In the Driver's Seat

Activities from Project Learning Tree focusing on fuel economy, alternative means of transportation and what can be done to improve it.

Target Level:
Grades 5-8

Subjects:
Science, Social Studies, Math

Materials Needed:
- Consumer magazine with information about 20 or more different vehicle makes and models;
- chart paper;
- pens or crayons;
- chalk or rope;
- copies of student page

Time Considerations:
- Preparation: 20 minutes
- Activity: Two 50-minute periods

Concepts

- By reducing waste and recycling materials, individuals and societies can extend the value and utility of resources and also promote environmental quality. (5.4)
- Consumers "drive" the marketplace with their demands for goods and services. Such demands shift with time and may have positive or negative effects on the resource base and environmental quality. (15.2)
- Increased public knowledge of the environment and the need for conservation of natural resources have resulted in lifestyle changes in many cultures. (15.5)

Skills

- Identifying Relationships and Patterns
- Analyzing
- Making Decisions
- Organizing Information

Objectives

Students will:
- gain knowledge about the differences in fuel economy between different vehicles, and
- explain strategies for reducing the amount of fuel used by vehicles.

Overview

In this activity, students learn about gasoline, then explore fuel conservation and energy efficiency by simulating the distance they can travel on a set amount of gasoline using different vehicles.

Background

Transportation plays an important part in our everyday lives. We rely on cars, buses, trains, bicycles, and even our own feet to take us where we need to go. All of these methods are powered by some source of energy. For example, most cars today run on gasoline.

Gasoline is a refined product of crude oil, or petroleum. The word petroleum comes from the Latin words "petra" meaning rock and "oleum" meaning oil. Petroleum is a fossil fuel formed millions of years ago from the remains of microscopic organisms. As these tiny plants and animals died they sank to the sea floor, and over many centuries they were buried with sand and mud. With increased pressure and heat from the layers above, the tiny organisms were transformed, ever so slowly, into hydrocarbons, the building blocks for petroleum and natural gas.

Most of the petroleum consumed in the United States is used for transportation. The process to convert petroleum into gasoline and other products begins at the refinery. The United States has more than 170 active refineries.

Follow the refinery process on the teacher page. From a well to a pipeline, the incoming petroleum is treated to remove sulfur, nitrogen, and trace metals. The next step takes advantage of the fact that different hydrocarbons boil at

different temperatures. In a fractionating tower the petroleum is heated until it boils. Horizontal trays divide the column at different levels. As the petroleum boils, it vaporizes. Each hydrocarbon rises to a tray at a temperature just below its own boiling point. There, it cools and turns back into a liquid. This process separates the petroleum into different products. These products go through additional processing (cracking/coking, alkylation, blending and removal of impurities) to become the products we use each day.

Improved refining technologies have made it possible to produce more than 19 gallons of gasoline from a barrel (42 gallons) of petroleum. This is a remarkable advance over the industry's early days, when a barrel of petroleum yielded just 11 gallons of gasoline. Diagram 1 shows the percentage of different products that are refined from a typical barrel of crude oil.

The final step of the refining of gasoline is purifying and fine-tuning the fuels to meet today's performance and environmental standards. Additives that keep engines clean and increase oxygen help today's gasolines burn cleaner.

While gasoline is a versatile fuel, yields a relatively high amount of energy, and is easy to transport, when combusted (burned) it releases carbon dioxide and other pollutants into our atmosphere. Over the years, technological advancements have led to many improvements in automobile emissions and fuel economy. Those improvements have included the introduction of catalytic converters, the construction of lighter and more energy efficient cars, and the development of cleaner fuels (by eliminating lead in gasoline and reducing the amount of sulfur in diesel fuel).

Much can be done on the part of consumers to ensure this progress continues. One example is to use gasoline more efficiently by carpooling, planning trips more efficiently, and getting regular tune-ups for your car. Another example is to find alternatives to driving such as walking, bicycling, and using public transportation.

One of the most important environmental decisions a consumer can make is choosing a car with good fuel mileage. In general, small cars have better fuel economy than larger cars, and cars have better fuel economy than vans, sport utility vehicles, and trucks. Fuel economy is measured in terms of miles per gallon, that is, the number of miles you can drive in that vehicle on a gallon of gas.

Electric vehicles are gaining attention as an option for reducing air emissions. However, their use is limited because the batteries are expensive, heavy, and store little power, allowing a car to travel only 60-70 miles on a charge.

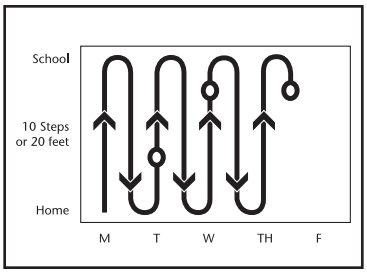
Electric vehicles are sometimes referred to as "zero-emission" vehicles because they produce virtually no pollution through fuel evaporation or burning. However, while electric cars themselves are clean, generating the electricity to charge the vehicle batteries produces air pollution and solid waste.

Hybrid vehicles, which combine two power sources, are another option to reduce gasoline use. These vehicles have a small, clean, internal combustion engine combined with an electric motor powered by batteries. They recover energy when braking, will shut off the gasoline engine when stopped, use advanced aerodynamics to reduce drag, use low-rolling resistance tires, and use light-weight materials to reduce the weight of the vehicle. This combination of features allows these hybrid cars to achieve better gas mileage and still have a similar range, performance, and convenience of conventional gasoline cars.

Fuel cells are yet another viable alternative fuel source for vehicles. Like batteries, fuel cells rely on chemical reactions rather than combustion. Many fuel cell prototypes have been developed but cost continues to be a challenge.

Getting Ready

Review the sample travel log on the next page. View the EPA websitehttp://www.fueleconomy.gov. Become familiar with the process of looking up different vehicles and determining the miles per gallon the vehicles achieve. On a playing field or in a multi-purpose room, mark two lines that are about 10 steps apart (20 feet). Label one line "home" and the other "school." Divide the width of the area into 5 days – Monday through Friday. See diagram at right.



Doing the Activity

Part A

1. Begin a discussion with your students about how they get around in their community. What methods of travel do they use? What sources of energy do they use? How far do they travel? Keep a list of their answers to compare after they complete the Weekly Log.
2. Instruct students to calculate the amount of miles their family vehicle travels during a week. Students without vehicles should estimate the number of miles they travel (walk, bus, etc.). See the "Sample Travel Log" on the Teacher Page. Students should work with a parent or gaurdian and record the mileage of the vehicle(s) on Sunday evening. Throughout the week, they will log the use of the vehicle, the purpose of the trip, the type of travel, and mileage. They will record the mileage again the following Sunday evening.
3. Discuss the findings with the students. What was the average mileage per vehicle? Average mileage per student? Compare the findings with the list developed at the beginning of the activity.
4. Ask students what they think gasoline is made from? How is it made? Where do we get petroleum from? What are some different products that are made from petroleum? What different types of gasoline are they familiar with? Discuss how a refinery operates. Make a list of how students use gasoline. What are some impacts of using gasoline?

Part B

1. Ask students what type of vehicle they would like to drive. Why did they choose this vehicle?
2. Have students select and research a vehicle make and model of their choice. They should get a picture (newspaper, brochures, magazines) or create a drawing of their vehicle. The students should determine the number of people the vehicle holds and check the EPA Fuel Economy website for the mpg rating. Other information could include: type and size of engine, cost, and options that are available.

   Students will do a simulation in which they will use their vehicles to "drive" to school and then home again for 5 days. Give the students 3 poker chips to represent 3 gallons of gasoline. For the purpose of the simulation their vehicle will go "steps per gallon" instead of miles per gallon. For example, if the vehicle is rated 24 mpg, every 24 steps they will drop a chip to indicate they have used a gallon of gasoline.

   Have the students begin at the line marked home in the Monday area (see diagram). They will count the number of steps they take to travel to school (10) and then return home for Monday. They will drop a chip each time they use one gallon of gasoline. Do the same with Tuesday. Continue for one week. Have the students stop in place when they "run out" of gasoline. Which vehicles ran out first? Do any still have gasoline?
3. For Round 2, give each student 3 chips again. Challenge the students to think of a way to get the greatest amount of trips using the same amount of gasoline. How can they increase it? (They might suggest carpooling but the limit is the number of people the vehicle holds).
4. For Round 3, give each student 3 chips again. A bus arrives that can carry 45 people and gets 5 mpg (EPA Estimate). Pooling the gasoline, how far can the bus go?

Enrichment

1. Students conduct a survey to determine the average vehicle occupancy in your community. First, choose an observation point that is safe and yet allows students a vantage point for seeing the number of people in vehicles passing by. Have students tally the number of passing vehicles and the number of people in each vehicle. Tallying works best with partners, with one person being the counter and the other being the recorder. Have students keep count for 10 minutes or until they record 100 vehicles. Compare the results for different times and, if possible, different sites in the community. Discuss how occupancy affects the amount of gasoline being used. What ways could your community try to increase the average vehicle occupancy?
2. Using Mapquest (www.mapquest.com) have students take a trip with a car. How many miles will they go? How many mpg will the car get? How many gallons will they need for the round trip? How much will it cost in fuel?

Assessment Opportunity

To assess students' learning, have them develop a poster, door hanger, or other public information piece that could be used to educate the school community about fuel economy and alternative modes of transportation. Their piece should include an explanation for why fuel economy and saving gas are important.

Related Activites

Waste Watchers, Energy Sleuths, On the Move

References

ABC's of Oil, Chevron Corp., http://www.chevroncars.com/know/oil/index/html.

Fuel Economy, United States Department of Energy and the United States Environmental Protection Agency, http://www.fueleconomy.gov.

MacKenzie, James J., Roger C. Dower, and Don Chen. The Going Rate: What it really costs to drive. World Resources Institute, 1992.

Wouk, Victor. "Hybrid Electric Vehicles," Scientific American. October 1997, pp 70-74.

How Hybrid Cars Work – www.howstuffworks.com/hybrid-car.htm

HybridCars – www.hybridcars.com

Billy Brennan, "On the Move" Energy & Me, CD. Takoma Park, Maryland: Do Dreams Music; Washington, DC: Project Learning Tree.

American Petroleum Institute – http://www.api.org

U.S. Department of Energy – http://www.energy.gov

Mapquest – www.mapquest.com

Sample Travel Log

Vehicle _____ Model _____
Year _____ EPA Miles Per Gallon _____

Weekly Travel

First Sunday Mileage: _____ Total Miles Traveled: _____
Second Sunday Mileage: _____

Daily Travel

Day	Reason for Travel	Mode	Miles Traveled
Monday	Mom - to work	Car	15
	School	Walked	1
	Grocery Store	Car	6
	Visit a friend	Bike	1
	Mom - to library	Car	9
	Soccer - Mom and me	Car	10
	Daily Totals	Car	40
		Walked	1
		Bike	1
Tuesday	Mom - to work	Bus	15
	School	Bike	1
	Shopping - Mom and me	Car	17
	Music lesson	Car	7
	Daily Totals	Car	24
		Bike	1
		Bus	15