

## 5E Lesson

<b>Lesson Author(s)</b>	Andrew Groth
<b>Lesson Title</b>	Alternative Fuels Road Trip
<b>Lesson Source</b>	U.S. Department of Energy
<b>Technology Needs</b>	Computers with internet capabilities, Projector
<b>Date/Time Lesson to be Taught</b>	
<b>School</b>	
<b>Supervising Teacher</b>	
<b>Math or Science?</b>	Science
<b>Lesson Concepts</b>	Alternative Fuels
<b>Objectives</b>	<p>Students will be able to...</p> <ul style="list-style-type: none"> <li>• Define what an alternative fuel is</li> <li>• List several major alternative fuels</li> <li>• Map a road trip route around alternative fueling stations</li> </ul>
<b>CO State Standards</b>	<p>High School Science</p> <ul style="list-style-type: none"> <li>• Standard 1: Physical Science 5 <ul style="list-style-type: none"> <li>○ Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined</li> <li>○ Relevance &amp; Application 3 <ul style="list-style-type: none"> <li>▪ There are advantages and disadvantages to using various energy sources such as gasoline, diesel, ethanol, hydrogen, and electricity as transportation fuel.</li> </ul> </li> </ul> </li> </ul>
<b>Materials List and Advanced Preparation</b>	<p>Computers with internet capabilities, Projector</p> <p>Make sure the computer and projector are on and warmed up before class</p>
<b>Safety</b>	No major concerns; however, all other classroom expectations and procedures must be followed.
<b>Accommodations for Learners with Special Needs</b>	<p>More time with the internet programs</p> <p>Ask more specific and basic questions</p>

<b>1. ENGAGEMENT</b>		<b>Time: 10 Minutes</b>
<b>What the Teacher Will Do</b>	<b>Probing/Eliciting Questions</b>	<b>Student Responses and Misconceptions</b>
<ul style="list-style-type: none"> <li>Prompt video by introducing what alternative fuels are</li> <li>Show video <a href="http://www.youtube.com/watch?v=zzNoM3j9wk4">http://www.youtube.com/watch?v=zzNoM3j9wk4</a></li> <li>Discuss alternative fuels</li> </ul>	<ul style="list-style-type: none"> <li>What are alternative fuels?</li> <li>What are fossil fuels?</li> <li>What's the difference?</li> <li>Name some alternative fuels</li> <li>Surprised electric cars can go so fast?</li> </ul>	<ul style="list-style-type: none"> <li>Different fuels</li> <li>Nonrenewable fuels</li> <li>Electric, Hydrogen, Natural Gas</li> <li>"I didn't knew they could go that fast."</li> </ul>
<b>Evaluation/Decision Point Assessment</b>		<b>Student Outcomes</b>
Ask students what an alternative fuel is Ask students to compile a list of common alternative fuels		Students should be able to define what an alternative fuel is and list a few common ones

<b>2. EXPLORATION</b>		<b>Time: 30 Minutes</b>
<b>What the Teacher Will Do</b>	<b>Probing/Eliciting Questions</b>	<b>Student Responses and Misconceptions</b>
<ul style="list-style-type: none"> <li>Split the class into six different groups               <ul style="list-style-type: none"> <li>Biodiesel, Hydrogen, Electricity, Natural Gas, Ethanol, Propane</li> </ul> </li> <li>Each group will investigate a different fuel               <ul style="list-style-type: none"> <li>The group will discover the basics, benefits, stations, and laws about their fuel</li> <li>Must include the advantages and disadvantages of their fuel</li> </ul> </li> <li>Most of the information can be found at <a href="http://www.afdc.energy.gov/fuels/">http://www.afdc.energy.gov/fuels/</a></li> <li>The groups will compile the information in their notebooks</li> </ul>	<ul style="list-style-type: none"> <li>What are the advantages of your fuel? Disadvantages?</li> <li>Would you recommend this fuel to your friends?</li> <li>Is this fuel common?</li> <li>Are there many fueling stations?</li> <li>Much emissions?</li> </ul>	<ul style="list-style-type: none"> <li>Cheaper fuel, Better gas mileage, Less emissions</li> <li>Few refueling stations, More expensive vehicles, Bad gas mileage, More emissions,</li> <li>I would(n't) because...</li> <li>Very common, Less common</li> <li>Few/Many refueling stations               <ul style="list-style-type: none"> <li>Located mostly in one area of the country</li> </ul> </li> <li>Less and cleaner emissions, Less CO<sub>2</sub>, More emissions</li> </ul>
<b>Evaluation/Decision Point Assessment</b>		<b>Student Outcomes</b>
Ask students the advantages and disadvantages of their fuel		Students should become familiar with their specific fuel. They should be able to give the basics, benefits, stations, and laws attaining to their fuel.

3. EXPLANATION		Time: 30 Minutes
What the Teacher Will Do	Probing/Eliciting Questions	Student Responses and Misconceptions
<ul style="list-style-type: none"> <li>• Each group will plan a road trip               <ul style="list-style-type: none"> <li>○ They must decide where they'd like to go</li> <li>○ They may start at any location</li> <li>○ Trip must be at least 500 miles long</li> </ul> </li> <li>• Using the map of alternative refueling stations, located here...  <a href="http://www.afdc.energy.gov/locator/stations/route/">http://www.afdc.energy.gov/locator/stations/route/</a>, they must plan a route without running out of fuel</li> <li>• They must use the accepted gas mileage for their fuel</li> <li>• After the route is mapped, they must figure out how much the trip would cost in fuel               <ul style="list-style-type: none"> <li>○ This can be calculated by the total distance and the gas mileage</li> </ul> </li> <li>• Screenshot the map and either save it as an image or paste it into a PowerPoint</li> </ul>	<ul style="list-style-type: none"> <li>• Where are you starting?</li> <li>• Where are you going?</li> <li>• Is there any reason why you picked those locations?</li> <li>• Does it have anything to do with the locations of your refueling stations?</li> <li>• How much will your road trip cost? How did you figure this out?</li> <li>• Is that cheap?</li> </ul>	<ul style="list-style-type: none"> <li>• Any location</li> <li>• Any location</li> <li>• I had to pick an area with a higher number of refueling stations. The central United States doesn't have many stations for my fuel</li> <li>• The trip will cost...</li> <li>• I figured this out by multiplying the total distance by the gas mileage</li> </ul>
<b>Evaluation/Decision Point Assessment</b>		<b>Student Outcomes</b>
Ask the students how much their trip will cost Ask the students how they figured the question out		Students should have a completed map showing the route of their road trip. Also, they should have the amount their road trip will cost.

4. ELABORATION		Time: 40 Minutes
What the Teacher Will Do	Probing/Eliciting Questions	Student Responses and Misconceptions
<ul style="list-style-type: none"> <li>Each group will present their fuel               <ul style="list-style-type: none"> <li>Each presentation should be short; about 4 to 6 minutes</li> </ul> </li> <li>The presentations should focus on what their fuel is and the advantages and disadvantages of it               <ul style="list-style-type: none"> <li>Also, their road trip route should be shown</li> <li>Then, the group can discuss why they picked that route and how much it would cost them</li> </ul> </li> <li>While the presentations are occurring, the students not presenting should be taking notes about each fuel               <ul style="list-style-type: none"> <li>Listing the pros and cons of each</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>What makes your fuel unique?</li> <li>Would you use this fuel?</li> <li>What did you like about your fuel? Didn't like?</li> <li>Why did you pick that route?</li> <li>How much is it going to cost?</li> <li>Is that amount comparatively cheap?</li> </ul>	<ul style="list-style-type: none"> <li>Less/More emissions, (Non)Renewable, Cheap/Expensive, Common/Uncommon, Many/Few refueling stations</li> <li>Yes/No because...</li> <li>I liked how cheap it was, the little pollution it creates, renewable, and the better gas mileage</li> <li>I didn't like how expensive it was, how few stations there are, more expensive vehicles, and more emissions</li> <li>We picked a route with many stations</li> <li>Cheap/Expensive</li> <li>Cheaper/More than typical gas</li> </ul>
<b>Evaluation/Decision Point Assessment</b>		<b>Student Outcomes</b>
Ask the students the advantages and disadvantages of each fuel Ask which fuel they'd like to use		Students should be able to name and list the pros and cons of each alternative fuel

5. EVALUATION		Time: 5 Minutes
What the Teacher Will Do	Probing/Eliciting Questions	Student Responses and Misconceptions
Have every student write out which fuel they'd like to use and why; describing the advantages and disadvantages of it		
<b>Differentiation</b>		<b>Time: N/A</b>
<b>Students who are behind or need support</b>	<b>For advanced or gifted students</b>	
Students behind can focus more on the advantages and disadvantages of the specific alternative fuels, while others in the group work on the map	Advanced students can use their same route with other alternative fuels and see if it'd work. Also, calculate how much the other fuels would cost compared to their original fuel	