

LESSON PLAN: AUTOMOBILE CHOICES AND ALTERNATIVE FUELS

Background, Activities and Critical Analysis

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http://www.pbs.org/newshour/extra/teachers/lessonplans/science/ethanol_interactive.html

Environmental science, economics, chemistry, social studies, language arts

Two 45-minute periods with options to extend

Grades 9-12 (lesson can be modified for lower grades)

Students will:

1. Compare and make distinctions among 5 alternative fuels
2. Understand the impact of different types of fuel on:
 - a. the environment
 - b. lifestyle
 - c. the economy/personal finances of car choices
3. Use critical thinking skills to support multi-step decision-making for buying a car

Americans love their cars. Most Americans use gasoline-powered cars to commute, run errands, take family vacations, and get places they want to go. Americans consume 25 percent of the world's oil each year, but the country only provides 2-3 percent of the world's oil resources, according to the U.S. Department of Energy. As demand for oil grows, car manufacturers and scientists have been looking for alternative fuels to reduce cost, dependence on international sources of oil, and the amount of greenhouse gases that contribute to global warming.

Today's typical car releases "**greenhouse gases**." Ozone, Nitrogen Oxides, and carbon monoxide are pollutants that come from motorized vehicles when fuel is burned up in internal combustion engines to produce energy to move the car forward. People have been using this type of engine for over 100 years.

Gasoline is an aliphatic hydrocarbon, which means it is made up of molecules composed of hydrogen and carbon arranged in chains. Gasoline is made from crude oil. The crude oil pumped out of the ground is called petroleum.

Many new cars have been designed to use alternative fuels to run the engine. Alternative fuels for vehicles are any materials or substances that can be used as a fuel, other than conventional fossil fuels (oil and natural gas). The alternative fuels discussed here today include Ethanol (E85), natural gas (CNG), electric, hydrogen, and biodiesel.

Ethanol is an alcohol produced from feed corn that is used to fuel internal combustion engines, either alone or in combination with other fuels. When alcohol fuel (ethanol) is mixed into gasoline, the result is labeled with an 'E' followed by the percentage of Ethanol. E10 is commonly found throughout the southern United States and E85 refers to an 85 percent ethanol fuel. To be considered an alternative fuel vehicle (for tax incentives), the car or truck must be able to operate on up to 85 percent ethanol.

Compressed Natural Gas (CNG) is high-pressure compressed natural gas, mainly composed of methane that is used to fuel normal combustion engines instead of gasoline. Gasoline cars can be retrofitted to compressed natural gas and become natural gas vehicles (NGVs) that use both gasoline and compressed natural gas.

Electric vehicles run on the chemical energy of batteries. Electric vehicles produce no emissions while being driven. The electrical energy to power the motors comes from battery packs. Battery powered cars have primarily used lead-acid batteries and NiMH batteries.

Hydrogen fuel cells produce electricity through a chemical reaction between hydrogen and oxygen and produce no harmful emissions. In hydrogen fuel cell vehicles, hydrogen is stored as a pressurized gas in the car's fuel tanks. The electricity feeds a storage battery that energizes the vehicle's electric motor.

Biodiesel is a processed fuel derived from biological sources (such as vegetable oils), which can be used in diesel-engine vehicles. Biodiesel is biodegradable and largely non-toxic. Most cars need to be modified to run on 100 percent biodiesel, but nearly all diesel engine cars can run on a blend of biodiesel without modifications.

Using the interactive, you can find additional information about the above fuels (click on more info. under each fuel) and you will learn about cost and carbon dioxide emissions of using the various alternative fuels. When discussing the different fuels, keep in mind the accessibility and availability of the different fuels according to different lifestyles, i.e., how far away is the nearest hydrogen pump? Or where will the biodiesel come from? Also keep in mind the constraints of different types of fuels, i.e., if you want to go on a long trip in an electric vehicle, where will you recharge the car?

Guiding the Lesson:

For Homework and background to the topic, have the students watch the NewsHour Report, ["Ethanol Boom Aids Farmers, but Stirs Environmental Concerns"](#), which is available as streaming video or a written transcript and/or have students read the Online NewsHour Reports, ["Case Study: Switch to Unleaded Gas"](#) and ["Ethanol: Questions Loom"](#).

People have been using gasoline engines for over 100 years; why is it a problem now? Guide students to discuss the impact of increasing numbers of motor vehicles over time on air quality, oil resources, public health, and the economy (personal/family finances).

Students should keep in mind that carbon dioxide, a known greenhouse gas, is emitted from conventional gasoline vehicles; too much carbon dioxide in the atmosphere contributes to global warming. The human activity that has the largest impact on climate change is driving a vehicle. For each gallon of gasoline burned, 20 pounds of carbon dioxide is released into the atmosphere.

Every million gallons of gasoline consumed by vehicles releases about 10,000 U.S. tons of carbon dioxide into the atmosphere. The population of the United States uses approximately 420 million gallons of gasoline per day. So, just from gasoline, the United States releases over 8 billion pounds of carbon dioxide into the atmosphere per day, according to the Department of Energy, Alternative Fuels Data Center (AFDC).

Researchers and car manufacturers have looked into the problems associated with conventional gasoline-burning cars and have been developing vehicles that use alternative fuels. Advise students that good shoppers research what is out there before they purchase items, especially big-ticket items like cars. Good sellers know what is out there so they can make comparisons to win over their buyers.

Today the students are going to go shopping for different types of cars. They are going to examine several issues: What does it mean to be environmentally friendly in terms of vehicles? What are some vehicles that they have heard of that might be considered green because they use alternative fuels, and why? How would the seller

of an automobile use these different pieces of information to sell his particular car? What are the characteristics of a green vehicle if they were going to buy one? For instance, how much gas it uses (mpg), the cost of fuel, how much air pollution it puts out. What does it mean to be fuel-efficient?

Because buying a car is a big decision, it is important to do "comparison shopping." Many magazines, books, and Web sites rate and compare vehicles. Use an overhead projector to familiarize the students with the Online NewsHour Interactive: "[How Does Your Car Stack Up?](#)" by comparing their family's car to other cars that use alternative fuels. Give short explanations of each of the fuels used in the cars on the Interactive.

Student Activity:

It is now time to buy and sell. Your students have looked at some alternative fuel options: biodiesel, ethanol, electricity (batteries), hydrogen and compressed natural gas.

Divide the students into groups:

Selling: Have the "seller" students sign up in groups of two to represent a category of alternative fuel to sell, including one group for conventional gasoline. Designate the groups by fuel type, not by car make and model. Encourage students to be scientific, creative, and persuasive in their arguments to the buyers about the cars available in their fuel type. Have students work on their pitches for homework, researching not only their type of fuel, but the others as well, so they can give compelling comparisons to their buyers. The sellers will need to be able to discuss each of the fuel types to be successful salespeople.

Buying: Have the "buyer" students sign up in groups of two to represent a variety of different types of buyers. Buyers need to be very well educated before they choose a car. Give them a profile of their socio-economic backgrounds to guide them in their decision.

Examples include but are not limited to the following. You are a:

1. family of four that takes two vacations to the beach (that is 300 miles away by car) each year and commutes 250 miles per week from their home in the suburbs.
2. married couple with one car, sharing it for commutes to two different jobs each, up to 400 miles per week, family income less than \$50,000 per year.
3. family of 3 with more than \$100,000 income that lives in the city and uses public transportation to commute.
4. single person who commutes 50 percent of the time about 100 miles per week, but likes to go hiking to the country on the weekends.
5. family of 5 who lives in rural America with no commute, but most travel 40 miles each way to buy household items.

Students can also come up with additional socioeconomic backgrounds or use their own family as a model.

Use the rest of the class period for student groups to meet and design their pitches or decide what might be important to a particular buyer. For homework, have the students research the different kinds of fuels and how they meet their needs. They should be prepared to come in the next class ready for the alternative fuel sales event.

Have the buyers meet with each of the seller groups for 5-10 minutes to hear their pitches and ask questions. Use the [Alternative Fuels Worksheet \(PDF\)](#) to record the pros and cons of each type of fuel. At the end of the class, the buyers should present to the group which car they decided to buy and why. This can be done as formally as needed and provide an opportunity to fulfill the state requirements for various types of speaking presentations.

Have each buyer group share their decisions with the class. Discuss the socioeconomic, accessibility, financial, and environmental issues that were used to make decisions. There will be no right and wrong answers for automobile choices, as they depend on each person's needs, finances, and choices about the environment. Teachers may use additional class time to have the groups trade places and use different car makes and models.

Last Updated: July 2009

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