



Classroom Activity | Grades 6-8

Drive It Green

GUIDING QUESTION

How can we make greener transportation options for our families and why is it important?

LEARNING OBJECTIVES

Students will be able to:

- rank the importance of several car buying considerations.
- research the fuel efficiency and environmental friendliness of their family car or another car of their choice.
- research green transportation innovations.
- design an environmentally-friendly transportation innovation that meets their family's needs.

OVERVIEW

Millions of people around the globe are moving every day, creating a myriad of energy challenges and opportunities for new innovation. In this three-part lesson, students will imagine and design greener transportation solutions for their families.

NEXT GENERATION SCIENCE STANDARDS

- ESS3.D: Global Climate Change
 - Human activities, such as the release of greenhouse gasses from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)
- ETS1.A: Defining and Delimiting an Engineering Problem
 - The more precisely a design task's criteria and constraints can be defined, the

more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (MS-ETS1-1)(secondary to MS-PS3-3)

- ETS1.B: Developing Possible Solutions
 - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) (secondary to MS-PS1-6)
 - Models of all kinds are important for testing solutions. (MS-ETS1-4)
- ETS1.C: Optimizing the Design Solution
 - Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process- that is, some of the characteristics may be incorporated into the new design. (MS-ETS1-3)(secondary to MS-PS1-6)
 - The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)(secondary to MS-PS1-6)

LESSON TIME FRAME

Three class periods

BACKGROUND INFORMATION

Motor vehicles cause pollution that is instant and long-standing on the environment. One major effect is known as global warming, or the gradual increase of Earth's temperature. If global warming is not controlled, it may become difficult for plants, animals, and even humans to live on Earth. Scientists are working hard to find different modes of transportation that are more green for Earth's environment.

Green transportation refers to modes of transportation that do not negatively impact the environment, such as fossil fuels. Green transportation modes rely on renewable energy sources such as wind and solar energy and hydroelectric, among others.

Public transportation such as the school bus can reduce gas emissions by 37 million metric tons annually. Other options, like walking and biking are even better for the environment.

Scientists and inventors are constantly working together to invent new ways of creating green transportation. One of these inventions is the electric vehicle. This is a vehicle that uses electricity for power, rather than gas.

MATERIALS

Teacher Materials/Prep

- Print copies
 - What Drives You? Student Capture Sheet, one per student
 - Drive It Green Student Capture Sheet, one per student
 - My Transportation Innovation Student Capture Sheet, one per student
 - Home Connections Resource to send home with students
- Print copies and cut out
 - Six Word Story Summary Student Capture Sheet
- Markers
- 7 sheets of flip chart paper

Note to teacher: *Before students enter the room, hang the sheets of flip chart paper in different areas of the room with a marker by each one. Write one of the following words at the top of each sheet of paper: Cost, Color, Size, Fuel-Efficiency/Environmental Impact, Reliability, Safety/Reliability, Other.*

Student Materials

- Six Word Story Student Capture Sheet
- What Drives You? Student Capture Sheet
- Drive It Green Student Capture Sheet
- My Transportation Innovation Student Capture Sheet
- Home Connections Resource
- Notebook paper
- Pencil
- Markers
- Calculators
- Access to the Internet

CLASSROOM ACTIVITY

Day 1

1. Ask students to imagine that they have been asked by their parents to pick out a car for their family to drive on a road trip. What would be most important to them? Color? Cost? Size? Something else?
2. Point out the 7 signs around the room. Tell students that each sign represents a different consideration they could use when selecting their car. Direct students to get

out a sheet of paper and rank the considerations from 1-6 (or 1-7 if they want to add a different consideration to the “other” category).

3. When they are finished with their rankings, direct them to walk around the room and write the corresponding ranking on each sheet of flip chart paper. If they have an “other” consideration they should write it and its corresponding number on the sign marked, “other.”
4. When all students are finished, analyze the results. Which category was ranked #1 most frequently? Which was ranked #6 or #7 most frequently? What conclusions can students draw based on the results? Have someone who ranked #1 in each category justify their ranking.

Then ask:

- a. Based on the justifications, do any of you want to change your #1 ranking?
 - b. Do you think these results are representative of your generation?
 - c. Do you think your parents would have the same rankings?
 - d. Do you think older teenagers would have the same rankings?
 - e. How might the results have been different if asked 50 years ago? What about 50 years into the future? What categories might become more important in 50 years? Less important?
 - f. Ask students to focus on the category of fuel efficiency/environmental friendliness. What do students think “fuel efficiency” means? Fuel efficiency means using less gas to go farther. Have students brainstorm all of the ways they think fuel efficiency would be important, personally and globally, when choosing a car.
5. Distribute the Drive It Green Student Capture Sheet. Have students work individually or in groups to answer the questions.

Teacher Note: # 7 requires Internet access as students are asked to go to the EPA’s [fueleconomy.gov](http://www.fueleconomy.gov) site to research a specific car’s fuel efficiency and carbon emissions.

6. Once students complete the chart for their own car (or a car of their choice), have them compare their vehicle’s miles per gallon and carbon emissions with other students’ vehicles.
7. Review answers to the capture sheet together with the class. Which cars got the most miles per gallon? The least? Which cars had the most CO² emissions? The least? Which 3-5 cars would be considered both fuel-efficient and environmentally friendly? Which 3- 5 cars would be considered least fuel-efficient and environmentally friendly?

Teacher Note: Students can view lists of the most and least fuel efficient vehicles at <http://www.fueleconomy.gov/feg/bestworst.shtml>

8. What conclusions can students draw about fuel efficiency and environmental friendliness? How might this information help them when purchasing a car?

Day 2

1. Many innovations and new technologies are designed to solve a problem. Challenge students to identify current environmental problems or challenges related to today's vehicles (fossil fuel is expensive, fossil fuel is a non-renewable resource, carbon emissions from fossil fuels are bad for the environment, etc.).
2. Ask students if they know of any existing (or in development) innovations or technologies designed to address some of these problems. Examples include alternative vehicles such as hybrid, electric and plug-in, or new clean burning fuels like methanol, ethanol, flex-fuel, and hydrogen.
3. Tell student groups that they will now act as investigators to learn about the benefits and challenges of these new technologies.
4. Have each group select one of the innovations from the list above or another innovation that has been designed to address current energy-related transportation concerns.
5. Distribute the Drive It Green Student Capture Sheet. Review the directions and give students ample time to complete their research.
6. Have each group report what they've learned to the rest of the class.
7. Then discuss:
 - a. Which new innovation would you be most likely to purchase or use? Why?
 - b. Are there elements of different technologies that you would combine into a new innovation if you could?
 - c. Why is continued innovation related to transportation and energy so important?

Day 3

1. Direct students to review the car purchasing considerations they ranked at the beginning of the lesson. Given what they've learned, would their considerations change or remain the same?
2. Finally, challenge students to use all they've learned to design one transportation innovation that would be environmentally friendly while still meeting the purchasing criteria that is most important to them. This could be a gadget, device, type of fuel, vehicle feature, type of vehicle, etc.
3. Hand out the My Transportation Innovation Student Capture Sheets to students.
4. Have them draw a sketch of their innovation and write a one paragraph description that explains their innovation, how it could work, and the advantages and disadvantages it would offer.

EXTENSIONS

- Have students develop a presentation to persuade others in the class to purchase or use their new innovation.
- Have students track the miles per gallon, fuel costs, and CO² emissions (using the formula above) of their family car or a school bus for one month. Have them analyze the data including which vehicles were most and least fuel efficient during this time.
- Have students brainstorm other innovations related to “How We Move.”

REFLECTION

Young scientists will reflect on their learning by completing the Six Word Story summary. Print off the Six Word Story Summary Student Capture Sheet, cut them out, and distribute one to each student. Alternatively, students may create this reflection activity in their science journal:



SIX WORD STORY SUMMARY

Exit Ticket:

Summarize your learning in **six** words.

WHAT DRIVES YOU?

Read the following scenario. Then answer the questions that follow.

You and your parents go to the gas station and put 21 gallons of gas in the tank. Each gallon is \$3.00. You look at the odometer when you are finished filling up and it reads 4,200 miles. Your family drives the car for a few days, and your Dad says he needs more gas because there is only 1 gallon left. You look at the odometer again and it reads 4,500 miles.

1. How many miles have you driven?
2. How many miles per gallon did your car get?
3. Imagine if the car got 20 mpg, how far would your family have been able to drive?
4. If your family drove 250 miles each week and gas was \$3.00 per gallon, how much money would you save on gas by driving a car that got 20mpg vs. 15mpg? Given the calculation in #4, how much money would your family save each year?
5. In addition to costing money, each gallon of gas we burn releases 20 lbs of CO² into the environment. CO² is the gas that comes out of the exhaust pipe when your car burns the fuel it needs to move. CO² causes air pollution and has been called the main cause of global warming. How many lbs of CO² did your family release into the environment in the scenario above?
6. How do you think your car (or a car of your choice) ranks in terms of fuel-efficiency and CO² emissions? In the chart below, write the model and year of your family's car (or choose another car to research). Then predict the car's MPG and CO² emissions and go to <http://www.fueleconomy.gov/feg/findacar.htm> to find your vehicle's data.

Make/ Model/ Year	Predicted MPG	Actual MPG	Predicted Annual Fuel Cost	Actual Annual Fuel Cost	Predicted Annual Tons of CO ² Emissions	Actual Annual Tons of CO ² Emissions

*Average passenger vehicle emits 5.20 metric tons of CO² each year.

7. Why is fuel efficiency and environmental friendliness important, personally and globally, when choosing a car?

DRIVE IT GREEN

Select one new technology or innovation that has been designed to address current energy-related transportation problems. Then research the description/status, science behind, advantages, and challenges of the technology you've chosen. Highlight the information that is most important and be prepared to present your information to the class.

Name of Technology/Innovation:	
Description:	
Science Behind/How It Works:	
Advantages: 1. 2. 3.	Challenges: 1. 2. 3.
Would you/your family consider using this technology? Why or why not? Consider the advantages and challenges, and your family's needs.	

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