

Calculating School Trip Emissions

Subject: Math



OBJECTIVES:

- Students will determine the amount of CO₂ emitted in their travel to school.
- Students will calculate emissions for various vehicles and occupancies.
- Students will understand how transportation contributes to climate change.



MATERIALS:

- Calculating School Emissions handout



SETTING: indoors



ESTIMATED TIME:

1 hour



VOCABULARY:

Emissions, miles per gallon, fuel efficient vehicles



ACTIVITY SOURCE:

Strategic Energy Innovations
“Protect Your Climate” Curriculum Guide



OVERVIEW: In this lesson, students will calculate the pounds of carbon dioxide released into the atmosphere from their commute to school. This exercise introduces students to the concept of passenger miles per gallon and underscores the important role that walking, bicycling, carpooling and public transportation plays in curbing air pollution and climate change.

BACKGROUND: The amount of carbon dioxide that a car emits depends on its fuel efficiency. **Fuel efficiency** is the measurement of how much fuel a car needs to travel, and is measured in miles per gallon, mpg. The fuel efficiency of a car is related to the car's weight, engine, size and type, and maintenance. The more fuel efficient a vehicle is, the less it will pollute and the fewer greenhouse gas emissions it will emit.

A bus is less fuel efficient than a car because it weighs a lot more and has a much bigger engine. However, a bus has a much higher passenger miles per gallon rate than a car. Passenger miles per gallon, pmpg, is the mpg of a vehicle multiplied by the number of people in the vehicle. The higher the pmpg rate, the less greenhouse gas emissions are emitted per passenger.

Cars and trucks are the biggest source of air pollution and greenhouse gas emissions in the Bay Area. Cars emit 29 pounds of carbon dioxide emissions for every gallon of gasoline burned (EPA, 2005).

Carbon Dioxide is naturally occurring in our atmosphere and is essential to our survival. However, humans have dramatically increased the levels of CO₂ since the early 1900's; the level is at 384 parts per million, up from 284 parts per million in 1832. This increase has caused climate change to occur, with higher temperatures, extreme weather, sea levels rising and other dramatic changes.

LESSON SET-UP:

1. Photocopy handout for all students.

STATE STANDARDS

Math:

3.0: Students solve problems involving addition, subtraction, multiplication, and division of whole numbers and understand the relationships among the operations.

3.2: Solve problems involving multiplication of multi-digit numbers by two-digit numbers.

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BUILDING BACKGROUND/ DISCUSSION:

1. Ask students to write down or discuss all of the ways that make cars different from each other.
Answers may vary from color to size to how many gallons per gallon they get.
2. Ask students what miles per gallon means, and what the word fuel-efficient means.
Fuel efficiency is the measurement of how much gas a car needs to travel, and is measured in miles per gallon, mpg.

ACTIVITY

Part I: Handout

1. Explain to students that today they will learn how to calculate the amount of fuel used on their daily trips to school and the quantity of carbon dioxide produced.
2. Have students look at the chart title “Average Miles per Gallon” on the handout.
 - Which type of vehicle gets the worst miles per gallon? *(The bus. Large trucks. Large SUVs).*
 - Which type of vehicle gets the best miles per gallon? *(The hybrid car).*
 - What are some things that determine how fuel-efficient a vehicle is. *(The size, weight and type of motor help determine a vehicle's fuel efficiency).*
 - What determines a vehicle's passenger miles per gallon *(The number of passengers in that vehicle times the vehicle's miles per gallon).*
 - How is a bus' miles per gallon figure different than a bus' passenger miles per gallon? *(The bus will always get around 4 miles per gallon, but the bus' passenger miles per gallon will change depending on the number of riders).*
4. Have students complete Handout 1, providing assistance as needed.

Part II: Discussion

1. Once students have completed the handout, ask:
 - Why do vehicles generate Carbon Dioxide and other forms of air pollution? *(A vehicle's engine combusts gasoline or diesel for power, and CO2 is a by-product of combustion).*

- What's the problem with too much CO2 in the atmosphere? *(CO2 occurs naturally in the atmosphere, but too much of it is causing global warming, leading to temperatures rising throughout the world).*
 - What does CO2 have to do with the fuel efficiency of vehicles? *(The more efficient the vehicle, the less CO2 it will produce).*
 - Why is riding the bus or carpooling better than driving in a car alone? *(Fewer pounds of CO2 will be emitted per person in a bus or carpool than in driving alone in a car).*
2. Discuss students' results and facts about vehicle emissions in the handout.
 - What are some ways they can reduce personal travel emissions?
 3. How many students walk, bike carpool or take the bus to school?
 - For those students who don't do any of the above, discuss why they don't.
 - Challenge them to walk, bike, carpool or take the bus at least one day per week to school or on the weekends..



EXTENSION IDEAS

1. Which gets the higher passenger miles per gallon—a minivan with six passengers or a hybrid car with two passengers? Students find the answer using the calculations in Handout 1.
2. Have students keep a “travel emissions log” and track their emissions over a week or month. They can summarize their log and make suggestions about how they could improve their emissions.
3. Have students do a research project about global warming. What are the causes, effects and solutions, especially here in the Bay Area? What can students do to help stop global warming?