

Exploring Alternative-Fuel Vehicles



Target Grade Levels

Third - Fifth

Time

Three 45 minute sessions

Materials

- resources
- display list of vocabulary words
- computers with Internet access
- large sheets of butcher paper
- markers or tempera paint
- grid paper
- four large sheets of paper with one of the following topic headings on each:
 - Model solar cars
 - Solar car races
 - Electric cars
 - Gasoline, cars and smog
- form of assessment questions
- model solar car kits
1 kit per 3 students

Knowledge and Skills (TEKS)

- Science:
 - Make wise choices in the use and conservation of resources and the disposal or recycling of materials;
 - Analyze and interpret information to construct reasonable explanations from direct and indirect evidence;
 - Analyze, review, and critique scientific explanations; and
 - Identify the sun as the major source of energy for the earth and understand its role in the growth of plants, in the creation of winds, and in the water cycle.
- Language Arts:
 - Communicate valid conclusions.
- Math:
 - Construct simple graphs, tables, maps and charts to organize, examine, and evaluate information.

Overview

Students will learn about using vehicles that are powered by renewable forms of energy. Students will engage in a class discussion, create a word wall, and work in groups and gather information about specified topics in renewable energy. Students will present a topic using written explanation and various visual aids.

Background Information

Renewable energy was used for transportation long before any other energy source.

For hundreds of thousands of years, humans used only their own energy to get around. Later, they learned to use animals for this. People and animals get their energy from food. Since the energy in food comes from sunlight, food is a form of renewable energy.

We eat plants, and plants are sometimes called biomass. Biomass can also be used to produce biofuels, like ethanol, to power our automobiles.

A few thousand years ago people discovered that they could use the wind to move them around. Think about how fast sailboats can move. Wind is another form of renewable energy.

Less than 200 years ago, people started using fossil fuels (such as coal and oil) to power vehicles for transportation. These fuels can't last forever, so they are not renewable. And they cause air pollution.

With new technology, there are new we can use renewable energy to reduce air pollution.

Procedure

- 1) Vocabulary
 - a) alternative
 - b) biomass
 - c) ethanol

- d) fossil fuel
- e) green electricity
- f) kilocalorie
- g) pollution
- h) renewable energy
- i) solar
- j) sustainable
- k) SUV

2) Activities

a) Assess Current Level of Knowledge

- i) Create a way of visually organizing information to display what the students already know about renewable forms of energy production. To assess what students know, prompt a class discussion with questions such as:
 - (1) What is the difference between renewable and non-renewable energy?
 - (2) What types of nonrenewable forms of fossil fuels are used in Texas?
 - (3) Why has coal, oil, and natural gas been the primary energy source used in the 20th century to produce electricity?
 - (4) How do these affect our environment? What are the major types of renewable energy in Texas?
 - (5) Why are wind and sun renewable forms of energy?
 - (6) How do these affect the environment?
 - (7) How is wind energy used in Texas to produce electricity?
 - (8) What are some of the good reasons to depend upon renewable energy sources?
 - (9) Are there enough renewable forms of energy to provide all our needs?

b) Language Arts

- i) Create a “word wall” by displaying the key vocabulary words.
- ii) Working in groups, have students write down the vocabulary words in their science notebooks and find the definitions in the dictionary or from reading the fact sheet. Evaluate understanding by having the students either create meaningful sentences with the words or create a story using the words.

c) Cooperative Group Work

- i) Explain to the class that each group will give a class presentation on one of the four Solar and Electric Cars topics (Model Solar Cars; Solar Car Races; Electric Cars; and Gasoline, Cars and Smog). Let the students know that each group must:
 - (1) summarize in clear and concise language the information within its topic;
 - (2) support its summary with details; and
 - (3) present some type of visual aide, different from any found in the fact sheet, to help explain and teach its topic. A written explanation should accompany the visual aide.

- ii) As a class, create clear expectations for presentations by writing down what the students and teacher agree upon to be a quality presentation and what are effective behaviors by listeners during presentations. This could lead into developing a rubric, or system of standards for grading purposes, if the teacher desires.
- iii) Display the four pieces of paper with the topic headings. Divide the class into groups of four or five. Assign or allow groups to choose the topic.
- iv) Instruct the model solar cars group to use grid paper and design a schematic of a model solar car using information from this Internet site: www.nrel.gov/business/education/SprintWeb and the fact sheet. Have them answer the question: How does a model solar car get its power to move?
- v) Have the solar racecars group research this Internet site: solarcar.arizona.edu. Have them answer the following questions: What is the racecourse and about how long does it take the winning car to complete it? What do engineers have to keep in mind, when designing their cars, to allow them to run at optimum potential?
- vi) The electric cars group can research other forms of electric transportation at this site: www.electricbikes.com/. Have them answer the following questions: How does an electric car work? How is it different from a solar car?
- vii) Have each group present its topic with the mandatory elements. The listeners should be encouraged to generate questions in order to broaden their scope of understanding. After each presentation, the class as a whole should generate an outline of the information on the paper for that topic. If time allows, students can copy the outline into their science notebooks. After each group presents, new information can also be added to the graphic information-organizer that was created at the beginning of the lesson.

3) Review

- a) Each group that presented a topic can verbally quiz the class on the topic they presented (do this at least One hour after the presentation took place to ensure long-term memory recall).
- b) The teacher can then further quiz the students that presented each topic to further draw out their opinions on how alternative fuels can be more widely and better applied in the local area, inviting the class to discuss as a whole.

4) Evaluation

- a) Have the students answer the questions below in complete sentences, reflecting the question in their answers. Alternatively, the class can answer the questions as a group discussion either instead of a written assignment or as a review before giving it to them as a test.
 - i) Explain what biomass is and give three examples.
 - ii) How can biomass help produce fuels to power our automobiles?
 - iii) Wind is another form of renewable energy. How can wind be used to help with our transportation needs?

- iv) List two disadvantages of depending on fossil fuels for our transportation needs?
- v) What are two alternative types of transportation that don't use fossil fuels?
- vi) List two ways electric cars are different from solar cars.
- vii) How are solar and electric cars alike?
- viii) Are gasoline-powered cars more efficient or less efficient than electric cars?
- ix) How does a model solar car get its power to move?
- x) Which uses more energy: an SUV or an electric car?

b) Possible Answers to Assessment Questions:

- i) Biomass is all living matter. In terms of energy sources, biomass comes from plants, like corn or quick grass, and from garbage.
- ii) Corn is biomass, and it can be used to produce ethanol, a renewable biofuel.
- iii) Wind generators can produce "green" electricity to supply energy or power for electric cars.
- iv) We cannot depend on fossil fuels because their supply is limited, and they pollute our atmosphere.
- v) Two alternative forms of transportation are solar and electric cars.
- vi) Electric cars plug into an electric outlet for energy while a solar car uses a solar panel. However, the panel could be separately built. Electric cars don't have to carry fragile solar panels so they can be larger and carry more people.
- vii) Both solar and electric cars don't burn gasoline, so the motor does not produce air pollution. However, electricity to charge-up the vehicle may be from coal, oil or gas power plants.
- viii) Gas-powered cars are less efficient than electric cars.
- ix) A model solar car gets its power from a solar panel that converts light from the sun into electrical power. It is then transmitted by a wire to the motor, causing the drive shaft to turn, which causes the wheels to spin and moves the car.
- x) A sport utility vehicle takes a great deal more energy to run than a compact sedan because they are heavier and therefore less fuel-efficient.

5) Extension

a) Class Discussion

Introduce the following scenario to the class and prompt discussion: The year is 2005 and fossil fuel reserves, especially oil, have drastically declined because of increased use and population growth. Oil prices have soared so high most people are not able to purchase gasoline for their vehicles. As a community, use the information you have discovered and develop a plan for becoming sustainable. As the students begin to brainstorm ideas, use graphic-organizers, such as webs, to display their concepts.

b) Narrative Writing

Have the students write a narrative story from the class discussion. Students need to develop the setting with “who, when and where” statements and develop a story line leading to a climax and a conclusion.

c) Building Model Solar Cars

If model solar car kits are available, divide the class into groups of three and have them follow the instructions for building a solar car. With help from outside mentors, this takes about 4 hours of class time. The best approach to conduct this activity is to first build a car. Once you have built a car, you can determine the best way to use this activity in your classroom: either strictly following the kit instructions or allowing the students to be flexible in their design and construction; or you may simplify or expand on the instructions yourself and distribute them to the class. The following are guidelines to instruct students on the activity that can be posted:

- i) Examine and test all your parts, and make sure you have all the parts and test them.
- ii) Design and draw your solar car by using your imagination and creativity as a team to design your car. Think about the important features of the car. Should it be lightweight? Low to the ground? Motor in the front or rear? What gear ratio?
- iii) Construct the body of the car by using your design; construct the body of the car.
- iv) Install the motor, wheels and solar panel with the assistance of a mentor or teacher, install the final parts. Soldering the wires to your motor and alligator clips make a better electrical connection.
- v) Test the car and make final adjustments, and then take the car out into the sun and do a test run!
- vi) Race your car with others!

d) “Comparing Energy Used” Bulletin Board

Create a classroom or hallway bulletin board depicting the concept of “doughnut energy” from the fact sheet to compare transportation energy used. Encourage students to be creative in how they want to transfer the information onto the bulletin board. Suggest they choose an object other than doughnuts for comparison.

SOLAR AND ELECTRIC CARS



RENEWABLE ENERGY
THE INFINITE POWER
OF TEXAS

FACT SHEET 7 A RESOURCE FOR CLASSROOMS AND TEACHERS

Highlights

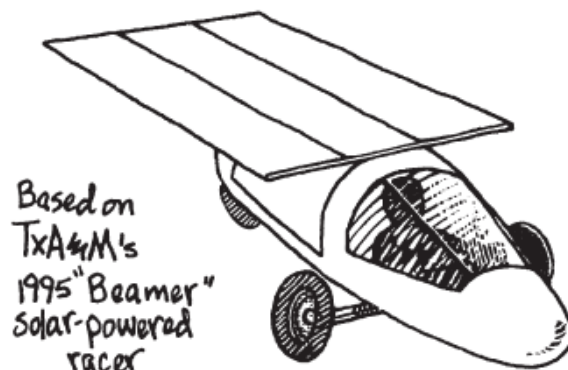
- ◆ Renewable energy for transportation
- ◆ Solar-powered model cars: The Junior Solar Sprint Project
- ◆ Electric- and gasoline-powered cars and air pollution
- ◆ Compare the doughnut energy used

Renewable Energy and Transportation

Renewable energy was used for transportation long before any other energy source.

For hundreds of thousands of years, humans used only their own energy to get around. Later, they learned to use animals for this. People and animals get their energy from food. Since the energy in food comes from sunlight, food is a form of renewable energy.

We eat plants, and plants are sometimes called biomass. Biomass can also be used to produce biofuels, like ethanol, to power our automobiles.



POWERED BY THE SUN A solar-powered car has a panel of photovoltaic cells that convert sunlight into electricity.

A few thousand years ago people discovered that they could use the wind to move them around. Think about how fast sailboats can move. Wind is another form of renewable energy.

But less than 200 years ago, people started using fossil fuels (such as coal and oil) for transportation. These fuels can't last forever, so they are not renewable. And they cause air pollution.

But with new technology, there are new ways we can use renewable energy to get around and reduce air pollution.

Model Solar Cars

Model solar-powered cars have some parts that are similar to a family car, but the power system is very different. Here is how they work:

- a solar panel converts light energy from the sun into electrical power
- that power is transmitted by a wire to the motor, causing the drive shaft to turn
- the drive shaft causes the wheels to spin
- the spinning wheels move the car forward

Solar Race Cars

Since a full-sized race car's solar panel is much larger than a model car's, it can capture more solar energy and produce more electricity. Solar race cars have a battery bank that stores some of the sun's energy while it is stopped or driving slowly.

If the car is driving fast, all of the power from the solar panel is used by the motor. In some

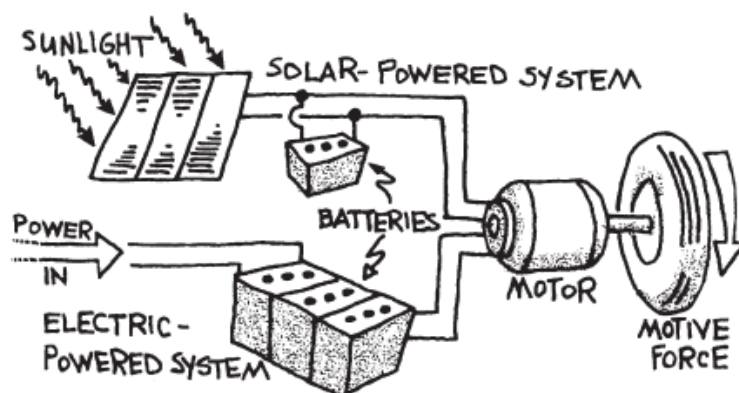
THE JUNIOR SOLAR SPRINT PROJECT

In this project, students form small teams to design and build model solar-powered cars. Teams then compete to determine the fastest car. For more information, check the internet at www.txses.org/tjss or send an e-mail to solarsprint@txses.org

cases, the car may need more power than the panel can provide. Then the motor uses energy stored in the batteries.

Electric Cars

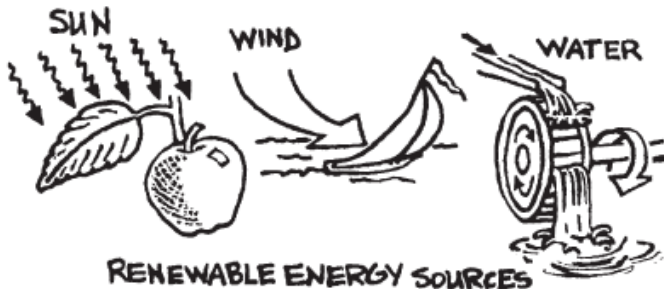
Electric-powered cars are very similar to solar-powered cars. But instead of carrying a solar panel for energy, electric cars plug into an electric power outlet, similar to the ones in your classroom or at home. The electricity from the outlet can come from renewable energy sources.



SOLAR AND ELECTRIC-POWERED CARS Sunlight or electricity can be used to power a car's motor instead of gasoline or diesel.



RENEWABLE ENERGY
THE INFINITE POWER
OF TEXAS



RENEWABLE ENERGY SOURCES

CLEAN POWER SOURCES FOR ELECTRIC CARS Many renewable energy sources can be converted to electricity to power electric cars.

Because electric cars don't have to carry the fragile solar panels, they can be larger and can carry more people.

Just like solar cars, electric cars don't burn gasoline, so the motor does not produce air pollution. If they use power from nonpolluting power plants, like wind turbine farms, then they don't produce any pollution.

If you drove an electric car, you would recharge its battery bank overnight while you slept.

Gasoline, Cars and Smog

Gasoline-powered cars are much less efficient than electric cars. They also produce air pollution, such as smog. Air pollution can be harmful to your health. It also can make the air look dirty and make it hard to see pretty sights like city skylines and mountain ranges.

LET'S COMPARE THE ENERGY USED

We can compare the amount of energy used by four kinds of transportation: a bicycle, a solar car, an electric car and a gasoline-powered sport utility vehicle. There are a number of ways to measure energy. For this comparison, we'll use doughnuts.



1. A 60-pound girl riding her bike at 10 miles per hour burns up 24 kilocalories per mile. A typical glazed doughnut provides her body 245 kilocalories. About how much doughnut-energy does she burn per mile?
2. The fastest solar car is almost as efficient as the girl on her bike. It uses 30 kilocalories per mile. How much doughnut-energy does it use?
3. One of the most efficient electric cars you can buy is the General Motors EV-1. Since it can store more energy than a solar car, it doesn't have to be as efficient as the solar car. The EV-1 would use 214 kilocalories per mile. How much doughnut-energy would it use per mile?
4. One of the least efficient cars you can buy is the General Motors Chevy Suburban. A Suburban uses 2,729 kilocalories per mile. How much doughnut-energy would it need per mile?

ANSWERS

1. The girl burns about one-tenth of a doughnut per mile.
2. It uses about one-eighth of a doughnut per mile.
3. It would need about nine-tenths of the doughnut.
4. About 11 doughnuts!

 60-LB GIRL ON BIKE 

 SOLAR CAR 

 ELECTRIC CAR 

GMC SUBURBAN

DOUGHNUTS REQUIRED TO TRAVEL ONE MILE
(1 DOUGHNUT = 245 KILOCALORIES)

ANSWER TO "LET'S COMPARE THE ENERGY USED" It takes far more energy to run a gasoline-powered car than a solar- or electric-powered car.