, drug innuendo, or mature/suggestive themes).
- Teams may submit more than one infographic, but each infographic must respond to a different research prompt.
- Each submission must be in PDF format and no larger than 8.5" x 11".
- Each submission must be emailed by the sponsoring educator to zachary.a.peterson@ee.doe.gov by 5:00 p.m. Central Standard Time on October 30, 2014 (for fall session).
- Any submissions that have previously advanced to the top 10 finalists may not be re-submitted.
- Infographics may not endorse a particular company or entity, nor display a trademarked product, without the explicit permission of the Department of Energy.
- Each submission must be the contestant's original work and must not infringe, misappropriate, or otherwise violate any intellectual property rights, privacy rights, or any other rights of any person or entity.
- Failing to meet submission requirements or other submission screenings will result in that submission being deemed ineligible to win a prize.

4 JUDGING AND REVIEW

Each infographic should be reviewed and scored by the team's sponsoring educator using the rubric provided in Section 7. Infographics receiving at least a "3" in the research content category may be

submitted to the Bioenergy Technologies Office by the sponsoring educator via email. We suggest that the sponsoring educator provide feedback to infographics receiving less than three points and give student teams the opportunity to rework and resubmit those infographics for a qualifying score.

All submitted infographics will be reviewed by a bioenergy expert panel selected by the Bioenergy Technologies Office. The panel will evaluate each entry for objectivity and well-referenced content and make a "go" or "no-go" determination. Only submissions receiving a "go" will be allowed to participate in the social media campaign portion of the challenge.

After the bioenergy expert panel has reviewed all of the infographics, the sponsoring educators for each infographic receiving a "go" will be contacted and provided with a social media campaign handbook to be distributed to the teams to assist with planning and implementation of the team's virtual media campaign. The "go" infographics will be posted to the Bioenergy Technologies Office website, and a link to the infographics will be provided to the sponsoring educators.

The teams whose infographics received a "go" will be encouraged to take part in a national bioenergy social media campaign by sharing the link to their infographic via their personal social media outlets. When the media campaign time period is complete, analytics will be gathered to determine the top 10 finalists, based on a social media campaign rubric provided in the campaign handbook.

The Bioenergy Technologies Office leadership team will review the top 10 infographics and select and overall winner. A "viewer's choice" winner may also be awarded based solely on the results of the analytics.

5 AWARD DETAILS

Awards:

Promotion of infographic on national website

Recognition of first-place team at national event

Recognition of all winners with official letters.

6 RESEARCH TOPICS

To ensure that teams have the flexibility to develop their ideas and conduct their own research, we have provided topic areas that help students explore the role of biomass in the context of an energy landscape that has changed many times throughout human history. Within each topic area are prompts that are foundational, broad, and open-ended to foster student-centered discovery.

As you consider your research topic and the prompts, please remember that the strongest entries will show that you have a clear and focused understanding of a relevant issue within the topic area and creativity in how you respond.

To participate, please choose at least one of the research topic areas below and then create an educational infographic.

6.1 BIOENERGY HISTORY

Throughout human civilization upon the earth, many different energy sources have been used to provide cooking, heating, lighting, transportation, communication, and a host of other things we take for granted in daily life. Biomass has been used many ways at different times to provide this energy.

1. How has human use of biomass for energy changed over time? How has it stayed the same? How have technological breakthroughs improved bioenergy efficiency over time?

> *Possible subject headings/key words:*
>
> History of biomass; history of bioenergy

6.2 WORKFORCE AND EDUCATION

The major resources used for energy production have changed over time depending on ecosystem diversity, abundance, transportability, safety, and opportunity for profit. Energy transitions have occurred many times, impacting the livelihoods of candle makers, loggers, whalers, miners, oil producers, and others.

1. Research one of these events, give an overview, and describe new research and employment opportunities that were created. (Note: Keep responses broad and do not focus on individual companies.)

> *Possible subject headings/key words:*
>
> Transitions in energy sources

2. What new research and employment opportunities could bioenergy development create? Describe one promising bioenergy-related career and the steps one would take to prepare to work in this position.

> *Possible subject headings/key words:*
>
> Bioenergy careers

6.3 SCIENCE AND TECHNOLOGY

1. How do plants capture and store energy from the sun? Describe a process for harvesting energy from plants for sustainable transportation fuels. Include mention of the research challenges being addressed to make your selected method of conversion feasible for widespread public adoption.

   Possible subject headings/key words:

   Energy from biomass

   Grain ethanol, biodiesel (commercially established)

   Cellulosic ethanol (emerging or under development for near term)

   Pyrolysis oil, gasification (under development for mid term)

   Algae (Under development for more distant future)

2. What are common types of biomass that are being explored in the United States to produce biofuels? What characteristics do biofuels developers look for in selecting types of biomass to use as feedstocks for biofuels? Select one resource and describe its availability, its bioenergy-related benefits, and challenges that are being addressed or that need to be addressed to encourage broad use as a bioenergy feedstock.

   Possible subject headings/key words:

   Bioenergy feedstock: agricultural residues such as corn stover; energy crops such as switchgrass and miscanthus; forest product residues; plantation woody crops such as southern pine, poplar, or willow; algae; municipal solid waste.

6.4 ENVIRONMENTAL IMPACTS

1. How can biofuel production help benefit the environment? How can bioenergy production augment forestry or agriculture to provide bioenergy feedstock while benefiting the environment?

   Possible subject headings/key words:

   Environmental benefits bioenergy; environmental bioenergy benefits forestry; environmental benefits bioenergy agriculture; landscape design bioenergy gulf hypoxia

2. Research and explain why the U.S. Energy Independence and Security Act of 2007 and the Renewable Fuel Standard[c] were created, why they include biofuels, and how they intend to ensure that biofuels have positive effects on greenhouse gas reduction.

   Possible subject headings/key words:

   Purpose of the U.S. Energy Independence and Security Act of 2007; Renewable Fuel Standard, greenhouse gas reduction

3. Why is it important to develop sustainable forms of transportation, and what are important characteristics that sustainable transportation should have?

   Possible subject headings/key words:

   Biofuels sustainable transportation; sustainable transportation quality of life

[c] http://www.gpo.gov/fdsys/pkg/PLAW-110publ140/pdf/PLAW-110publ140.pdf; see Section 201–202 for the Renewable Fuel Standard.

7 RUBRIC

Infographic Rubric				
		3	2	1
Research Content	• Evidence based • Clear analysis and explanation • Logical flow	• The data and facts presented are evidence based and reliable. All sources are referenced. • There is clear analysis and explanation of the research topic selected. • The information and messages present a logical flow.	• The content contains one inaccuracy, and content is partially cited with credible sources. • The analysis and explanation are incomplete. • One of the elements of the infographic does not logically flow with the subject matter.	• The content contains more than one inaccuracy, content is occasionally cited, and/or credible sources are visibly lacking. • Lacking analysis and explanation. • More than one of the elements of the infographic does not logically flow with the subject matter.
		3	2	1
Design	• Aesthetics (font, color, shape) • Correct use of data visualization • Relevance of graphics	• The infographic is highly attractive in terms of layout, design, and neatness. The color choices enhance the visibility of the infographic, and the fonts used are readable and complement the content. • The chosen data visualization formats make the data presented clear and simple for the viewer to understand. • The images and illustrations match the tone and subject matter of the infographic.	• The infographic is adequately attractive in terms of layout, design, and neatness. Color and font choices do not add or detract from the infographic. • The chosen data visualization formats illustrate the data correctly, but some may be difficult for the viewer to understand. • The images and illustrations are relevant but may distract attention away from the content of the infographic	• The infographic lacks attractiveness in terms of layout, design, and neatness. Fonts used are difficult to read, and color choices are distracting. • Data visualizations are seen, but other formats could have been chosen to better illustrate the data for the viewer. • The images and illustrations used do not match the subject matter of the infographic and take away from the content of the infographic.
		2	1	
Mechanics	• Grammar • Guideline/ format	• The writing is free of errors.	• The writing contains one or more errors.	

8 RESOURCE LIBRARY

The Bioenergy Technologies Office collaborated with the Library of Congress to develop a resource library of quality resources for the BioenergizeMe Virtual Science Fair. The Resource Library is designed to provide a solid foundation of credible sources covering the various aspects of bioenergy for students to use to focus their research. The Resource Library contains various sources such as books, fact sheets, and publications.

8.1 LIBRARY OF CONGRESS RESOURCES

The Library of Congress is the world's largest library by number of items catalogued and serves as the research library for the U.S. Congress. For the BioenergizeME Virtual Science Fair, the Library of Congress put together a research guide for students to use as a starting point. This research guide will be available on the Library of Congress website :

- Library of Congress Research Guide—Will be available for spring session

The Library of Congress is a valuable resource for researchers at any level, and the "Ask a Librarian" function is a great way to get research assistance from Library of Congress librarians. Check out the video interview of Library of Congress Research Specialist, Jennifer Harbster, to learn more about the capabilities of the Library of Congress and of your own public library!

- Video Interview—Will be available for spring session

8.2 GOVERNMENT RESOURCES

Government agencies such as the U.S. Department of Agriculture (USDA), Environmental Protection Agency (EPA), and Department of Energy (DOE) are on the leading edge of science and technology research and produce valuable publications, factsheets, and reports that are available to the public for free. The U.S. Department of Energy's Bioenergy Technologies Office (BETO) has compiled a list of bioenergy-related resources from various government agencies to provide a foundation for students to begin their research:

8.2.1 GENERAL RESOURCES

Below are general resources provided by BETO and USDA that can assist with providing background on various bioenergy topics:

- Bioenergy Technologies Office website
    - Biomass Basics
        - Biofuels Basics
        - Bio-Benefits
        - Bioproducts
        - Biopower

    - Field-to-Fuel Gateway to BETO—Will be available for spring session
    - BETO Educator's Toolbox—Will be available for spring session
- Bioenergy Knowledge Discovery Framework—A resource providing access to a variety of data sets, publications, and collaboration and mapping tools that support bioenergy research, analysis, and decision making.
- Alternative Fuels Data Center—Provides information, data, and tools to help fleets and other transportation decision makers find ways to reduce petroleum consumption through the use of alternative and renewable fuels, advanced vehicles, and other fuel-saving measures.
- USDA "Ask the Expert"—Visitors can click "Submit a Question" to submit a question to USDA subject matter experts.

8.2.2 NATIONAL LAB RESOURCES

The U.S. Department of Energy provides funding to national laboratories across the United States that provide valuable bioenergy-related research:

- National Renewable Energy Laboratory
    - Biomass Energy Basics
    - Biomass Research Homepage
    - Library
- Oak Ridge National Lab
    - Biomass Energy Data Book
    - Research Library
    - Ask a Librarian
- Pacific Northwest National Laboratory
    - Publications Page

8.2.3 BIOENERGY RESEARCH CENTERS

The U.S. Department of Energy established three bioenergy research centers in 2007 to help to address the challenges of biofuel production:

- Great Lakes Bioenergy Research Center
- BioEnergy Science Center
- Joint BioEnergy Institute

8.3 INFOGRAPHIC RESOURCES

8.3.1 INFOGRAPHIC EXAMPLES

The three infographics found below provide great examples of high-quality infographics that were produced by U.S. Department of Energy. Students are not expected to submit infographics of this caliber, but they may use these infographics as examples of how they can design their own.

- Warding Off Energy Vampires and Phantom Loads
- Wind Energy in America
- Home Heating

8.3.2 IMAGE RESOURCES

The following resources provide free image galleries that can be used to find bioenergy-related photos and graphics:

- Pacific Northwest National Laboratory—PictureThis
- National Renewable Energy Laboratory—Image Gallery
- United States Department of Agriculture
  - Agricultural Research Service Image Gallery
  - Photography Services

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

eere.energy.gov
bioenergy.energy.gov

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