

Calculators, Automobiles, and Climate Change

Activity 5

Students gather information on their family car(s) and use a web-based calculator to help them evaluate the potential for reducing CO₂ emissions by choosing to use automobiles with higher fuel efficiency.

Objectives

Students appraise the ability of technology to reduce CO₂ emissions by increasing automobile fuel efficiency in light of the United States population's desire to drive more miles and own larger cars. Through this, students call upon scientific knowledge and ways of thinking to help make personal decisions and to recognize that issues related to science, technology, and society often are complex and involve risk/benefit trade-offs.

Standards

Students will develop the ability to ask good questions and apply experimental procedures to collect and analyze data. Students will develop interest in global issues and the ability to collect, analyze and use data to explore and explain related science concepts. Students will address standards 7.1, 9.3, 9.8, 9.9, scientific inquiry, scientific literacy, and scientific numeracy from Connecticut's Core Science Curriculum Framework.

Time

- 15 to 30 minutes to complete and review the Fuel Efficiency Worksheet depending on the mathematical capacity of the students
- Homework time over one to two days to complete the survey
- 20 to 30 minutes computer time to fill out the Family Vehicle Survey Analysis sheet
- 20 minutes to sum up and analyze class totals

Materials

One copy of each per student:

- Fuel Efficiency Worksheet
- Family Vehicle Survey
- Family Vehicle Survey Analysis

Method

Hand out the Fuel Efficiency Worksheet and give students a few minutes to complete it. As a class, discuss their answers to ensure that students understand the relationships between:

- a. fuel efficiency and level of CO₂ emissions
- b. number of miles driven and level of CO₂ emissions

Hand out the Family Vehicle Survey and Survey Analysis sheets. Give the students one to two days to collect the information and complete the survey analysis. Encourage them to

work with their parents on this task but also give them some class time and access to school computers.

You may also want to encourage students to explore the www.fueleconomy.gov web site further. Through this web site they can find safety and air pollution information for each car and read about why fuel economy is important.

Tallying Class Results

Divide students into groups of four or five. Tell the students that you will now see how much CO₂ the class could avoid producing over a year's time if all of their cars got three or six miles per gallon more than they do now. Have each team sum and record the group's totals for the three and six MPG increases. For each situation they should record the annual savings and avoided CO₂. As a class, sum and record all group totals on the board to obtain class totals.

Ask students to refer to the graph at the bottom of the Fuel Efficiency Worksheet they completed at the start of this activity. Through a discussion raise the following issues.

Will the number of miles Americans drive continue to increase or will it level off?

Can we expect science and technology to improve vehicle efficiency enough to decrease our total carbon dioxide emissions:

- and allow us to drive increased numbers of miles?
- if we hold the number of miles we drive steady?
- if we are willing to buy higher efficiency vehicles?

Extensions or extra credits

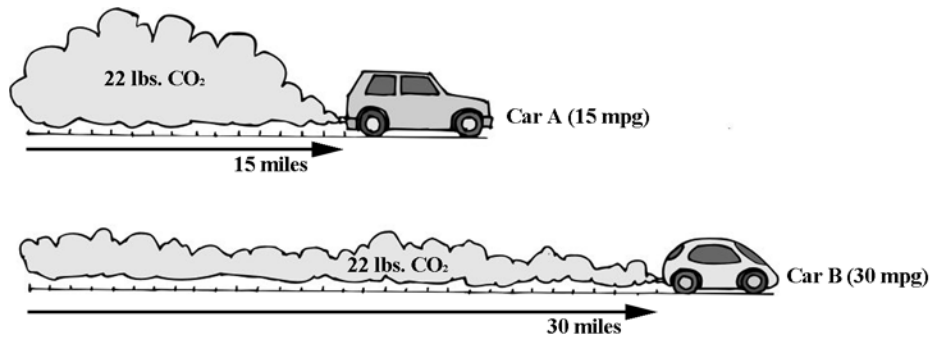
Estimate for Town

Challenge the students to use their information to estimate how many tons of CO₂ their town could avoid if every car got three or six miles per gallon better fuel efficiency.

Name _____

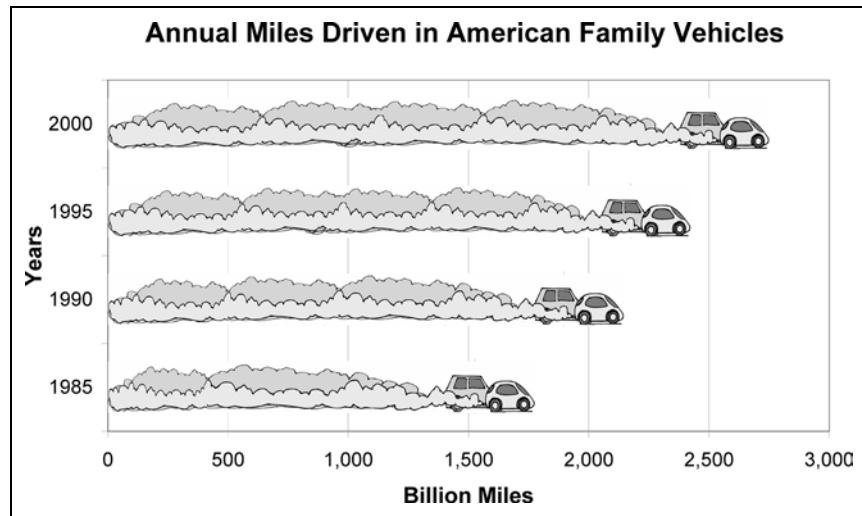
Date _____

Fuel Efficiency Worksheet



Every gallon of gasoline burned produces 22 pounds of carbon dioxide.

1. Car A gets 15 miles per gallon (mpg) and is driven for 15 miles. How many gallons of gas does it burn? How many pounds of carbon dioxide does it produce?
2. Car B gets 30 miles per gallon (mpg) and is driven for 30 miles. How many gallons of gas does it burn? How many pounds of carbon dioxide does it produce?
3. How many pounds of carbon dioxide does car A produce in each mile of driving? Car B?
4. If car A also drove 30 miles, how many pounds of carbon dioxide would it produce?



5. From 1986 to 2000, Americans increased the number of miles they drove each year by one and a half times. In 1986, the average American family vehicle got 26 miles per gallon. To keep the amount of carbon dioxide emitted each year by American cars at 1986 levels, year 2000 cars would have to have an average miles-per-gallon of how much?
- Half 1986 average miles per gallon or 13 mpg
 - One and a half times 1986 average miles per gallon or 39 mpg
 - Twice 1986 average miles per gallon or 52 mpg

Extra credit:

What is the average mile-per-gallon for this year's American family cars and trucks?

Name _____

Date _____

Family Vehicle Survey



Fill out a copy of the following for each car your family owns.

1. List the year, manufacturer, and model

2. Does this car have a standard or automatic transmission? (circle one)

Manual **Automatic**

3. Does this car have two-wheel or four-wheel drive? (circle one)

2WD **4WD**

4. What is this car's engine size. (in liters) _____

5. How many cylinders does this car have?

4 cyl **6 cyl** **8 cyl**

6. How many miles does this car travel each year? * _____

7. Estimate how many miles of city vs. highway driving this car is used for.

Percent (%) of City Miles _____
Highway Miles _____

Percent (%) of

8. What type of fuel does this car use? (regular, premium, diesel, or an alternative fuel)

9. How much does this fuel cost per gallon? _____

* If unknown, use the US average of 15,000 miles.

Name _____

Date _____

Family Vehicle Survey Analysis

Gasoline and the Greenhouse Effect

- The average American car will travel 24.5 miles on a gallon of gas. (2002)
- A car that gets 24.5 miles per gallon (MPG) will produce almost 1 pound of carbon dioxide each mile it is driven.

Cars that get higher miles per gallon produce less carbon dioxide each mile they are driven. Cars that get fewer miles per gallon produce more carbon dioxide each mile they are driven. The more you drive, the more carbon dioxide you produce.

Your Family's Car

- 1) Go to the web site www.fueleconomy.gov and click on "Find and Compare Cars." Look up your family car by year, manufacture, and model.
- 2) Scroll to the bottom of the page and click [customize](#) to customize your fuel costs, annual miles driven, and driving patterns. (See Figure 1)

From the information you collected in the Family Car Survey, enter your cost of fuel, the number of miles this car is driven each year, and the percent of city vs. highway miles. Click on [customize](#) to return to information on this car.

Fuel Price (dollars)						
Per gallon**						Per kw-hr
Regular Gasoline	Premium Gasoline	Diesel Fuel	E85	LPG	CNG	Electricity
1.55	1.65	1.40	1.80	1.30	1.30	0.08
Annual Miles			% of Miles (City)	% of Miles (Highway)		
15000			55	45		
<input type="button" value="Customize"/>			<input type="button" value="Use Default Values"/>			

Cost of Fuel

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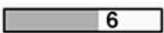
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Number of miles car is driven each year

↖

City vs. highway miles car is driven

Figure 1: Customize Your Fuel Costs, Annual Miles Driven, and Driving Patterns

Compare up to 4	Model	MPG		Annual Fuel Cost*	Greenhouse Gas Emissions	EPA Air Pollution Score
		(city)	(hwy)		(tons/yr)*	From 0 to 10 (best)
<input type="checkbox"/> compare	Chrysler Concorde/LHS 6 cyl, 2.7 L, Auto(4), Regular	21	29	\$970	7.8	 6
<input type="checkbox"/> compare	Dodge Intrepid 6 cyl, 2.7 L, Auto(4), Regular	21	29	\$970	7.8	 6

City MPG Highway MPG Annual fuel cost Annual greenhouse gas emissions (tons)

Figure 2: Sample search on MPG

- Record the city and highway mpg for your car. City MPG _____ Highway MPG _____
- Record the annual fuel cost and greenhouse gas emissions in the first row of Table 1.
- Click on “Search by MPG” and browse through the web site to find a car that gets 3 mpg more than your car in both city and highway driving. If possible, find a car in the same class as your family’s car. Record the annual fuel cost and greenhouse gas emissions for this car in the second row of the table below. Subtract numbers from the second row from the first row to get annual savings and avoided CO₂.
- Repeat this for a car that gets 6 mpg more than your car in both city and highway driving.

Table 1: Savings and Avoided CO ₂	Annual Fuel Cost	Annual CO ₂ emitted
Your Car		
2 nd car: 3 MPG higher efficiency		
A car with 3 mpg better gas mileage: Your car’s data – 2 nd car’s data =	would save _____ \$/yr	would avoid _____ CO ₂ /yr
3 rd car: 6 MPG higher efficiency		
A car with 6 mpg better gas mileage: Your car’s data – 3 rd car’s data =	would save _____ \$/yr	would avoid _____ CO ₂ /yr