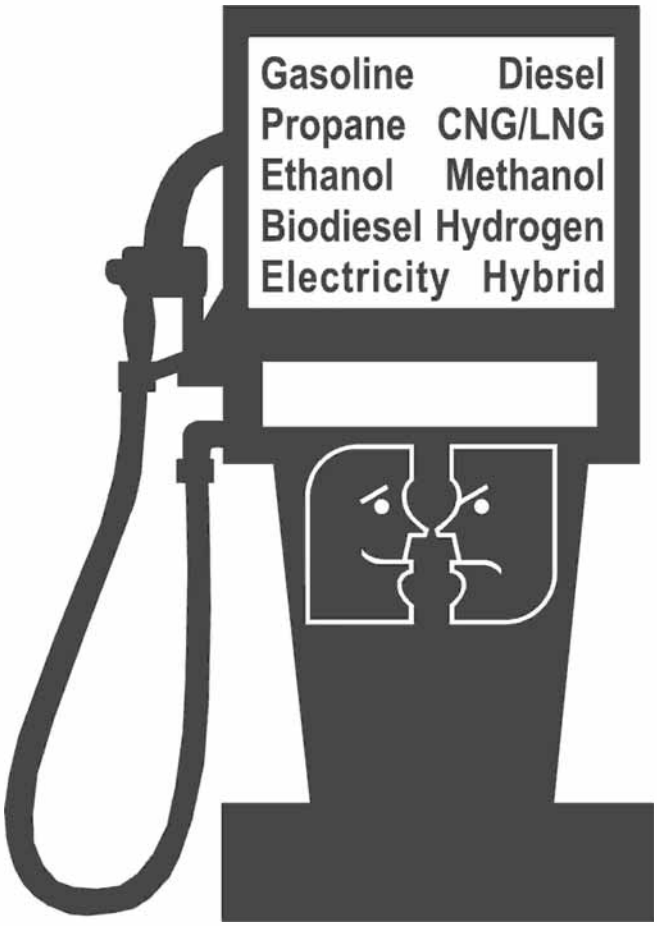
TRANSPORTATION FUELS DEBATE GAME

TRANSPORTATION FUELS

GRADE LEVEL
5–12

SUBJECT AREAS
Science
Social Studies
Language Arts

Students evaluate the advantages and disadvantages of conventional and alternative transportation fuels in an innovative debate format.



NEED 2008-2009
Putting Energy into Education
NEED Project PO Box 10101 Manassas, VA 20108 1-800-875-5029 www.NEED.org

Teacher Advisory Board

NEED Mission Statement

The mission of the NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

Teacher Advisory Board Vision Statement

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

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Correlations to National Science Standards

(Bolded standards are emphasized in the unit.)

INTERMEDIATE (GRADES 5-8) CONTENT STANDARD–B: PHYSICAL SCIENCE

3. Transfer of Energy

g. The sun is the major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches earth, transferring energy from the sun to the earth. The sun's energy arrives as light with a range of wavelengths.

INTERMEDIATE–D: EARTH AND SPACE SCIENCE

1. Structure of the Earth System

a. The solid earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core.

3. Earth in the Solar System

b. The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle.

INTERMEDIATE–E: SCIENCE AND TECHNOLOGY

2. Understandings about Science and Technology

c. Technological solutions are temporary and have side effects. Technologies cost, carry risks, and have benefits.

f. Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency, and appearance. Risk is part of living in a highly technological world. Reducing risk often results in new technology.

g. Technological designs have constraints. Some constraints are unavoidable, such as properties of materials, or effects of weather and friction. Other constraints limit choices in design, such as environmental protection, human safety, and aesthetics.

INTERMEDIATE–F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES

3. Natural Hazards

b. Human activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal.

SECONDARY (GRADES 9-12) CONTENT STANDARD–B: PHYSICAL SCIENCE

1. Structure of Atoms

f. Fission is the splitting of a large nucleus into smaller pieces.

SECONDARY–D: EARTH AND SPACE SCIENCE

1. Energy in the Earth System

d. Global climate is determined by energy transfer from the sun at and near the earth's surface.

SECONDARY–F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES

3. Natural Resources

a. Human populations use resources in the environment to maintain and improve their existence.

b. The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and depletes those resources that cannot be renewed.

c. Humans use many natural systems as resources. Natural systems have the capacity to reuse waste but that capacity is limited. Natural systems can change to an extent that exceeds the limits of organisms to adapt naturally or humans to adapt technologically.

4. Environmental Quality

a. Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients. Humans are changing many of these basic processes, and the changes may be detrimental to humans.

Teacher Guide

TO INVESTIGATE THE ECONOMIC AND ENVIRONMENTAL ADVANTAGES AND DISADVANTAGES OF TRANSPORTATION FUELS.

BACKGROUND

In **Transportation Fuels Debate Game**, student teams learn about transportation fuels, then are assigned to represent the different fuels. Working cooperatively, the students develop arguments on the merits of their fuel over the others. Two debates should be conducted, one for personal vehicles and one for fleet vehicles.

CONCEPTS

- We use petroleum products for most transportation fuels today.
- Petroleum-based fuels produce emissions that can have a detrimental effect on air quality.
- There are many conventional and alternative transportation fuels.
- Some transportation fuels affect the environment more than others.
- Some transportation fuels are widely used, others are not.
- Some transportation fuels are more expensive than others.
- Some transportation fuels are more suitable for fleet vehicles, others for personal vehicles.

TIME

Four–five 45-minute class periods *(see alternative procedure on page 7)*

MATERIALS

- A set of **Transportation Fuels Debate Sheets** for each team.
- A set of **YES/NO** cards for the judges.
- Two transparencies of the **Game Board**.

PROCEDURE

Step One—Preparation

- Decide which fuels you will be using for each debate (personal and fleet vehicles), depending upon the number of students in the class or group. You need a minimum of three students in each group. For a large class, you can have half of the students participate in the personal vehicle debate and half participate in the fleet vehicle debate. For smaller groups, you can have all of the students participate in each debate.
- Make one copy of the **Debate Sheets** you will be using for each group in each debate.
- Make a transparency of the game board for each debate. Write in the fuels you have chosen for each debate in the blocks at the top of the boards. (It is suggested that you use gasoline, electricity, CNG, hybrid electrics, ethanol, hydrogen, and methanol for the personal vehicle debate and diesel, biodiesel, ethanol, hydrogen, CNG, propane, and hybrid electrics for the fleet debate.)
- Make sets of **YES/NO** cards for the judges.
- Decide who will be in each of the groups. If your students are not used to working in groups, you may want to give them guidelines for group work.

Step Two—Introduce the unit to the class

- Introduce the **Transportation Fuels Debate Game** to the class, using the concepts as a guide.
- Select a panel of judges. The teacher can serve as the judge, or each group can select one person from their team to serve as a judge. Each judge is given a **YES/NO** card.

Step Three—Monitor group work

- Once students are in their groups, explain the procedure. Answer any questions they have.
- Have each group complete the sheet of its fuel first. This should take about five minutes.
- Have the groups complete the sheets for the other fuels. This should take about twenty minutes.

Step Four—Play the game (personal vehicles first, then fleet vehicles)

Begin the game by giving the teams the following instructions:

- The object of this game is to be the first team to reach the top of the game board. The game is played in rounds, with each team given the opportunity to move its token up by giving an advantage of its fuel. You may instead choose to move an opponent's token down by giving a disadvantage of the opponent's fuel.
- The teams will present their advantages or disadvantages to a panel of judges. If a team gives an advantage of its fuel and the judges agree, then the team moves up one space. An opposing team can object to the judges' decision. The opposing team must convince the judges that the statement is not an advantage. The team that stated the advantage will then have the opportunity to defend its position. The judges will vote again and one of two things will happen. The judges may vote in favor of the defending team. In this case, the defending team maintains its new position and the opposing team moves down one space. Or the judges may decide the statement is a disadvantage or irrelevant. In this case, the defending team moves back to its original position.
- If a team states a disadvantage to try to move an opposing team down, then the opposing team can defend itself without penalty.
- Ask the first team to give an advantage or disadvantage. Action continues until one team reaches the top line, until time is called, or until each team has had the opportunity to begin a round. Each team should have the opportunity to begin a round.
- **DAY ONE—**complete the first round of the personal vehicle debate.
- **DAY TWO—**finish the remaining rounds of the personal vehicle debate.
- **DAY THREE—**complete the first round of the fleet vehicle debate.
- **DAY FOUR—**finish the remaining rounds of the fleet vehicle debate.

Step Five—Interpret the game results

At the conclusion of the game, point out that all transportation fuels have advantages and disadvantages. Ask the class the following questions:

Was there an obvious winner in either game?

If the game continued, would the results change? Why or why not?

Why do we use transportation fuels that have negative impacts on the environment?

What are some other factors that we need to consider in our choice of transportation fuels?

Have the students write short essays answering the following questions:

What was the purpose of playing this game?

What were the important concepts you learned from playing the game?

What fuel would you most likely use for a personal vehicle and why?

What fuel would you most likely use for a fleet and why?

OPTIONAL PROCEDURE

Step One—Preparation

- Make one set of **Transportation Fuel Debate Sheets** for each student participating, plus an additional set for each group.
- Make a transparency of the game board for each debate and write in the fuels you have chosen in the blocks at the top. (It is suggested that you use gasoline, electricity, hybrid electrics, ethanol, CNG, hydrogen, and methanol for the personal vehicle debate and diesel, biodiesel, ethanol, hydrogen, hybrid electrics, CNG and propane for the fleet debate.)
- Make a transparency of one of the debate sheets to explain the procedure, if necessary.
- Make sets of **YES/NO** cards for the judges.

Step Two—Introduce unit to the class

- Introduce the **Transportation Fuel Debate Game** to the class, using the concepts as a guide.
- Assign the students to either personal or fleet debate groups. Distribute one set of debate sheets for either personal or fleet vehicles to each student. Explain the procedure for completing the sheets, using the transparency, if necessary.
- Assign each student to complete all of the debate sheets in their debate group as classwork or homework.

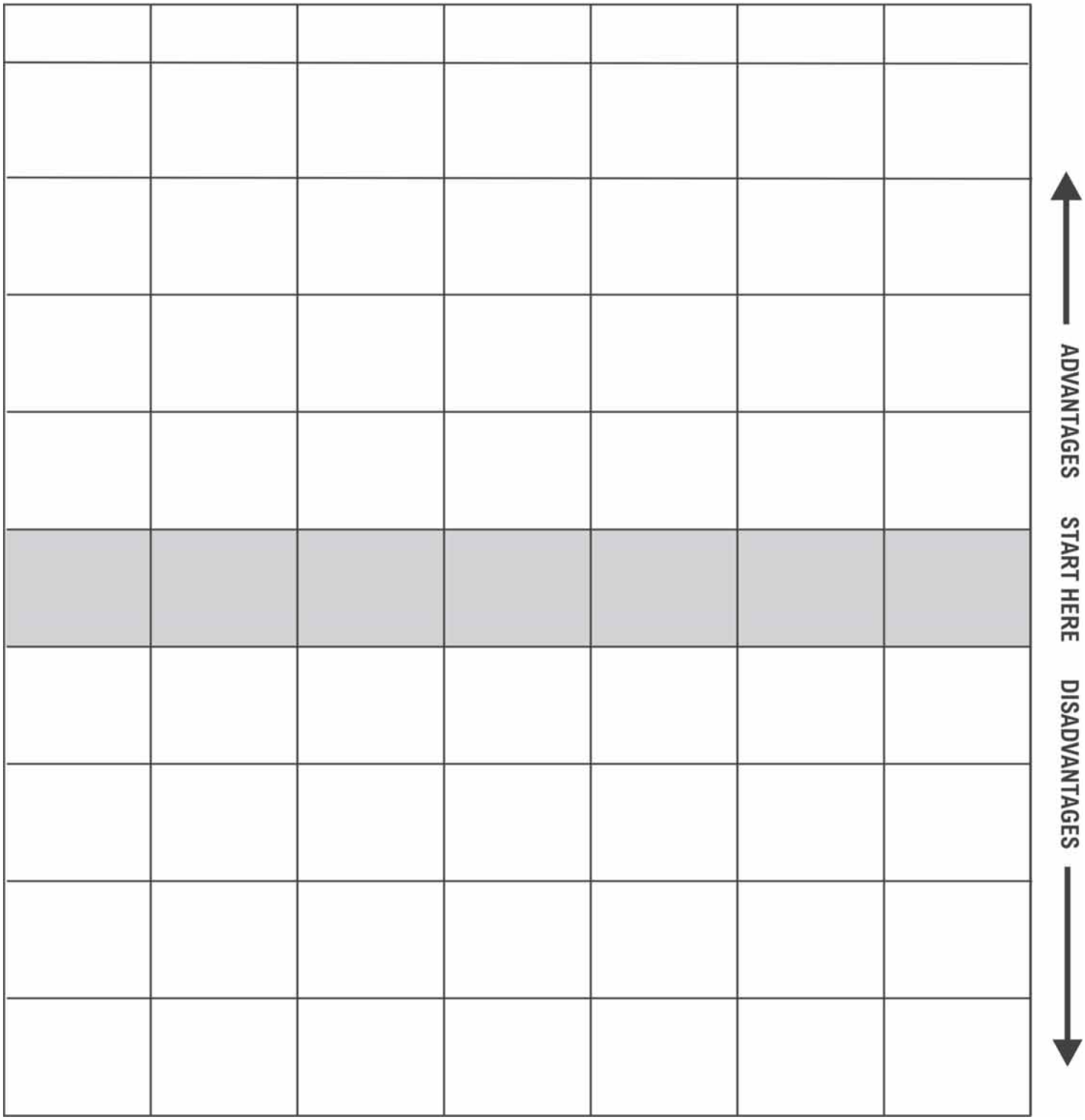
Step Three—Monitor group work

- Decide who will be in each of the fuel groups. If your students are not used to working in groups, you may want to give them guidelines for group work.
- Place students into groups. Distribute a set of debate sheets to each group according to topic. Have the students complete the debate sheets in their groups, using their individual sheets as guides. This should take about thirty minutes.

Step Four—Play the game using the instructions on page 6

Step Five—Interpret the game results using the instructions on page 6

TRANSPORTATION FUELS DEBATE GAME BOARD



GASOLINE

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Gasoline is a petroleum-based fossil fuel made of hydrogen and carbon.			
2. The chemical formula for gasoline is $C_8H_{15\text{-}18}$.			
3. Petroleum is a nonrenewable source of energy.			
4. Forty-five percent of crude oil is refined into gasoline in the U.S.			
5. The octane rating for gasoline is 86 to 94.			
6. Gasoline has a high energy content of 114,000 Btu/gallon.			
7. More than 95 percent of the vehicles in the U.S. use petroleum-based fuels.			
8. The U.S. has a vast infrastructure of refineries, pipelines, and filling stations to distribute gasoline efficiently and conveniently.			
9. The U.S. imports about two-thirds of the crude oil it uses from other countries.			
10. There are about 170,000 gasoline fueling stations in the U.S.			
11. There are about 200 million cars in the U.S. that use gasoline.			
12. The average gasoline-powered vehicles travels 12,000 miles per year.			
13. Vehicles that use petroleum-based fuels emit air pollutants.			
14. In the last 50 years, gasoline-powered vehicle emissions have decreased an average of 95 percent.			
15. In many metropolitan areas, vehicles contribute about half of the air pollution.			
16. Almost half of the people in the U.S. live in areas that do not meet air quality standards.			

DIESEL

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Diesel is a petroleum-based fossil fuel made of hydrogen and carbon.			
2. The chemical formula for diesel is $C_{16}H_{34}$.			
3. Petroleum is a nonrenewable source of energy.			
4. Diesel has a very high energy content; it contains 18-20 percent more energy per gallon than gasoline.			
5. About ten gallons of diesel are produced from every 42-gallon barrel of crude oil.			
6. Diesel is used in internal combustion engines designed specifically for diesel fuel.			
7. Diesel is used in more than two-thirds of all farm equipment because it can power demanding work.			
8. Ninety-four percent of the goods in the U.S. are moved by diesel-powered vehicles.			
9. The U.S. has a vast infrastructure of refineries, pipelines, and filling stations to distribute diesel efficiently and conveniently.			
10. The construction industry uses diesel-powered vehicles to perform heavy-duty jobs.			
11. Vehicles that use petroleum-based fuels emit air pollutants.			
12. In the last 50 years, petroleum-fueled vehicle emissions have decreased an average of 95 percent per vehicle.			
13. Today, there are approximately seven million commercial trucks and 700,000 buses on U.S. roads that use diesel.			
14. Diesel vehicles built today are eight times cleaner than those built 15 years ago.			
15. Using low sulfur diesel fuel and advanced exhaust control systems can reduce particulate emissions by 90 percent and nitrogen compounds by 25-50 percent.			
16. Almost half of the people in the U.S. live in areas that do not meet air quality standards.			

PROPANE (LPG)

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Propane is a fossil fuel, sometimes called liquefied petroleum gas or LPG.			
2. The chemical formula for propane is C_3H_8; propane is a hydrocarbon.			
3. Propane is a by-product of petroleum refining and natural gas processing.			
4. Propane is a nonrenewable source of energy.			
5. Under normal pressure and temperature, propane is a gas. Under moderate pressure or lower temperature, propane can be converted into a liquid and stored in pressurized tanks.			
6. As a liquid, propane is 270 times more compact than as a gas.			
7. There is an infrastructure of pipelines and distribution terminals in the U.S. to transport propane.			
8. There are about 2,300 propane vehicle fueling stations in the U.S.			
9. Propane has been used as a transportation fuel for more than 75 years.			
10. About three percent of propane consumption is for transportation.			
11. After petroleum-based fuels, propane is the most widely used and accessible transportation fuel.			
12. Today, about 270,000 vehicles, mostly fleet vehicles such as mail trucks, use propane fuel.			
13. For fleet vehicles, the cost of using propane is five to 30 percent less than gasoline.			
14. Propane is cleaner burning than gasoline and produces less air pollution.			
15. The octane rating for propane (104) is equal to or higher than that of gasoline.			
16. It costs about $2,500 to convert a conventional automobile engine to use propane fuel.			

ETHANOL

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Ethanol is an alcohol fuel made by fermenting the sugars in grains and other plants.			
2. The chemical formula for ethanol is C_2H_5OH.			
3. The most commonly used processes today use yeast to ferment the sugars to produce ethanol.			
4. A new process being developed uses enzymes to break down the cellulose in woody fibers, making it possible to produce ethanol from trees, grasses, and crop residues.			
5. Ethanol is made from renewable sources of energy.			
6. The use of ethanol provides new markets for U.S. agriculture.			
7. Since ethanol contains oxygen, adding it to gasoline reduces ozone-forming and carbon monoxide emissions.			
8. Gasoline containing 10 percent ethanol—E10—is used in many urban areas that fail to meet air quality standards for carbon monoxide and ozone.			
9. Vehicles can use E10 without any changes to their engines.			
10. The Federal government provides incentives to use ethanol.			
11. Conventional vehicles cannot use E85—a mixture of 85 percent ethanol and 15 percent gasoline.			
12. Flexible fuel vehicles (FFVs) are manufactured to use any combination of ethanol and gasoline up to E85.			
13. Today there are about 5 million FFVs that can use E85.			
14. The octane rating for ethanol is 100, slightly higher than that of gasoline.			
15. The energy content of ethanol is about 15 percent less than that of gasoline.			
16. There are more than 1,400 E85 fueling stations in the U.S., mainly in the Midwest and South.			

CNG/LNG

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Natural gas can be used as a vehicle fuel when it is compressed (CNG) or liquefied (LNG) by lowering its temperature to -259^{0}F.			
2. The formula for natural gas is CH_4.			
3. Natural gas is a nonrenewable fossil fuel.			
4. Natural gas is a clean-burning fuel. It produces very low emissions of ozone-forming hydrocarbons, toxics, and carbon monoxide.			
5. Methane—the main ingredient in natural gas—can be produced from biomass, a renewable energy source.			
6. When compressed, natural gas has less energy per gallon than gasoline, so vehicle range is shorter unless additional tanks are added, which reduces payload capacity.			
7. CNG has an octane rating of 120+, which provides good power and acceleration to vehicles.			
8. Today, there are about 140,000 vehicles in the U.S. that run on CNG.			
9. Conventional vehicle engines can be converted to use CNG at a cost of $2,000 - $3,000, depending on the number of pressurized tanks installed.			
10. The production and distribution systems for natural gas are in place, but the delivery system of fueling stations is not extensive.			
11. CNG vehicles are well suited for fleets that have their own refueling stations.			
12. There are about 3,100 vehicles in the U.S. that run on LNG.			
13. LNG takes up much less space than CNG, so the tanks are much smaller.			
14. LNG tanks must be kept cold, which uses energy.			
15. CNG and LNG tanks are designed to be safe in case of accidents.			
16. There are about 790 natural gas refueling stations in the U.S.			

ELECTRICITY

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Electricity can be produced by many sources of energy.			
2. Electric vehicles must have batteries that can be discharged and recharged repeatedly.			
3. Most batteries cannot store large amounts of electricity, so electric vehicles must carry several batteries.			
4. In some electric vehicles, the batteries constitute half the weight of the vehicle.			
5. The batteries in electric vehicles must be replaced every three–six years.			
6. A typical electric vehicle can travel 50 - 130 miles between charges.			
7. Weather conditions, terrain, and accessory use can reduce the range of an electric vehicle.			
8. Electric vehicles are best suited for neighborhood vehicle use, for consumers going short distances at 30 mph or less.			
9. Extensive research is ongoing to develop longer-lived batteries that will also extend the range of electric vehicles.			
10. Electric vehicles produce no tailpipe emissions.			
11. Some power plants - such as coal-fired plants - that generate electricity produce air pollution.			
12. It is easier to control the emissions from power plants than from vehicles.			
13. Electric vehicles are low maintenance; they require no tune-ups, oil changes, water pumps, radiators, injectors, or tailpipes.			
14. Electric vehicles can be recharged at home at night when electricity rates and demand are low.			
15. There are about 440 electricity refueling stations, mostly in California and Arkansas.			
16. Consumers who drive electric vehicles receive tax incentives.			

HYBRID ELECTRIC

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Hybrid vehicles have two power sources—an energy conversion unit (such as an internal combustion engine) and an energy storage device (such as a battery).			
2. The typical hybrid on the market today has a gasoline-powered engine and an electric motor with a battery.			
3. Hybrid electric vehicles (HEVs) can have either a series or parallel design.			
4. In a parallel design, the engine and motor are connected directly to the vehicle's wheels. The primary engine is used for highway driving; the electric motor provides added power during periods of high demand.			
5. In a series design, the primary engine is connected to a generator that produces electricity. The electricity charges the batteries and drives a motor that powers the wheels.			
6. HEVs can function as purely electric vehicles for short trips, using the internal combustion engine only when longer range or more power is required.			
7. HEVs can get twice the fuel economy of comparable conventional vehicles.			
8. HEVs have generators powered by the internal combustion engines to recharge the batteries when they are low.			
9. HEVs have regenerative braking systems that capture excess energy when the brakes are engaged; this recovered energy is also used to recharge the batteries.			
10. HEVs reduce air pollutants by one-third to one half over gasoline-powered vehicles.			
11. HEVs have a higher purchase price than comparable gasoline-powered vehicles.			
12. Tax incentives and superior fuel economy produce savings over the life of the vehicles to make them competitive with gasoline-powered vehicles.			
13. Today, there are several hybrids available to consumers, including the Toyota Prius, Honda Insight and Civic, and Ford Escape SUV.			
14. HEVs on the market today average 40-60 mpg and can travel 500-700 miles on one tank of gasoline.			
15. Within the next few years, there will be many models of HEVs to meet consumer needs, including trucks and SUVs.			
16. Hybrids use established gasoline fueling stations.			

BIODIESEL

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Biodiesel is a fuel made by chemically reacting alcohol with organic fats, oil, or grease. Most biodiesel is made from soybeans.			
2. Biodiesel is a renewable fuel.			
3. Biodiesel is usually blended with diesel fuel in different percentages, such as B20, which is 20 percent biodiesel.			
4. Neat (or pure) biodiesel (B100) can also be used as a transportation fuel.			
5. Biodiesel fuels can be used in regular diesel engines without modifications.			
6. Biodiesel fuel can be used in the existing fuel infrastructure.			
7. Biodiesel is the fastest growing alternative transportation fuel.			
8. Biodiesel contains no sulfur and can reduce the amount of sulfur in the nation's diesel fuel supply.			
9. Adding biodiesel in small amounts to regular diesel fuel improves the lubrication qualities of diesel fuel without sulfur.			
10. Biodiesel can improve the smell of diesel fuel.			
11. Biodiesel reduces air pollutants such as particulates, carbon monoxide, hydrocarbons, and air toxics.			
12. Using biodiesel slightly increases the emissions of nitrogen oxides.			
13. Today, biodiesel is mainly available through bulk suppliers. There are about 644 fueling stations.			
14. Biodiesel is well suited for fleets with their own refueling stations.			
15. Biodiesel fuel is more expensive than regular diesel fuel.			
16. Using biodiesel can reduce maintenance cost because of its good lubricating characteristics.			

METHANOL

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Methanol, or wood alcohol, is a simple alcohol fuel.			
2. Methanol (CH_3OH) is made by replacing one hydrogen atom of methane with a hydroxyl radical (OH).			
3. Methanol can be produced from natural gas, coal, oil, or biomass.			
4. Today, most methanol is made from natural gas.			
5. Most methanol plants are located in conjunction with ammonia plants, since both use the same gas in the production process.			
6. Methanol was widely used to produce MTBE, a gasoline additive in declining use because of concerns about ground water pollution.			
7. Methanol can be used in its pure form (M100) or blended with 15 percent gasoline (M85).			
8. No major auto manufacturers offer methanol-compatible vehicles at this time.			
9. The cost of M85 is equal to or slightly higher than premium gasolines.			
10. There is no distribution infrastructure for methanol today.			
11. With an octane rating of 105, methanol can provide superior power to vehicles and is used in several racing classes.			
12. Methanol is a cleaner burning fuel than gasoline, producing fewer hydrocarbon emissions.			
13. Methanol produces more formaldehyde emissions than gasoline.			
14. Today, there are about 4,600 vehicles in the U.S. that use M85.			
15. M85 has lower energy content than gasoline, so vehicle mileage is reduced.			
16. Vehicles that use methanol must use a special, expensive lubricant.			

HYDROGEN

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Hydrogen is the most abundant element in the universe.			
2. Pure hydrogen does not exist on Earth; it is only found in molecules with other elements.			
3. Hydrogen is a gas at normal temperature and pressure.			
4. Hydrogen can be produced from water by electrolysis, a process in which water molecules are separated into hydrogen and oxygen using electricity.			
5. Today, it takes more electricity to electrolyze water than is produced by the hydrogen fuel.			
6. Hydrogen can be produced from natural gas, coal, or biomass.			
7. Today, most hydrogen comes from the steam reforming of natural gas, a nonrenewable energy source.			
8. Fuel cells use hydrogen and oxygen to produce electricity without harmful emissions; water is the main by-product.			
9. No hydrogen production or distribution infrastructure exists at this time.			
10. Hydrogen gas takes up six times as much space as gasoline per energy equivalent.			
11. The production of hydrogen is very expensive today.			
12. Fuel cells are an expensive method of producing electricity today.			
13. Hydrogen is the fuel used in the space shuttles.			
14. There no hydrogen fuel cell vehicles on the market today and only 35 fueling stations for test vehicles.			
15. There is ongoing research into hydrogen fuel cell technology.			
16. The Bush administration has launched a hydrogen fuel cell initiative to support research and development of new technologies.			

TRANSPORTATION FUELS DEBATE GAME

Evaluation Form

State: _____ Grade Level: _____ Number of Students: _____

1. Did you conduct the entire activity?	Yes	No
2. Were the instructions clear and easy to follow?	Yes	No
3. Did the activity meet your academic objectives?	Yes	No
4. Was the activity age appropriate?	Yes	No
5. Were the allotted times sufficient to conduct the activity?	Yes	No
6. Was the activity easy to use?	Yes	No
7. Was the preparation required acceptable for the activity?	Yes	No
8. Were the students interested and motivated?	Yes	No
9. Was the energy knowledge content age appropriate?	Yes	No
10. Would you use the activity again?	Yes	No

How would you rate the activity overall (excellent, good, fair, poor)?

How would your students rate the activity overall (excellent, good, fair, poor)?

What would make the activity more useful to you?

Other Comments:

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Puerto Rico Energy Affairs Administration
Puget Sound Energy
Roswell Desk and Derrick Club
Roswell Geological Society
Rhode Island State Energy Office
Sacramento Municipal Utility District
Saudi Aramco
Schlumberger
Sentech, Inc.
Shell Exploration and Production
Snohomish County Public Utility District–
WA
Society of Petroleum Engineers
David Sorenson
Southwest Gas
Spring Branch Independent School
District–TX
Tennessee Department of Economic and
Community Development–Energy Division
Toyota
TransOptions, Inc.
TXU Energy
University of Nevada–Las Vegas, NV
United Illuminating Company
U.S. Environmental Protection Agency
U.S. Department of Energy
U.S. Department of Energy–Hydrogen,
Fuel Cells and Infrastructure Technologies
Virgin Islands Energy Office
Virginia Department of Mines, Minerals
and Energy
Virginia Department of Education
Virginia General Assembly
Wake County Public Schools–NC
Western Kentucky Science Alliance
W. Plack Carr Company
Yates Petroleum