

# 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?
2. Why were corn and soy based biofuels not appropriate for this project?
3. What are the advantages of camelina?
4. What is transesterification?
5. Is camelina the only feedstock that can be used for Navy flight?
6. In your own words, describe the testing conducted before the biofuel was allowed to be used in test flights.
7. What are the environmental benefits of the new biofuel?
8. What are some advantages of using algae as a base for biofuels?
9. How has the Navy led the way in the past regarding energy change?

**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.

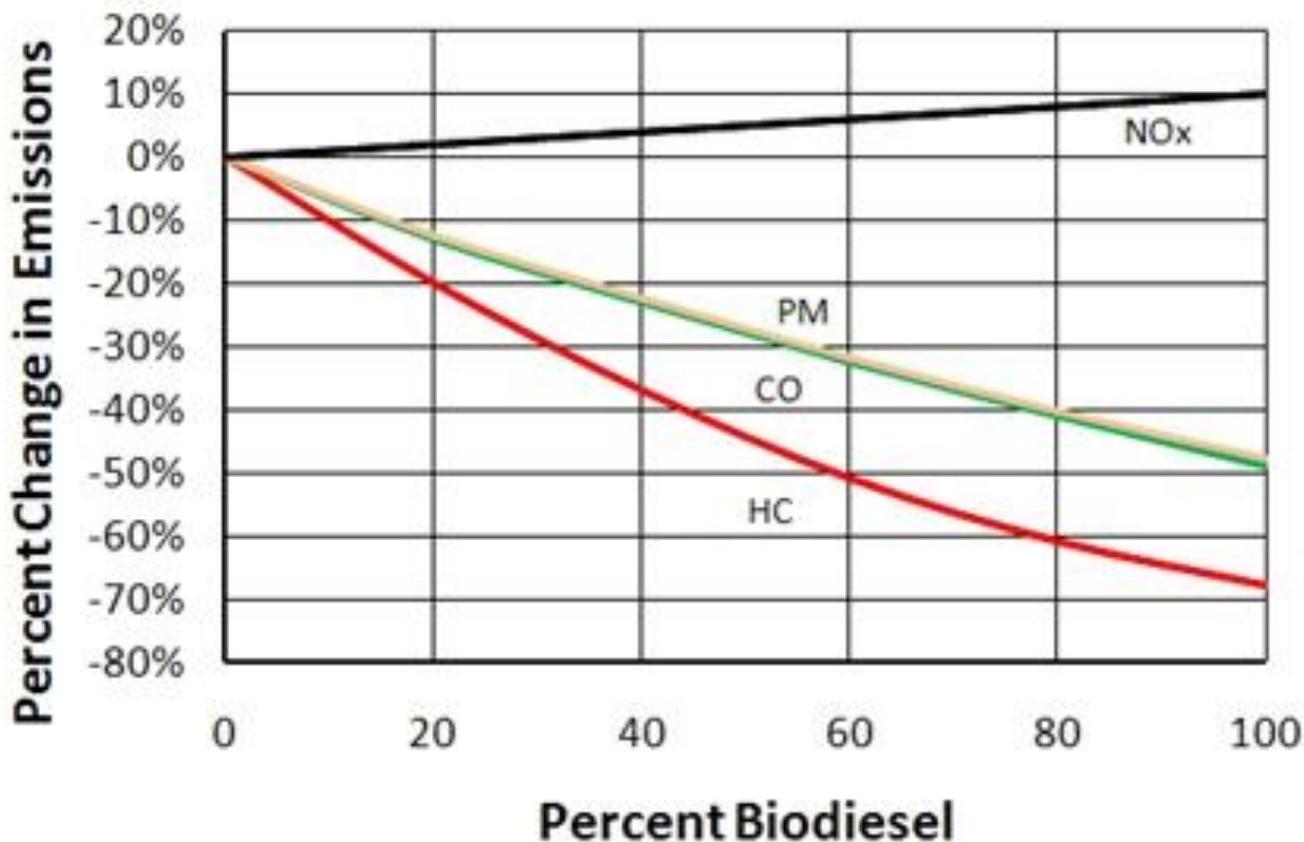
## **Biodiesel Basics**

1. What is biodiesel?
2. What would B35 be composed of?
3. Why is it recommended to use B20 made with No.2 diesel manufactured for cold weather in very cold conditions?

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**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](http://www.afdc.energy.gov/fuels/biodiesel_benefits.html)). In the graph (HC) = hydrocarbons, CO = carbon monoxide (CO), PM = particulate matter, NO<sub>x</sub> = nitrogen oxides

### Average Emissions Impact of Biodiesel for Heavy-Duty Highway Engines



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

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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?

