Your ECOLOGICAL *footprint*

Personal Transportation

Transportation is an important aspect of modern life. People in developed nations spend at least one hour in travel each day, which consumes about one-sixth of the average household's income. The high degree of mobility enjoyed in developed nations is one of the defining characteristics of an affluent lifestyle.

Transportation also is a leading cause of resource depletion and environmental degradation. Globally transportation accounts for about a third of crude oil consumption and about 14 percent of emissions such as carbon dioxide. In the United States transportation is even more important—it accounts for about two-thirds of oil consumption, 32 percent of carbon dioxide emissions, 45 percent of nitrogen oxide emissions, and 77 percent of carbon monoxide emissions.

Why is transportation such a big environmental problem in the United States? One reason is that Americans use technologies that consume huge amounts of energy and release great quantities of pollutants. The single most important technology is the automobile. On a per capita basis, Americans own more cars and drive them more miles than all other nations. They also travel by air more frequently than inhabitants of most other nations. These choices are significant because cars and planes have large environmental impacts. Driving a single-occupant car to work uses 1,826 kcals of gasoline per passenger mile, whereas riding a bus uses less than 250 kcals of diesel fuel per passenger mile. Riding a bicycle is the most energy-efficient technology—it uses just 35 kcals per mile of relatively low-pollution carbohydrate energy (your morning breakfast) rather than fossil fuels such as gasoline and diesel fuel, which release harmful pollutants.

Why do Americans have a love affair with the automobile? Cultural values play an important role. Many Americans see their cars as a source of individual freedom and believe that a car says a lot about its owner. Advertising reinforces this belief with images of sleek, powerful vehicles streaking down deserted country roads, trees rustling in the wind, the sun majestically setting in the background.

These desires are supported by Americans' affluence. The rise in the affluence of the average American over the past several decades produced a surge in automobile use, and with it an increase in the use of gasoline and the release of air pollutants. In 1950 the average U.S. household owned one car—it now owns two. In 1950 each licensed driver drove an average of about 16,000 kilometers (10,000 miles) each year; now licensed drivers per household drive over 30,000 kilometers (19,000) miles each year.

Economic incentives also promote the use of cars. Due to market failures and government subsidies, car owners do not pay the full costs of operating a vehicle. External costs stemming from pollution, climate risks, a military presence in the Middle East, oil storage costs, accidents, and noise amount to $126 billion per year. Other costs of driving that are spread over the general population include road construction and repair, highway services, and parking, amount to $170 billion. The total cost not paid directly by drivers is nearly $300 billion, equivalent to more than 5 percent of the U.S. gross domestic product. If drivers had to pay these costs, they would probably drive less and choose alternative modes of transportation.

Calculating the Ecological Footprint of Your Transportation

1. Estimate the total number of miles you traveled last year by each transportation mode and enter them in column 2 of the accompanying worksheet. The easiest way to do this is to estimate the distance of your average commute from home to work or school and the number of trips per year. Also include trips you made to visit relatives, go on vacation, and so on.
2. In column 4 calculate the amount of energy consumed by your transportation choices. To do so, multiply column 2 (miles traveled) by column 3 (energy intensity). Each mode of transportation has a different energy intensity, expressed in kcal/passenger mile. This is the amount of energy required to transport you each mile.
3. In column 6 calculate the pollution generated by your transportation choices. To do so, multiply column 2 (miles traveled) by column 5 (pollution intensity). Each mode of transportation has a different pollution intensity, expressed in grams/passenger mile. This is the sum of six pollutants released by transporting you one mile in each mode. Those pollutants include carbon dioxide, sulfur dioxide, nitrogen oxides, total suspended particulates, carbon monoxide, and nonmethane hydrocarbons.
4. Calculate the annual total energy use and pollution released by your use of transportation (sum columns 2, 4, and 6).

Comparing Your Footprint to People in Other Nations

Reliance on various modes of transportation varies tremendously among nations. Table 1 shows the transportation modes used by the average Swede:

What would your footprint look like if you traveled as the average Swede does? The following exercise answers that question:

1. Multiply the Swedish fraction for each mode of transportation times the total number of miles you traveled last year (from the bottom of column 1 in the worksheet). This will give the number of miles traveled by each mode *if you had traveled like the average Swede.*
2. Recalculate the energy use and pollution released as you did in steps 2, 3, and 4.

TABLE 1 Mode of Transportation (fraction of total)

Country	Bicycle	Walking	Motorcycle	Automobile	Public Transport
Sweden	0.1	0.39	0.02	0.36	0.13

3. Compare the results of the two exercises. Can you explain the differences in energy use and pollution release based on the differences in transportation technology used in the United States and in Sweden?

ADDITIONAL READING

Gordon, Deborah. *Steering a New Course: Transportation, Energy, and the Environment.* Washington, DC: Island Press, 1991.

Greene, David L., and Danilo J. Santini (Eds.). *Transportation and Global Climate Change.* Washington, DC: American Council for an Energy-Efficient Economy, 1993.

MacKenzie, James J., Roger C. Dower, and Donald D. T. Chen. *The Going Rate: What It Really Costs to Drive.* New York: World Resources Institute, 1992.

STUDENT LEARNING OUTCOME

- Students will be able to rank the major forms of transportation in terms of their energy requirements.

Worksheet for Calculating the Ecological Footprint of Transportation

(1) Transport Mode	(2) Miles Traveled	(3) Energy Intensity (kcal per mile traveled)	(4) Total Energy Used (kcal) (col 2 × 3)	(5) Pollution Intensity* (grams per mile traveled)	(6) Total Pollution Emission (grams) (cols 2 × 5)
Bicycle	_____	35	_____	0	_____
Walking	_____	76	_____	0	_____
Motorcycle	_____	629	_____	12.48	_____
Automobile					
Single occupancy	_____	1,826	_____	25.16	_____
Average occupancy	_____	968	_____	14.82	_____
Personal truck/van					
Single occupancy	_____	2,423	_____	33.65	_____
Average occupancy	_____	1,200	_____	17.71	_____
Rideshare					
3-person carpool	_____	623	_____	8.58	_____
9-person vanpool	_____	222	_____	3.75	
Bus (diesel)					
Transit	_____	741	_____	3.74	_____
Intercity	_____	237	_____	1.20	_____
Rail					
Intercity Amtrak (diesel)	_____	667	_____	2.41	_____
Transit (diesel)	_____	929	_____	7.73	_____
Commercial airline	_____	1,762	_____	2.26	_____
Annual totals:	_____		_____		_____

*Carbon dioxide, sulfur dioxide, nitrogen oxides, total suspended particulates, carbon monoxide, and nonmethane hydrocarbons.

Sources: Data from D. Gordon, *Steering a New Course: Transportation, Energy, and the Environment*, Island Press; data from S.C. Davis, *Energy Transportation Databook*, Oak Ridge National Laboratory.