

BioenergizeME Infographic Lesson

TEACHER GUIDE

This Teacher Guide aligns with the U.S. Department of Energy (DOE) BioenergizeME Infographic Lesson, an engaging and fun way for students to use technology to learn about bioenergy in the classroom. The BioenergizeME Infographic Lesson provides a framework for students to explore one or more bioenergy research prompts and then communicate what they've learned in a student-developed infographic. This lesson incorporates research, interpretation, synthesis, design, and collaboration skills, while students use their creativity to illustrate the findings of their research.

This Teacher Guide is comprised of aids for teachers who wish to include bioenergy and/or the BioenergizeME Infographic Lesson in their curriculums, and includes

- Web links to valuable resources for incorporating bioenergy and exploration of bioenergy career opportunities in the classroom,
- Web links to the latest in bioenergy research,
- A concept map to help students focus on fundamental bioenergy understanding,
- Research guides aligned to BioenergizeME Infographic Lesson topic areas/prompts, and
- A rubric to guide infographic development and evaluation.

Valuable resources for incorporating bioenergy and exploration of bioenergy career opportunities in the classroom:

[Education and Workforce Development Resources](#)

[Bioenergy Career Map](#)

[Bioenergy Internship and Fellowship Opportunities](#)

The latest in bioenergy research

[Bioenergy Basics](#)

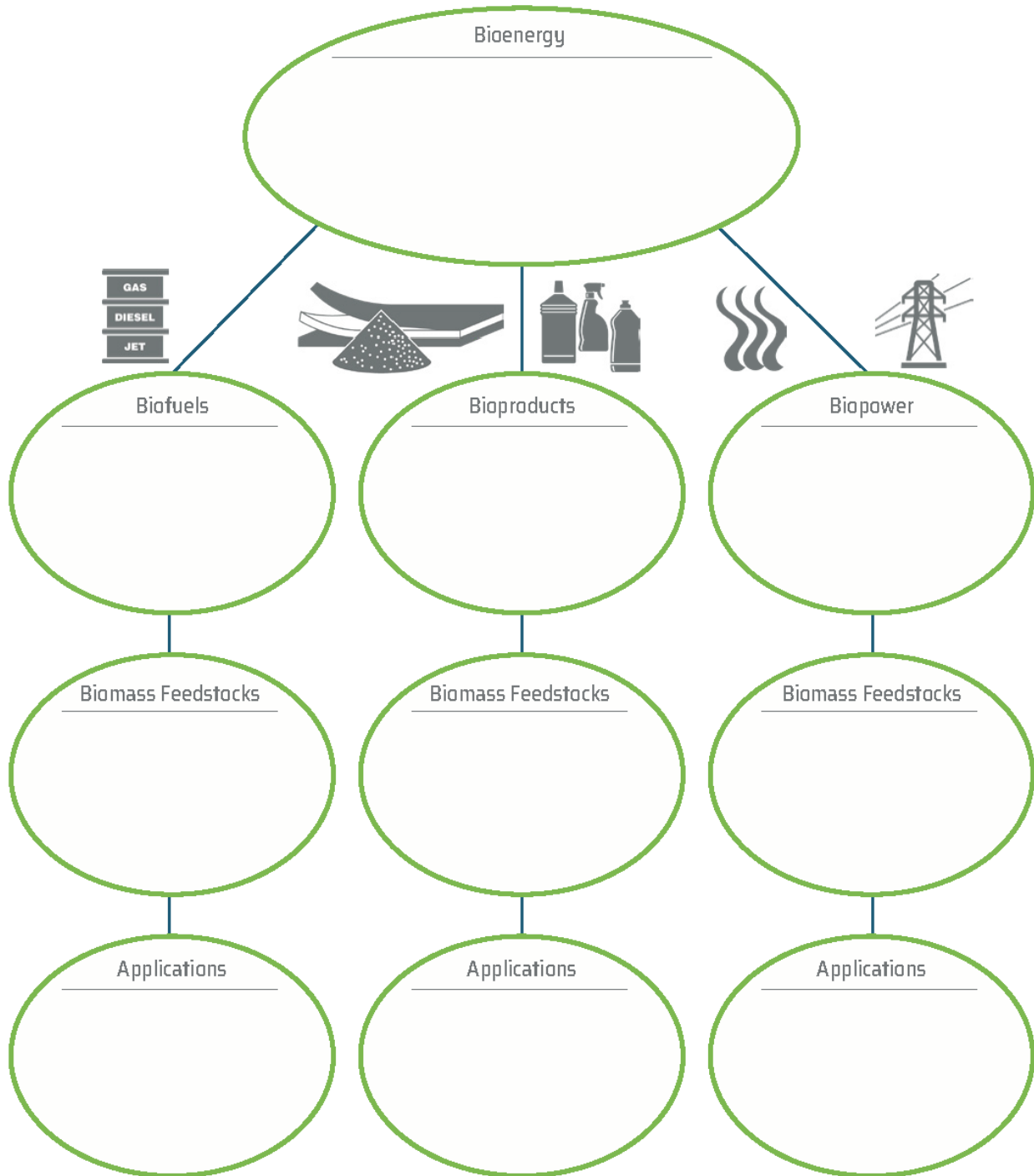
[BioenergizeME Infographic Lesson Concept Map and Introduction](#)

[BioenergizeME Infographic Lesson Note Guides](#) (with focus on next-generation bioenergy)

[BioenergizeME Infographic Lesson Rubric](#)

INTRODUCTION TO BIOENERGY

See the BETO [Bioenergy Basics](#) website to learn about bioenergy, and this concept map to start exploring the topic. Students can write 2–3 main concepts or ideas in each bubble.



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INTRODUCTION TO BIOENERGY

See the BETO [Bioenergy Basics](#) website to learn about biomass, biofuels, and bioproducts and answer the following questions:

1. Why do we need a diverse portfolio of energy resources in the United States?
2. What is biomass?
3. Describe cellulosic fuels.
4. Describe two types of biofuels.
5. Describe bioproducts and provide examples of bioproducts that DOE and BETO are researching.

NOTE GUIDE: BIOENERGIZEME INFOGRAPHIC LESSON RESEARCH TOPIC AREA/PROMPTS
(WITH FOCUS ON NEXT-GENERATION BIOENERGY)

Topic Area 1 - History of Modern Bioenergy

Suggested key words, subject headings, and/or search phrases: *bioenergy, biomass, feedstock, next-generation feedstocks*

Guiding Questions:

1. What is bioenergy? What is biomass?

Key Points:

Reference(s):

2. What is a feedstock? What is a first-generation feedstock? What is a next-generation or advanced feedstock?

Key Points:

Reference(s):

3. Why have researchers expanded our biomass resources to include next-generation feedstocks?

Key Points:

Reference(s):

4. Name some benefits and research challenges associated with next-generation feedstocks?

Key Points:

Reference(s):

**NOTE GUIDE: BIOENERGIZEME INFOGRAPHIC LESSON RESEARCH TOPIC AREA/PROMPTS
(WITH FOCUS ON NEXT-GENERATION BIOENERGY)**

Topic Area 2 - Bioenergy and Technology

Choose one pathway from the list below and describe/illustrate the progression from feedstock to finished product.

Suggested key words, subject headings, and/or search phrases: algae biomass, renewable, crop residues, forest biomass, bio-oil, hydrothermal liquefaction, catalysis

Guiding Questions:

1. What are algae and biochemical processing?

Key Points:

Reference(s):

2. Describe the process of algae and hydrothermal liquefaction and possible products.

Key Points:

Reference(s):

3. Describe how cellulosic biomass is converted to ethanol and some possible uses.

Key Points:

Reference(s):

4. Describe how cellulosic biomass is converted to renewable hydrocarbon fuels via a biochemical process.

Key Points:

Reference(s):

5. Describe how cellulosic biomass is converted to renewable hydrocarbon fuels via thermochemical process.

Key Points:

Reference(s):

6. Describe bioproducts and how biomass can be used to create bioproducts. What are some of the challenges of this process?

Key Points:

Reference(s):

NOTE GUIDE: BIOENERGIZEME INFOGRAPHIC LESSON RESEARCH TOPIC AREA/PROMPTS
(WITH FOCUS ON NEXT-GENERATION BIOENERGY)

Topic Area 3 - Workforce and Education

Suggested key words, subject headings, and/or search phrases: *bioenergy career map, communications specialist, natural resource manager, chemical engineer, chemical technician*

Guiding Questions:

1. Describe one or more technical fields or disciplines that could lead to a career in bioenergy.

Key Points:

Reference(s):

2. Describe one or more non-technical fields or disciplines that could lead to a career in bioenergy?

Key Points:

Reference(s):

3. Research a bioenergy-related higher education program or job training institution in your state or region. How can the skills or knowledge gained from this program/institution apply to a career in the bioenergy industry?

Key Points:

Reference(s):

**NOTE GUIDE: BIOENERGIZEME INFOGRAPHIC LESSON RESEARCH TOPIC AREA/PROMPTS
(WITH FOCUS ON NEXT-GENERATION BIOENERGY)**

Topic Area 4 – Next-Generation Bioenergy

Suggested key words, subject headings, and/or search phrases: *Co-Optima, hybrid vehicle technologies, aviation biofuels, municipal solid waste, waste to energy, biorefineries, co-products, lignin, valorization*

Guiding Questions:

1. Describe how biomass can be used to produce alternative aviation fuels.

Key Points:

Reference(s):

2. Describe the Co-Optima program and how DOE’s BETO and VTO are working together to explore synergies among the fuels, engines, and powertrains used in today’s traditional vehicles.

Key Points:

Reference(s):

3. Describe how wet waste, solid waste, and gaseous waste streams can be used as resources for the domestic production of biogas, biofuels, bioproduct precursors, heat, and electricity.

Key Points:

Reference(s):

4. Describe performance-advantaged biobased products and their potential to BETO and the bioenergy industry.

Key Points:

Reference(s):

BIOENERGIZEME INFOGRAPHIC LESSON RUBRIC

A grading rubric is provided for students as they create their infographics and teachers as they evaluate the students' work.

Infographic Rubric				
Category/Point Value	1 Points	2 Points	3 Points	4 Points
Organization	No clear organization.	Very little organization; difficult to follow.	There is some organization and the infographic can be followed.	Well organized and the infographic is easy to follow.
Concept Summary	Student fails to explain in her/his own words.	Some concepts are explained; not all concepts are explained in the student's own words.	Most concepts are explained using student's own words.	Student explains things completely and in his/her own words.
Grammar Spelling	There are 4 or more spelling and/or grammatical errors.	There are 3 spelling and/or grammatical errors.	There are 1 or 2 spelling and/or grammatical errors.	No spelling and/or grammatical errors.
Design	No clear design or flow; the design is not related to the content; the font is difficult to read.	The design is not clearly organized and has some unrelated content; the font is difficult to read.	The infographic is mostly organized and has an appealing design; some of the font is difficult to read.	The infographic is neatly organized and has an appealing design; all fonts are easy to read.
Total Points				