

NAVAL HISTORY STEM-H LESSON PLAN

LESSON PLAN: The Great Green Fleet

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ACTIVITY TWO: Biofuels

OBJECTIVE: Introduce students to the economic and environmental impacts of using biofuels while evaluating the advantages/disadvantages of biofuels.

MATERIALS:

Navy Currents Article: From Seed to Supersonic and Article Questions

Video:

<http://www.youtube.com/watch?v=pwSAhEmmmN0&feature=youtu.be> (CNO Updates from USS Nimitz)

Video: <http://www.ndep.us/Biofuel> (Biofuels)

Biodiesel Basics Information Guide

Bio diesel Basics Questions



INSTRUCTIONS:

Part 1- View the Biofuels (<http://www.ndep.us/Biofuel>) as an introduction. Some potential discussion questions are listed below:

- a. Where do we get gasoline?
- b. What are biofuels and why do we need them?
- c. What is the relationship between biofuels and photosynthesis?
- d. What is the primary component of plant biofuel?
- e. What are some everyday items that can be used to make biofuels?
- f. Why is the freezing point of butanol important?
- g. Why is butanol so versatile?
- h. Would butanol or other biofuels be considered renewable? Why or why not?

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Part 2- Read the “From Seed to Supersonic” and answer/discuss the corresponding questions. This article describes another biofuel developed by the Navy.

From Seed to Supersonic Article Questions:

1. Analyze the requirements for new biofuel set by the Navy Fuels Team. Why do think they made these specific requirements?
Answer will vary. It is important that students understand that the biofuel had to meet the same standards as standard petroleum-based fuel. Extra modifications to existing ships, aircraft, fuel storage, or transfer infrastructure would have increased logistical challenges and the cost of the project.
2. Why were corn and soy based biofuels not appropriate for this project?
The procurement specification stipulated that the biological component of the blend must not compete with food crops, traditional materials or “feedstocks.”
3. What are the advantages of camelina?
It is best grown in rotation with dryland wheat during the part of the cycle where the land would otherwise lie fallow. Therefore it does not compete with food crops and require little irrigation. Camelina oil is also more cold-tolerant than other biofuel feedstocks.
4. What is transesterification?
A process the combines natural feedstocks such as vegetable oils or animal fats with a short chain alcohol in the presence of a catalyst.
5. Is camelina the only feedstock that can be used for Navy flight?
No, oils extracted from various other sources can also be used for biofuel production. Producers can select the ideal feedstock depending on their location, availability, or cost.
6. In your own words, describe the testing conducted before the biofuel was allowed to be used in test flights.
Answers will vary.
7. What are the environmental benefits of the new biofuel?
Camelina has been demonstrated to reduce carbon emissions by 80 percent which could save tons of aviation greenhouse gas emissions.
8. What are some advantages of using algae as a base for biofuels?
It can be grown in hostile regions and it doesn’t infringe on land set aside for food crops. It doesn’t require fresh water and can thrive in salt water or wastewater.
9. How has the Navy led the way in the past regarding energy change?
The navy moved from sails to coal-fired power, from coal to oil, and from oil to nuclear in the past.

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Part 3 - View the Navy video “CNO Updates from USS Nimitz”

<http://www.youtube.com/watch?v=pwSAhEmmmN0&feature=youtu.be> . The demonstration Great Green Fleet was launched in July 2012 using the fuels developed in the “From Seed to Supersonic” article.

Part 4- Biodiesel is one of the biofuels that students are probably familiar with. Read the first page of the “Biodiesel Basics” (from the U.S. Department of Energy) and answer the questions on the “Biodiesel Basics” worksheet.

Biodiesel Basics

1. What is biodiesel?

Biodiesel is a domestically produced, renewable fuel that can be manufactured from new and used vegetable oils, animal fats, and recycled restaurant grease.

2. What would B35 be composed of?

B35 (35% biodiesel, 65% petroleum diesel)

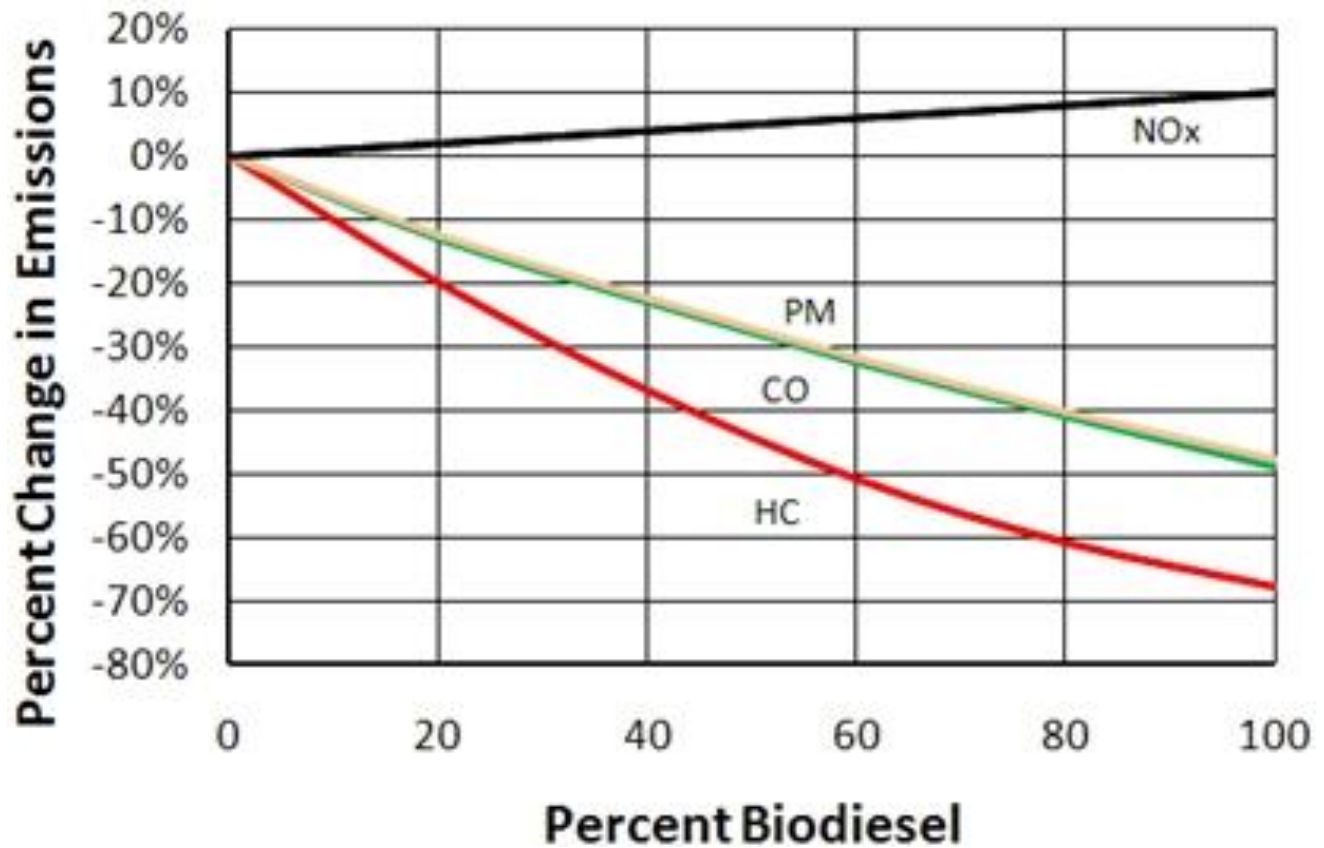
3. Why is it recommended to use B20 made with No.2 diesel manufactured for cold weather in very cold conditions?

Both biodiesel and No.2 diesel have some compounds that crystallize in very cold temperatures (flow improvers are added to No.2 diesel to combat crystallization). In addition a smaller percentage of biodiesel performs better in cold temperatures.

Data Analysis – Use the graph below to answer questions (graph is from U.S. Department of Energy, http://www.afdc.energy.gov/fuels/biodiesel_benefits.html). In the graph (HC) = hydrocarbons, CO = carbon monoxide (CO), PM = particulate matter, NO_x = nitrogen oxides

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Average Emissions Impact of Biodiesel for Heavy-Duty Highway Engines



1. Compared to diesel, pure biodiesel (B100) reduces particulate matter by what percent?
48% to 50%
2. Compared to diesel, B80 reduces hydrocarbons by what percent?
60%
3. Compared to diesel, what effect does pure biodiesel (B100) have on nitrogen oxides?
Increases nitrogen oxides by about 10%

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Part 5 – Each student, write a report (2 to 4 pages) discussing how biofuels are processed, the connection between plants and biofuels, and why biofuels are needed. Some additional factors that students can consider (but are not limited to) include the cost effectiveness of biodiesel and other alternative fuels. The effect of mass producing biofuels on farmers or land use? The effect of mass producing biofuels on national security?

Answers will vary, hopefully.

