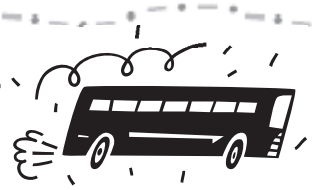
Transportation Tally



Activity 14

Introduction:

In 2006, the United States, there was one car for every 1.2 people (including children), and over four million miles of public roads.[1] Even though every city in the country experiences some degree of traffic congestion, the number of cars driving on U.S. roads is increasing even faster than our population.[2] Even with recent improvements, cars continue to be a major source of air pollution and prime contributors to global warming. Nationwide, the transportation sector contributes 30% of all carbon dioxide (CO_2) released each year in the U.S.[3] CO_2 is one of the primary causes of global warming. The more people drive fossil fuel-burning cars, the more rapidly supplies will be depleted.

Procedure:

1. Distribute Student Worksheet. Explain to the class that in this activity, they will be using math to look at different forms of transportation.
2. On the worksheet, students must solve word problems about cars.
3. You may wish to review the definitions of millions and billions before they begin.

Answers to the Student Worksheet:

Part 1: Driving to the Limit

1. 1.23 people.
2. a. 2/3 of an hour (.6666 hours); 40 minutes.
b. 80 minutes
c. 40 minutes (twice as long).
3. a. 56.7% percent change.
b. 31.2% percent change.

Part 2: Gassing Up

4. a. 0.91 gallons/day.
b. 0.44 gallons/day.
c. 3.1 gallons/day; .10 gallons per passenger/day
d. The bus.
5. 136,640,000,000 gallons or 136.6 million gallons of gas/year.

Part 3: Human Masses, Greenhouse Gases

6. 41.5% increase.
7. a. 0.78 tons of CO_2/year
b. 4.3 pounds/day
c. 4.3 miles
d. Carpooling, walking, using public transportation, or biking are all ways to reduce transportation related production of CO_2. Students may also think of other forms of energy conservation that would reduce CO_2 production including conservation of electricity in the home.
8. a. 1,507,000,000 tons of CO_2 year.
b. Not at all

Follow-up Activities:

1. There are many opportunities for students to graph their results, as either part of the assignment, or for extra credit.
2. "Road Trip": Using road maps to figure out mileage, groups of students can plan a trip to another city. Cities can be chosen by the students or assigned. Students will calculate how much gas would be used if they drove a car, rode on a bus or on a plane, and how much CO_2 they will generate in each mode of transportation using the same methods they used to solve the problems on the worksheets. The groups can report their findings to the class.

Concept:
The American dependence on cars creates challenges for the environment and our communities.

Objectives:
Students will be able to:
- Solve mathematical word problems about cars, gasoline use, and carbon dioxide.
- Describe, using mathematical terms, the environmental impacts of driving.
- Use transportation data to compare and reflect on transportation choices.

Skills:
Analyzing data, identifying problems, arithmetic, comparing numbers, calculating percent change, converting units of measurement

Method:
Students calculate the natural resource use, pollution and community impacts associated with our population's driving habits through a series of math problems, and develop suggestions to meet transportation challenges in the future.

Materials:
Student Worksheet
Calculator

Name_____ **Date**_____

TRANSPORTATION TALLY—Student Worksheet

Part 1: Driving to the Limit

1. In 2006 there were about 244 million vehicles on U.S. roads, while the country's population was 299 million.[4] How many people were there for each car in the United States in 2006? (round to the nearest hundredth) _____ people.

2. a. How much time would it take someone to get to work if he/she were traveling 20 miles at 30 miles per hour? (Use the formula: Time = Distance/Rate) _____ hours. How many minutes is this? _____ minutes.

b. As the number of cars on the road increases, the average speed a car can travel decreases. How much time would it take that same person to get to work if he/she could only travel at only 15 miles per hour? _____ minutes.

c. What is the difference in time between the two speeds? _____ minutes.

3. In 1980 there were 155,796,000 vehicles registered in the U.S. and our nation's population was 227,726,000 people.[5] In 2006 there were 244,166,000 vehicles and 298,755,000 people.[6]

a. What was the percent change in number of registered vehicles from 1980 to 2006? _____. (% of change = amount of change/original amount)

b. What was the percent change in U.S. population during the same time period? _____.

Part 2: Gassing Up

4. In the United States the average car burns 560 gallons of gasoline each year.[7] There are about 244 million autos in the U.S.[8]

a. If a person drives 10 miles each way to work and averages 22 miles per gallon, how much gas is used each day?_____ gallons.

b. If a person drives 10 miles each way to work in a gasoline/electric hybrid that averages 50 miles per gallon, how much gas is consumed each day? _____ gallons.

c. If 30 people take a bus 10 miles to work and back and the bus averages 6.5 miles per gallon, how much gas does the bus consume each day?_____ gallons. What is each passenger's share of gas consumed?_____ gallons.

d. Which of the options above is the most energy efficient people-mover? _____.

5. How many gallons of gasoline do all of the cars in the United States, combined, burn each year? _____ gallons.

Part 3: Human Masses, Greenhouse Gases

The "greenhouse effect" is caused by a layer of gases in the atmosphere. These gases trap the sun's warmth just like a greenhouse. If we add too many "greenhouse gases" to the air, the planet may get warmer and warmer. Carbon dioxide (CO_2), one of these gases, is released into the air when gasoline is burned. Nationwide, transportation accounts for 30% of all CO_2 emissions.[9]

6. To describe how much of something is in the air, scientists use the expression "parts per million," or "ppm." (For example, if you had a million dots, one of which was orange, while the rest were purple, the concentration of orange dots would be one part per million.) In the year 1900, the concentration of CO_2 in the air was around 270 ppm. In 2006 it was 382 ppm.[10] What percent increase is this?_____.

7. Scientists estimate we need to reduce CO_2 emissions to 7 billion tons per year by 2050, in order to stabilize global temperatures.[11]

a. By 2050, the population of the world is expected to grow to 9 billion.[12] How many tons of CO_2 would each person be allowed to add to the atmosphere if permits were allotted equally to all people? _____ tons.

b. How many pounds per day could each of us produce? (1 ton = 2,000 pounds) _____ pounds.

c. Driving one mile releases approximately one pound of CO_2 into the air, on the average.[13] How far could you get on your allotted CO_2 emissions by car? _____ miles.

d. What are some things you could do now and in the future to limit your share of CO_2 production?

8. a. If Americans drive a total of 3 trillion (3,014,000,000,000) miles each year, how many tons of CO_2 do cars release each year? [14] _____ tons.

b. If the average fuel efficiency increases from about 22 mpg to about 44 mpg, but the number of miles driven by all the cars on the roads doubles from 3 trillion to 6 trillion, how much will we have changed our total CO_2 production? _____.

Notes and Sources: [1,2,4,5,6,8,14] U.S. Census Bureau, Statistical Abstract of the United States: 2009. [3,9] Recent Trends in U.S. Greenhouse Gas Emissions, United States Environmental Protection Agency web site www.epa.gov. [7] Energy Information Agency. [10] National Oceanic and Atmospheric Agency (NOAA). [11] R. Socolow, S. Pacala, "A Plan to keep Carbon in Check," Scientific American, 25, 2006. [12] World Population Data Sheet 2009, Population Reference Bureau, www.prb.org [13] American Forests Association web site, www.americanforests.org.