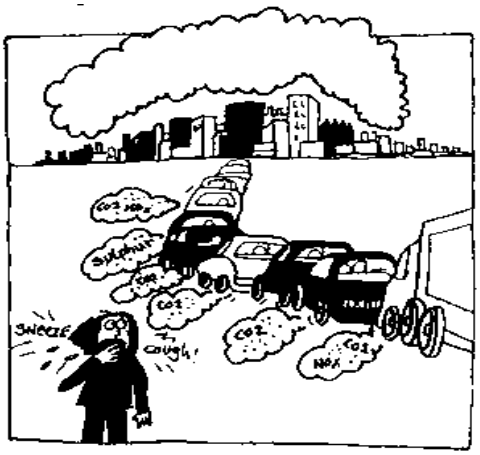
TEACHER BACKGROUND INFORMATION
CALCULATING YOUR CARBON FOOTPRINT

Your ***carbon footprint*** is a representation of the effect you, your family or school, have on the climate in terms of the total amount of greenhouse gases you produce (measured in units of carbon dioxide). Many of your actions generate carbon emissions, which contribute to accelerating global warming and climate change. By measuring your carbon footprint through such tools as the ***The Global Warming Wheel Card*** from the U.S. Environmental Protection Agency, you can get a better sense of what your individual impact is and which parts of your lifestyle deserve the greatest attention. Armed with such information you can more readily take effective action to shrink your carbon footprint, thereby minimizing your personal impact on the climate.



For example, when you drive a car, each gallon of gasoline you burn produces carbon in the form of carbon dioxide. Depending on the fuel efficiency of your vehicle and the miles traveled, a gasoline-powered car can easily generate its own weight in carbon dioxide each year. The average American is responsible for about 20 tons of carbon dioxide emissions each year, a far greater per capita number than that of any other industrialized country. In fact, the US, with less than 5% of the world's population, accounts for more than 20% of the world's total greenhouse gas emissions. You can reduce your carbon footprint by driving a more efficient car, or driving less. You can also plant trees or help preserve forests to offset your emissions, since trees are a sink for carbon.

The carbon footprint calculator estimates CO_2 emissions for energy use and transportation, and for organizations paper use, because these types of activities

are responsible for a significant percentage of U.S. emissions, and are measurable based on readily available information. Your total carbon footprint would account for the energy used to produce all the products and services you consume, as well as all your other activities, and would be substantially larger. Home energy use and transportation represent approximately 40% of all U.S. emissions, so for an average person the emissions from these two activities would have to be multiplied by 2.5 to determine the person's total carbon footprint.

Ecological Footprint

There are many other ways to visualize our individual and overall human impact on the environment. Some environmental and government groups feature a broader concept than the carbon footprint -- the ecological footprint, which is an estimate of how much land and water is needed to produce all the resources an individual consumes, and dispose of all the waste and pollution he or she generates. Because of increasing population and levels of consumption and pollution, human beings are leaving bigger and bigger ecological footprints - at a rate that is increasingly harmful to the planet.

For example, ***Redefining Progress*** estimates that the typical American uses 25 acres to support his or her lifestyle, almost five times more than is sustainable. This non-profit group provides tools to calculate your own ecological footprint, and links to many other such calculators. More information on ecological footprints is provided by ***Sustainable USA*** and the British group, ***Best Foot Forward.***

SafeClimate typically quotes greenhouse gas units in terms of carbon dioxide (1lb carbon dioxide = 0.2729 lbs of carbon), as well as converting other greenhouse gases into units of carbon dioxide based on their relative global warming potentials. This standardized approach simplifies things and makes for easier and more meaningful comparisons.

INSTRUCTIONAL ACTIVITY
CREATING A PERSONAL CARBON CALCULATOR

GOAL: Students understand their contributions to greenhouse gas emissions by collecting and analyzing their home energy use.

OBJECTIVES: Students will…

- Build a personal emissions calculator
- Gather information on their daily habits
- Evaluate their daily habits
- Determine their personal contribution to greenhouse gas emissions

MATERIALS (Determine by class size):

- Copies of "What Is A Carbon Footprint?"
- Copies of Personal Emissions Calculator – Student Sheet
- Copies of wheel pieces
- Glue sticks
- Scissors
- Brads or paper fasteners
- Optional: Highlighters in a variety of colors
- Optional: Calculators
- Optional: Copies of **Ecological Footprints of Nations** (1999 Data)

ALIGNMENT TO NATIONAL SCIENCE STANDARDS:

- ✓ Unifying Concepts and Processes (K-12)
  - Consistency, change, and measure
- ✓ Science as Inquiry, Content Standard A (9-12):
  - Abilities necessary to do scientific inquiry
  - Understandings about scientific inquiry
- ✓ Life Science, Content Standard C (9-12):
  - Interdependence of organisms
  - Matter, energy, and organization in living systems
  - Behavior of organisms
- ✓ Earth and Space Science, Content Standard D (9-12):
  - Energy in the earth system
- ✓ Science in Personal and Social Perspective, Content Standard F (9-12):
  - Personal and community health

- Environmental quality
- Science and technology in local, national, and global changes

PROCEDURE:

1. Pass out "What Is A Carbon Footprint" to each student. Allow them time to read while you pass out other materials.

2. Review the information on "What Is A Carbon Footprint".

3. Pass out the **Personal Emissions Calculator – Student Sheet**, wheel pieces, glue sticks, scissors, and brads to each student.

4. Have them follow the directions on the student sheet to create their personal emissions calculator.

5. Allow students time to build the wheel and calculate their personal emissions.

6. Ask each student to share their personal emission total and write their totals as a list on the board.

7. Pass out calculators or have students do addition manually to determine the class average emission total.

8. Compare this to the national average listed on the wheel they created and to the averages of other countries using the "**Ecological Footprints of Nations** "(1999 Data) .

9. Now have students use the "What Can I Do" side of the wheel to determine different ways they can help reduce emissions.

OPTIONAL HOMEWORK: Each student should write a commitment statement outlining how he or she will help reduce emissions.

EXTENSION: Students can use **Monthly Electricity Use - Common Household Appliances** to identify exactly where they expend the most energy.

***Adapted from Environmental Protection Agency's "Climate Change, Wildlife and Wildlands"**

PERSONAL EMISSIONS CALCULATOR - STUDENT GRID

SECTION 1: Complete the grid below. You will have to use your family's electric bill, natural gas bill, and an adult's input on car use. You should be able to *guesstimate* the waste disposal section. Remember that it is important to be honest when completing this grid. You will be assessed on the accuracy of your information. If you cannot find some of the information, your teacher can help you.

HOME HEATING	TRAVEL	WASTE DISPOSAL	ELECTRICITY USE
In the box below, write how much money your family spends on natural gas or fuel gas on average each month.	In the box below, write roughly how many miles your family puts on their car(s) on average per week.	In the box below, write how many items your family recycles (for example, plastics, aluminum, etc.).	In the box below, write how much money your family spends on electricity on average each month (check your electricity bill).

SECTION 2: After you make your personal emissions calculator, fill in the pounds of CO_2 your family emits each year (this will be the number in the small box of your personal emissions calculator). Add the first four numbers to calculate your total emissions.

HOME HEATING	
ELECTRICITY USE	
WASTE DISPOSAL	
TRANSPORTATION	
TOTAL EMISSIONS	

*Adapted from Environmental Protection Agency's "Climate Change, Wildlife and Wildlands"

PERSONAL EMISSIONS CALCULATOR - STUDENT SHEET
ASSEMBLY INSTRUCTIONS

1. Cut out the two large circles & two large rectangular pieces.

2. Cut out the two little rectangular windows on each of the large rectangular pieces.

3. Put glue on the backs of both circles and put them together to make the "wheel" of the wheel card, making sure that you align them so that the four labels that run along the outside of each circle (Waste Disposal, Home Heating, Electricity Use, and Transportation) line up with the corresponding labels on the other side. The Waste Disposal label on one side should line up with the Waste Disposal label on the other side, and so on.

4. Lay the rectangular piece entitled "What Can You Do?" upside-down on the table with the larger of the two cutouts closer to you. If you lift up the edge of the rectangular piece and see the words "Global-Warming—What Can You Do?" right side up, you've done it correctly.

5. Put the glued-together wheel on top of the rectangular piece, with the side that has all the questions (such as "On average, how much does your household spend on electricity each month?") facing up.

6. Lay the other rectangular piece entitled "What's Your Score?" on top of the wheel, with the smaller of the two cutouts closer to you.

7. Find the "belly button" on the pasted-together wheel and the two large rectangular pieces. Push a paper fastener ("brad") through the "belly button" to hold all the pieces together.

8. Glue the large rectangular pieces in all four corners just enough to hold the rectangles together but allowing the wheel to turn freely.

9. Highlight each line inside the windows in a different color to make it easier to read.

10. Using the information from your grid, calculate your personal emissions and fill in the last line on your grid worksheet.

11. Work with the class to figure your class emission average.

12. Use the "What Can You Do" side of the card to determine how you can help reduce emissions.

*Adapted from Environmental Protection Agency's "Climate Change, Wildlife and Wildlands"

PERSONAL EMISSIONS

MONTHLY ELECTRICITY USE COMMON HOUSEHOLD APPLIANCES

(HEATING AND LIGHTING NOT INCLUDED)

APPLIANCE	PEAK POWER (W)	APPROXIMATE MONTHLY USE KWH	MY HOME USE (ESTIMATE)
Blender	350	1	
Broiler	1450	8	
Coffee maker	900	10	
Clothes dryer 5 load per week	5000	83	
Dish Washer hot water not incl.	1200	120	
Electric Blanket	180	12	
Food freezer $(15ft)^3$	340	90 (manual defrost)	
Food freezer $(15ft)^3$	450	150 (auto defrost)	
Electric Food Disposal "garbarator"	450	3	
Electric Frying Pan	1200	15	
Electric Hand Iron	1000	12	
Microwave Oven	1400	16	
Radio/CD/Stereo	110	9	
Electric Range	180	70	
Self-cleaning unit (on range)	4000	4	

Refrigerator with freezer	330	60 (manual defrost)	
Refrigerator with freezer	600	140 (auto defrost)	
Toaster	1200	5	
TV (bw solid state)	55	10	
TV (color solid state)	200	36	
Vacuum Cleaner	630	4	
Washer (hot water not incl.)	500	8	
Water bed (heater)	370	150	
Water heater	4500	400	
		TOTAL (kWh)	
Conversion Chart - kWh to CO2		TOTAL (CO_2) (kg)	

ECOLOGICAL FOOTPRINTS OF NATIONS (1999 DATA)

		(in global acres per capita)		
COUNTRY	POPULATION (IN MILLIONS)	ECOLOGICAL FOOTPRINT (PER PERSON)	CURRENT CAPACITY (PER PERSON)	ECOLOGICAL DEFICIT (IF NEGATIVE)
WORLD	6,210.1	6.0	4.7	(-1.3)
Argentina	37.9	7.5	16.5	9.0
Australia	19.7	18.7	36.1	17.4
Austria	8.1	11.7	6.9	(-4.8)
Bangladesh	134.0	1.3	0.7	(-0.6)
Brazil	174.5	5.9	14.9	9.0
Canada	31.2	21.8	35.2	13.3
Chile	15.6	7.7	10.5	(-2.8)
China	1,284.2	3.8	2.6	(-1.2)
Denmark	5.4	16.2	8.0	(-8.2)
Egypt	66.2	3.7	1.9	(-1.8)
Finland	5.2	20.8	21.3	0.5
France	59.3	13.0	7.1	(-5.9)
Germany	82.2	11.6	4.3	(-7.3)
India	1,053.4	1.9	1.7	(-0.2)
Indonesia	217.3	2.8	4.5	1.7
Italy	57.7	9.5	2.9	(-6.6)
Japan	127.2	11.8	1.7	(-10.0)

Korea Republic	48.1	8.2	1.8	(-6.4)
Malaysia	24.4	7.8	8.4	0.6
Mexico	100.8	6.2	4.2	(-2.1)
Netherlands	16.1	11.9	2.0	(-9.9)
Norway	4.6	19.6	14.7	(-4.9)
Pakistan	144.8	1.6	1.0	(-0.6)
Philippines	78.3	2.9	1.4	(-1.5)
Poland	38.6	9.1	4.0	(-5.1)
Russia	144.2	11.1	12.0	0.9
South Africa	44.2	10.7	6.0	(-4.7)
Spain	39.5	11.5	4.4	(-7.1)
Sweden	8.9	16.6	18.1	1.5
Switzerland	7.3	10.2	4.5	(-5.7)
Thailand	61.7	3.8	3.4	(-0.4)
Turkey	67.2	4.9	3.0	(-1.8)
United Kingdom	60.2	13.2	4.1	(-9.1)
United States	288.3	24.0	13.0	(-10.9)