

Smart Moves Lesson 4

Trees, Cars and CO₂

Overview:

Students learn that CO₂ is emitted when gasoline is burned, that too much CO₂ is causing global warming, and that trees absorb CO₂ and produce oxygen. Using simple arithmetic to figure the amount of CO₂ emissions produced by their own travel, students discover why fuel-efficient cars are more environmentally friendly and consider alternative transportation. As a wrap-up activity, students design bumper stickers that express the information they have learned.

Objectives:

Students will be able to:

- Describe the impact of cars on air quality.
- Understand the importance of trees to air quality.
- Practice basic computation skills.
- Apply math skills to understand real-life issues and problems.
- Create a slogan that expresses the relationship between cars and air quality.

Time: 2 class periods

Materials:

- Student Handout: *There's a Connection*
- Student Handout: *Getting Warmer All the Time*
- Student Handouts: *Go Figure 1-3*
- Teacher's Resources for *Go Figure 1-3* (preview before class)

- Student Handout: *Bumper Stickers* (photocopy for students on adhesive paper if you want the students to produce actual bumper stickers)
- Art supplies: pens, scratch paper

Procedure:

1. Distribute the *There's a Connection* handout. Explain that one of just two words will complete each statement. Have the students, individually or as a group, read the statements and identify the words "car" and "tree" (or the plurals of these words). Briefly discuss the statements, explaining that CO₂ is an odorless, colorless gas released when burning fossil fuels such as gasoline. Tell the students that they will explore the connection between cars, trees, and air quality while practicing their math skills.
2. Point out that we usually don't connect cars with trees (unless we run into one), but that cars emit carbon dioxide that we can't breathe and that trees (and other plants) absorb CO₂ and produce the oxygen that we must have to live. This sounds like an ideal cycle, but if we have too much CO₂ there are serious consequences.

Ask students whether they know about "global warming" or "the greenhouse effect." Distribute the handout *Getting Warmer All the Time*. Explain – or have students explain – that most scientists believe that global warming has resulted from a build-up of CO₂ in the Earth's atmosphere, partially caused by the increasing number of vehicles.

Ask students why global warming is sometimes described as the "greenhouse effect." If necessary, explain the effect by comparing CO₂ to glass in a greenhouse. More CO₂ is the same as thicker glass. Light passes through easily and changes to heat, but heat does not pass through the thicker glass easily and it

builds up. Thicker glass/CO₂ doesn't stop much light, but thicker glass/CO₂ does block heat from escaping.

3. Now write on the board the following equation:

Less Car Emissions + More Tree Absorption = Better Air Quality

Have the class refer back to the handout *There's a Connection* in order to explain why the equation is true and what actions could reduce CO₂ and improve air quality. Confirm that fewer cars, the same number of fuel-efficient cars, and more trees would have a positive effect on air quality.

4. Distribute the handout *Go Figure*. Depending on the students' math skills, have them complete all or part of the handout individually, with a partner, or as a class. (Consult the Teacher's Resources for prompts, calculations, answers, and additional resources.) Go over the students' calculations and answers to the problems, and then facilitate a discussion around their responses to the three *Go Figure* questions about what they might do to promote better air quality.
5. Tell the students that they now will put the information they have learned to use by creating bumper stickers. Distribute the handout *Bumper Stickers*. Discuss the example and then have the students work individually or in teams to develop additional bumper stickers using what they have learned about car emissions, tree absorption, and air quality. Have them display their bumper stickers and, if time allows, have the class decide which ones are most eye-catching and effective at getting a clean-air message to the public.

Assessment Opportunities:

- Discussion of the equation: Less Car Emissions + More Tree Absorption = Better Air Quality
- Successful completion of the math problems (this would assess skills gained prior to the session) and application of them to the problem of global warming

- Answers to the *Go Figure* questions on the handout
- Slogan, mottoes, or information used on the bumper stickers

Extensions:

A Research Project

Have students learn about the 1990 Clean Air Act, how it is being addressed in the Portland metropolitan area, and how increased use of public transportation can improve air quality for our city. (The Web site <http://www.epa.gov/oar/oaqps> contains information about the Clean Air Act.) This research project will require students to learn about other pollutants emitted by cars and the impact of these emissions on the environment.

Benchmarks:

Arts

Create, Present, and Perform

Apply artistic elements and technical skills to create, present, and/or perform works of art for a variety of audiences and purposes.

- Create, present and/or perform a work of art, selecting and applying artistic elements and technical skills to achieve desired effect.

English

Reading

Locate information and clarify meaning by skimming, scanning, close reading, and other reading strategies.

- Locate information and clarify meaning by using tables of contents, glossaries, indexes, headings, graphs, charts, diagrams, and/or tables.

Demonstrate literal comprehension of a variety of printed materials.

- Identify sequence of events, main ideas, facts, supportive details, and opinions in literary, informative, and practical selections.

Demonstrate inferential comprehension of a variety of printed materials.

- Examine relationships, images, patterns, or symbols to draw conclusions about their meanings in printed materials.

Writing

Use varied sentence structures and length to enhance flow, rhythm, and meaning in writing.

Use correct spelling, grammar, punctuation, capitalization, paragraphing, and citations.

Use a variety of modes and written forms to express ideas.

- Write in a variety of modes (e.g. narrative, imaginative, expository, and persuasive) and forms (e.g. essays, stories, letters, research papers, reports) appropriate to audience and purpose.

Mathematics

Computation

Compute with whole numbers, fractions, decimals, and integers using paper and pencil, calculators, and/or computers.

- Perform calculations on whole numbers, fractions, decimals, and integers using paper and pencil, calculators, and/or computers.

Science

Unifying Concepts and Processes

Use concepts and processes of change, constancy, and measurement.

- Identify and explain patterns of change as cycles and trends.

Use concepts and processes of systems, order, and organization.

- Identify a system's inputs and outputs. Explain the effects of changing the system's components.

Scientific Inquiry

Analyze scientific information to develop and present conclusions.

- Analyze and summarize data including possible sources of error. Explain results and offer reasonable and accurate interpretations and implications.

Science in Personal and Social Perspectives: Understanding that science provides a basis for understanding and acting on personal and social issues.

- Describe how daily choices of individuals, taken together, affect global resource cycles, ecosystems, and natural resource supplies.

Resources:

For a list of ways to help reduce global warming from the **Environmental Defense** organization, see http://www.environmentaldefense.org/Want2Help/b_gw20steps.html

Visit the **Environmental Protection Agency's** Web site for kids about global warming at <http://www.epa.gov/globalwarming/kids/index.html>.

See resources after each problem in the Teacher's Resources for *Go Figure*.

HANDOUTS:

Handout 1 - There's a Connection

One of two words will complete the statements below. What are these two words?

- On the average, every gallon of gas used by a releases about 20 pounds of carbon dioxide (CO₂) into the air.
- A single fully grown can transform 13 pounds of carbon dioxide into life-giving oxygen every year.
- One acre of produces enough oxygen for 18 people every day.
- A Chevy Cavalier is a . It's a top performer in its class, but it is estimated to emit 39.4 tons of carbon dioxide over its useful life of 120,000 miles.
- In the year 2030, there will be double the number of on the world's streets and highways.

Handout 3 - Go Figure 1

"Every gallon of gasoline releases about 20 lbs of CO₂ into the air."

- US Environmental Protection Agency (EPA)

How much CO₂ do YOU contribute to the atmosphere?

1. Estimate the number of trips you make in a car during one week.
2. Estimate how many miles you travel in a car during a week.
3. Estimate how many gallons of gasoline you use per week.
4. Calculate how many pounds of CO₂ your car trips emit each week.

*** Go Figure Big Time:** What could you do every week to decrease the amount of CO₂ that you are responsible for putting in the air by car travel?

Check It Out:

<http://globalwarming.enviroweb.org/games/yourscore/> sponsored by the Environmental Defense Fund offers an interactive page where you can total up the amount of CO₂ you are producing through fuel consumption, including operating cars.

Handout 4 - Go Figure 2

Estimated fuel efficiency of transit compared to the average commuter automobile:

"One full bus equals 6 automobiles

One full light rail car equals 16.5 autos."

- Transfort

You wouldn't walk or take a bicycle the 64 busy freeway miles from downtown Fort Collins to DIA, not with luggage anyway. But you could think about air quality when you

choose how to get there and other places. Figure out how much less CO₂ you are responsible for emitting if you take the shuttle instead of a taxi.

1. How many pounds of CO₂ would you put into the air if you were the only passenger taking a taxi from downtown Fort Collins to the airport if that taxi gets 18 miles to the gallon?
2. How many pounds of CO₂ would you be responsible for emitting if you took a bus that got 8 miles per gallon and released 22 pounds of CO₂ per gallon of gas but was carrying 20 passengers?

*** Go Figure Big Time:** Why is taking the bus usually better for the environment than taking a car?

Handouts 5 - Go Figure 3

Different makes and models of cars get different gas mileage and emit different amounts of CO₂. When you choose a car, what will you consider besides the price and the color?

1. A four-wheel-drive Jeep Cherokee gets about 15 miles per gallon during city driving and is estimated to emit 11.3 tons of CO₂ per year. If a single tree can absorb 30 pounds of CO₂ per year, how many trees would it take to absorb the Cherokee's emissions for one year?
2. A Toyota Camry gets 24 miles per gallon in the city and is estimated to emit 7 tons of CO₂ per year. How many trees would it take to absorb the Camry's emissions?
3. If each tree takes a 20 foot by 20 foot area and there are 43,560 square feet in an acre, how many acres of forest are required for each Cherokee every year? How many acres for each Camry?

Check It Out

<http://www.fueleconomy.gov/feg/findacar.htm> sponsored by the Federal Environmental Protection Agency, allows users to identify the annual fuel cost and emissions in tons per year of specific models of cars.

TEACHER'S RESOURCES

TEACHER'S RESOURCE: *Go Figure 1*

How much CO₂ do YOU contribute to the atmosphere?

1. Estimate the number of trips you make in a car during one week.

Prompt students about trips to school, shopping, to sports events, visiting friends, going to religious services, etc.

2. Estimate how many miles you travel in a car during a week.

To facilitate estimating, have on hand the mileage from the school or a central location to malls, movie houses, and other places to which students are likely to ride in cars.

3. Estimate how many gallons of gasoline you use per week.

Point out that miles per gallon depends upon the type of vehicle and can vary widely. You might offer these examples as typical for city driving: compact: 30 miles per gallon: mid-sized: 20mpg, SUV: 15mpg; pick-up 18mpg.

4. Calculate how many pounds of CO₂ your car trips emit each week.

Point out that the amount of CO₂ emitted varies depending upon the year, make, model and condition of the car engine. Twenty pounds of CO₂ per gallon of gas burned is an average students can use.

(Miles traveled /miles per gallon) x 20 lbs. per gallon = 1 lbs. of CO2 per week.

*** Go Figure Big Time:** What could you do every week to decrease the amount of CO2 that you are responsible for putting in the air by car travel?

Actions could include:

1. Reducing the number of trips by car
2. Taking alternative transportation
3. Taking the most fuel-efficient cars, especially if your family owns more than one vehicle
4. Helping parents and older brothers and sisters to remember to have their cars tuned and serviced

Additional Resources for *Go Figure 1*

<http://globalwarming.enviroweb.org/games/yourscore/>, sponsored by the Environmental Defense Fund, offers an interactive page where you can total up the amount of CO2 you are producing through fuel consumption, including operating cars.

TEACHER'S RESOURCE for *Go Figure 2*

Estimated fuel efficiency of transit compared to the average commuter automobile:

"One full bus equals 6 automobiles

One full light rail car equals 16.5 autos."

Transfort

You wouldn't walk or take a bicycle the 64 busy freeway miles from downtown Fort Collins to DIA, not with luggage anyway. But you could think about air quality when you choose how to get there and other places. Figure out how much less CO2 YOU are responsible for emitting if you take the bus instead of a taxi.

1. How many pounds of CO₂ would you put into the air if you were the only passenger taking a taxi from downtown Fort Collins to the airport and if that taxi got 18 miles to the gallon?

64miles x 20 lbs of CO₂ = 1280 lbs (you emitted on the way to PDX)

18 mpg

2. How many pounds of CO₂ would you be responsible for emitting if you took a bus that got 8 miles per gallon and released 22 lbs of CO₂ per gallon of gas but was carrying 20 passengers?

64 miles x 22 lbs. of CO₂ / 20 passengers

8 mpg

= 8.5 lbs. (your share of emissions to DIA)

*** Go Figure Big Time:** Why is taking the bus usually better for the environment than taking a car?

Buses carry more people so there is less emission per person. A single bus replaces many cars.

TEACHER'S RESOURCE for *Go Figure 3*

Different makes and models of cars get different gas mileage and emit different amounts of CO₂. When you choose a car, what will you consider besides the price and the color?

1. A four-wheel-drive Jeep Cherokee gets about 15 miles per gallon during city driving and is estimated to emit 11.3 tons of CO₂ per year. If a single tree can absorb 30 pounds of CO₂ per year, how many trees would it take to absorb the Cherokee's emissions for one year?

Remind students that 1 ton equals 2000 pounds.

11.3 tons x 2000 lbs = 753 trees to absorb the Cherokee's CO2

30 lbs. of absorption per tree

2. A Toyota Camry gets 24 miles per gallon in the city and is estimated to emit 7 tons of CO2 per year. How many trees would it take to absorb the Camry's emissions?

7 tons x 2000 lbs = 466 trees to absorb the Camry's CO2

30 lbs of absorption per tree

3. If each tree takes a 20 foot by 20 foot area and there are 43,560 square feet in an acre, how many acres of forest are required for each Cherokee every year? How many acres for each Camry?

43,560 sq. ft. / acre = 109 trees per acre

20 ft x 20 ft per tree

753 trees per Cherokee = 7 acres of trees needed per Cherokee

109 trees per acre

466 trees per Camry = 4.28 acres of trees needed per Camry

109 trees per acre

The trees and other vegetation in parks absorb CO2 and produce oxygen, which improves the air quality for the city.

Additional Resources for *Go Figure 3*

<http://www.fueleconomy.gov/feg/findacar.htm> sponsored by the Federal Environmental

Protection Agency, allows users to identify the annual fuel costs and emissions in tons per year by make, model, and year of car.