

INTRODUCTION

Choosing to walk, take the bus, ride a bicycle, carpool, combine trips, buy high-efficiency cars, and support alternative-fuel technologies are among the most effective consumer actions Americans can take to battle global climate change. More than one-quarter of the average American's greenhouse gas emissions comes from the use of cars. No other single consumer behavior comes close.

In this unit your students will:

- Demonstrate that gases can cause a greenhouse effect.
- Recognize how respiration and photosynthesis move carbon through the earth's biosphere and ecosystems and how human activities have altered this movement on a global scale.
- Explain how increased atmospheric carbon dioxide is leading to global warming.
- Research and present on potential effects of global warming and global climate change.
- Assess and publish how much carbon dioxide they can avoid producing by choosing earth-friendly transportation choices.
- Investigate and propose a family vehicle that will suit their family's needs while reducing greenhouse gas emissions.
- Appraise various alternative-fueled vehicles and judge whether science and technology alone can solve the problem of global climate change.

LIST OF ACTIVITIES

1) Can Gases Act Like A Greenhouse?

In this lab, students will discuss what they know about the greenhouse effect and, through a controlled experiment, infer a potential for increased levels of atmospheric carbon dioxide leading to global warming. They will contrast the temperature rise in a CO₂ rich atmosphere to that of normal air when both environments are exposed to a bright light in a controlled experiment.

Objectives: To carry out a scientific inquiry that includes identifying preconceived ideas, developing questions, and collecting, charting and interpreting data. Students will make use of logical reasoning and creativity in devising hypothesis and explanations to make sense of evidence, identify and control variables in experiments, describe air as a mixture of gases, identify energy transformations between visible and infrared radiation and heat, compare and contrast different forms of energy in terms of their wavelengths on the electromagnetic spectrum, and identify evidence that waves (e.g., light) can transfer energy between two points.

2) Carbon on the Move

After completing a reading on the carbon cycle, conducting independent research (optional), generating a story of an imaginary carbon atom as it moves through Earth's ecosystems and carbon reservoirs, and completion of a puzzle on the carbon cycle, students will recognize how respiration and photosynthesis move carbon

through the earth's biosphere and ecosystems and how human activities have altered this movement on a global scale. Students will recognize how fossil fuels were formed.

Objectives: To identify respiration and photosynthesis as key processes that move carbon through the earth's biosphere and ecosystems, describe how human caused changes in land use and burning of fossil fuels are key activities that alter the movement of carbon and the composition of earth's atmosphere, explain that organic matter buried deep enough may be reformed by pressure and heat into fossil fuels, and understand that all organisms in the biosphere are linked to each other and to their physical environments by the transfer and transformation of matter.

3) Video: Climate Change, Wildlife, and Wildlands

Students will respond to a video on the potential effects of a rapidly changing climate on wildlife and wetlands by identifying how their families may reduce their contribution to greenhouse gas emissions.

Objectives: To explain that the number and variety of organisms and populations are dependent on the resources and physical factors of their environment, explain how both organisms and ecosystems can change if the physical conditions of an ecosystem change, and infer that our atmosphere is dynamic and has patterns of weather systems.

4) Give Your Car A Break

Over one week of homework activity, students complete two transportation surveys: the *Give Your Car A Break – Trip Log* and a *Family Transportation Survey*. At the end of the week students analyze their results to determine the potential for reducing greenhouse gas emissions through choosing alternative modes of travel instead of the single passenger car.

Objectives: To investigate and describe human uses of renewable and nonrenewable resources, recognize that science and technology cannot solve every problem faced by society, use scientific knowledge and ways of thinking in personal decision making, and recognize that issues related to science, technology, and society often are complex and involve risk/benefit trade-offs.

5) Calculators, Automobiles, and Climate Change

As a homework assignment, 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. As a class, students evaluate the potential for their community to reduce greenhouse gas emissions through the use of fuel-efficient cars.

Objectives: To describe how technology can contribute to the solution of an individual or community problem, understand that engineers, architects, and others use scientific knowledge to solve practical problems, and recognize that issues related to science, technology, and society often are complex and involve risk/benefit trade-offs.

6) Alternative Fuels

Students view a video containing news clips on an alternative-fuel vehicle event and read a set of fact sheets on alternative fuels to prepare them to compose a set of questions to ask individuals who operate alternatively powered cars and trucks. Information is provided to help the teacher set up student communication with owners of alternative-fuel vehicles. Options include the following: (1) a field trip to an alternative-fuel vehicle event, (2) communication with members of a web-based alternative-fuel vehicle owners club, and (3) organizing a transportation technology fair at your school.

Objectives: To investigate and describe human uses of renewable and nonrenewable resources, describe how technology can contribute to the solution of a global problem, recognize that issues related to science, technology, and society often are complex and involve risk/benefit trade-offs, identify technological advances that are reported in the media, and understand that engineers and others use scientific knowledge to solve practical problems.

Suggested Schedule for the Performance of Activities

Before the start of the unit, you may wish to begin organizing for one of the following: (1) a field trip to an alternative-fuel vehicle event, (2) communication with members of a web-based alternative-fuel vehicle owners club, or (3) organizing a transportation technology fair at your school.

Activities 1 – 3: The Greenhouse Effect and Global Warming

Pre-unit	Students bring in news clips – Optional
Day 1:	Discussion for Activity (1)
Day 2:	Lab for Activity (1) and assign the carbon cycle homework. The carbon cycle homework may require more than one evening depending on students' access to the Internet.
Day 3:	Activity (2)
Day 4:	Activity (3) and assign the transportation surveys for Activity (4) to be done at home.

Activities 4 – 6: Students Analyze Ways to Reduce Emissions

	Activity (4) is carried out at home for one week
Day 5:	Start Activity (5) and assign fuel efficiency and automobile surveys to be done at home.
Day 6:	Students develop questions for alternative fuel vehicle owners in Activity (6).
Day 7:	Alternative-fuel vehicle event
Day 8:	Students compile and analyze results of surveys for Activity (5).
Day 9:	Students compile and analyze results of surveys for Activity (4).