Biofuels of the Future: The Chemistry of Cars

Background
In this activity you will explore the world of automobile alternative energy sources through the study of biofuels. You will be part of a working group that will design and create an e-book on a pre-approved topic that illustrates and explains the processes by which the alternative energy source is produced and utilized. As part of your e-book, you will make a prediction about what the future may hold for biofuels in the automotive industry.

Important Scientific terms
- Algae culture
- Biofuel
- Biodiesel
- Biomass
- Cellulosic Ethanol
- Distillation
- Fermentation
- Greenhouse gases
- Renewable resource
* Add any additional terms found in your research

Brainstorming Resources
- www.learnbiofuels.org - sponsored by the Creative Discovery Museum
- http://www.ethanolrfa.org/ - Renewable Fuels Association
- http://biodiesel.org/ - National Biodiesel Board
- http://energy.gov/eere/bioenergy/logistics - Algal Biofuels
- https://www.studentenergy.org/topics/biofuels - Student Energy: Biofuels
- http://www.uvm.edu/~adahiya/bioenergy - University of Vermont Renewable Bioenergy Program

Objectives
By the end of this activity, you should be able to:
- Explain the meaning of the term Biofuel
- Consider the following questions:
  o Where do the carbon and the energy in a biofuel come from?
  o Where do the carbon and the energy in a biofuel go?
- Understand the processes of distillation and fermentation
Assignments
1. The chemical reactions we call *Photosynthesis* and *Cellular Respiration* are processes in which fuel (glucose) is produced and utilized by living organisms. How does the energy released in the combustion of one mole of glucose compare to the energy released in the combustion of one mole of ethanol?

Calculate the change in enthalpy for the following reactions:

**Ethanol:** \[ \text{CH}_2\text{CH}_2\text{OH} (g) + 3\text{O}_2(g) \rightarrow 2\text{CO}_2 (g) + 3\text{H}_2\text{O} (g) \]

**Glucose:** \[ \text{C}_6\text{H}_12\text{O}_6 (aq) + 6\text{O}_2(g) \rightarrow 6\text{CO}_2(g) + 6\text{H}_2\text{O}(g) \]

2. How does the energy released from the combustion of gasoline (assume one mole of octane for calculation purposes) compare with ethanol?

\[ 2 \text{ C}_8\text{H}_{16}(g) + 25 \text{ O}_2(g) \rightarrow 16 \text{ CO}_2(g) + 18 \text{ H}_2\text{O}(g) \]

3. Describe different types of biofuels and how they are produced, use this resource to help.
4. Construct a table outlining the advantages and disadvantages of biofuels versus petroleum based fuels

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<thead>
<tr>
<th>PROS/Advantages</th>
<th>CONS/Disadvantages</th>
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5. Construct arguments in defense of a position that:
   a. supports the use of biofuels in automobiles or,
   b. rejects the utilization of biofuels in automobiles
E-Book Creation
As a group, design and create a “Little e-Book” that illustrates and explains one of the following ideas:

- History of Diesel Engines and the connection to biofuel
- Petroleum Diesel versus Biodiesel
- Environmental Impact of Biofuels in the Automotive Industry
- Biofuels as gasoline additives
- Challenges of Biofuel production
- Comparison of Greenhouse Gas Emission from fossil fuels versus biofuels
- OR submit an original idea for teacher approval

Task Description
Each group will design and create an e-Book that illustrates and explains one particular aspect of Biofuels with respect to the “Chemistry of Cars”, including production, utilization and environmental considerations

- Select focus/title of project with connection to biofuels
- Prepare outline of research information
- Design and create a little e-Book using one of the following resources or one of your choosing:
  - Bookwright
  - Free E-book Creators
- Present project to class members

Required components
- Title page with original title and creative illustrations/images
- 4-6 pages of content related to the chosen topic
- Each page must contain graphics, illustration or images
- At least one embedded video
- Conclusion page including predictions for the future
- Works cited page (ALL non-original digital resources MUST be cited)
- Maximum of 9 pages

Conclusions
- As a group, a short concluding paragraph will be written that summarizes your findings and makes a prediction about the future of biofuels in the automotive industry.
- This will be the last content page of your e-Book.

Citations
All resources used should be properly cited in MLA format and submitted as a separate “works cited” page in your book.

Scoring Rubric
Refer to rubric below as your group prepares your e-Book.
**E-book Scoring Rubric:**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Exemplary</th>
<th>Accomplished</th>
<th>Developing</th>
<th>Beginning</th>
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<tr>
<td>Required components</td>
<td>The book includes all required components showing extraordinary attention to detail</td>
<td>The book includes all required components showing satisfactory attention to detail</td>
<td>The book includes most required components showing minimal attention to detail</td>
<td>The book includes few required components with little evidence of attention to detail</td>
</tr>
<tr>
<td>Creativity and Critical thinking</td>
<td>Book displays a high degree of creative effort in the presentation with strong evidence of the critical thinking process</td>
<td>Book displays creative effort in the presentation with some evidence of the critical thinking process</td>
<td>Book displays minimal degree of creative effort in the presentation with little evidence of the critical thinking process</td>
<td>Book displays little or no creative effort in the presentation with little or no evidence of the critical thinking process</td>
</tr>
<tr>
<td>Graphics (illustrations, images, videos)</td>
<td>All required graphics are included; graphics are sophisticated and highly appropriate to the topic</td>
<td>All required graphics are included; graphics are simple and appropriate to the topic</td>
<td>All graphics are included; graphics are simple and somewhat related to the topic</td>
<td>Many graphic have been omitted or are unrelated to the topic</td>
</tr>
<tr>
<td>Quality of information</td>
<td>All information is highly relevant to topic with no extraneous or unrelated details</td>
<td>Most information is relevant to topic with few extraneous or unrelated details</td>
<td>Some information is relevant to topic with some extraneous or unrelated details</td>
<td>Most information is irrelevant or unrelated to the topic</td>
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<td>ELA conventions (grammar, spelling, punctuation, etc.)</td>
<td>No errors in ELA conventions</td>
<td>Few minor errors in ELA conventions that do not take away from content clarity</td>
<td>Many errors in ELA conventions that do not take away from content clarity</td>
<td>Many errors in ELA conventions that seriously take from content clarity</td>
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Adapted from: E-book Scoring Rubric  