

Meeting the Kyoto Protocol

Subject: Earth Science

Grade Level: Middle School (6-8)

Rational or Purpose: This activity allows students to see how they and their households affect changes in climate and the atmosphere. They can gage their carbon dioxide footprint as well as see what changes they personally can make to improve their footprint.

Materials:

- Calculators
- Global Warming Wheel Card

Required Documents:

- Global Warming Wheel Card
- Pre-Lesson Homework Sheet
- Calculation and Conclusions Worksheet

Lesson Duration: 45 minutes

Sources: EPA Web Site

Science TEKS:

- 6th Grade Science: (2C), (2D), (2E)
- 7th Grade Science: (2C), (2D), (2E)
- 8th Grade Science: (2C), (2D), (2E), (6C), (12C), (14C)
- IPC: (1A), (2A), (2C), (2D), (8A), (8E)

Connections to AP:

- AP Environmental Science:
 - IV. Environmental Quality A. Air/Water/Soil 1. major pollutants
 - V. Global Changers and Their Consequences A. First-order Effects 1. atmosphere B. Higher-orders Interactions 1. atmosphere

Background Information:

The Kyoto Protocol was created by the United Nations Framework Convention on Climate Change as an amendment to the international treaty on climate change and was adopted by the United Nations in December of 1997. The objective of the protocol was to bring an international focus to limiting the emission of greenhouse gases and specifically focus on carbon dioxide, methane, and nitrous oxides. As of June 2007, 172 nations and other governmental entities have ratified the treaty. The United States has signed the protocol, but has neither ratified nor withdrawn from it. The Kyoto

Protocol has different recommendations for developed vs. developing countries and only recommends limiting emissions for the 38 nations with the highest emissions. Thirty-one of the high-emission nations have ratified it and are making efforts to reduce their emissions. The U.S. is one of the seven countries that has signed the protocol but not put any limits in place. Even for countries complying with the Kyoto Protocol, it is not a binding contract, and countries police themselves. You can find the Kyoto Protocol online at: <http://unfccc.int/resource/docs/convkp/kpeng.html>

Activity:

Students will be able to calculate their yearly CO₂ Footprint. Then, they will compare their results with the amounts listed in the international Kyoto Agreement on greenhouse gases.

Procedure:

1. The day before the lesson, pass out the Pre-Lesson Homework Sheet for students to work on with their parents that night. The worksheet involves questions about their household activities including heating costs, electricity cost, fuel usage, and recycling.
2. The Global Warming Wheel Card is available [http://yosemite.epa.gov/oar/globalwarming.nsf/uniquekeylookup/shsu5bwiq7/\\$file/wheelcard.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/uniquekeylookup/shsu5bwiq7/$file/wheelcard.pdf). Print enough copies either for each group or each child, and have them collated for the students.
3. In class, put students into groups, and pass out the copies.
4. Have students carefully cut out the parts of the Global Warming Wheel Card.
5. Instruct students to glue together the circle pieces, glue the corners of the rectangles together, match up the center marks (the “belly button”) of all four pieces, and then push a brad through the center marks to attach the pieces.
6. After students have completed their Global Warming Wheel Cards, they can use them and the information on their Pre-Lesson Sheets to fill in the Calculation and Conclusions Worksheet.
7. As the students finish, discuss with them their CO₂ footprint and what ideas from the “What Can You Do?” they think are feasible.



Pintail duck photo by Peter LaTourette

Climate Change, Wildlife, and Wildlands

Global Warming Wheel Card

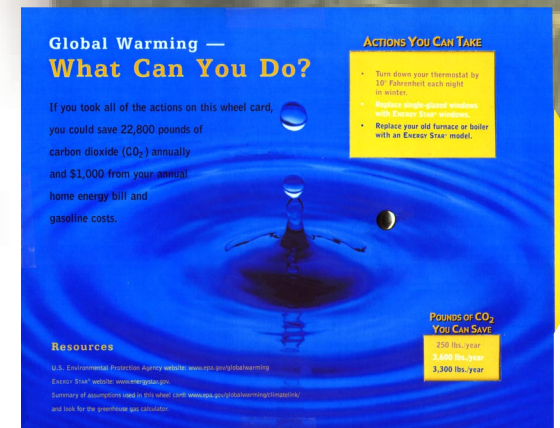
- Cut out the two large circles and the two large rectangular pieces.
- Cut out the two little rectangular windows on each of the large rectangular pieces.
- Put glue on the backs of both circles and put them together to make the "wheel" of the wheel card, making sure that you align them so that the 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.
- 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.
- 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.

- 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.
- Look for 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.
- Glue the large rectangular pieces in all four corners just enough to hold the rectangles together but allowing the wheel to turn freely.
- If you wish, highlight each line inside the windows in a different color to make it easier to read. If you have access to a color printer, this step will be unnecessary.
- If you are putting the wheel together to use in a demonstration, now you're ready to calculate the greenhouse gas emissions "score" of members of your audience and what they can do to reduce it.



Side 1



Side 2



Climate Change, Wildlife, and Wildlands

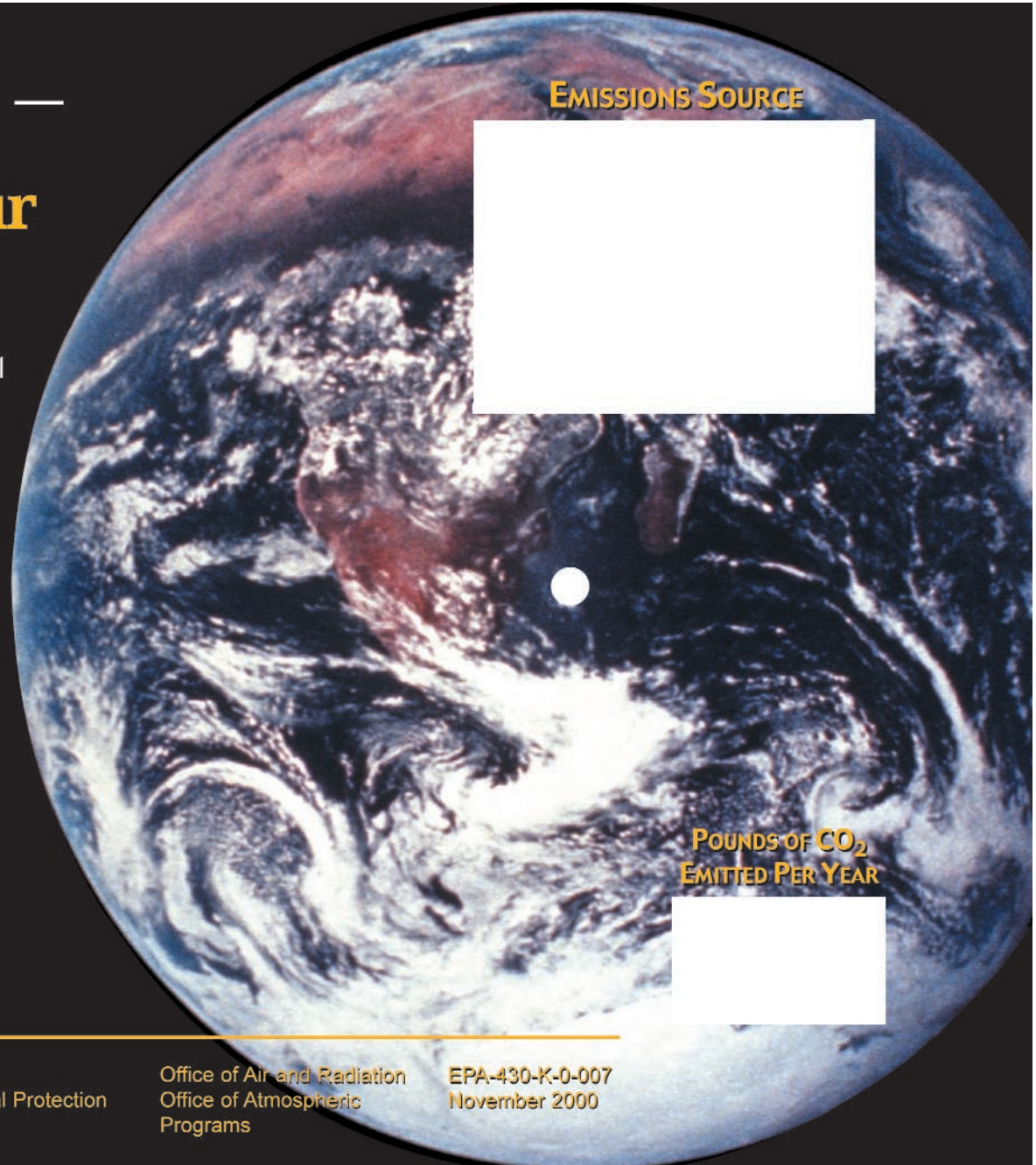
Global Warming Wheel Card

Side 1
[outside]

Global Warming —

What's Your Score?

In the United States, a typical household of two people generates approximately 60,000 pounds of carbon dioxide (CO₂) emissions every year from household activities and personal transportation.



United States
Environmental Protection
Agency

Office of Air and Radiation
Office of Atmospheric
Programs

EPA-430-K-0-007
November 2000

Climate Change, Wildlife, and Wildlands

Global Warming Wheel Card

Side 1
[inside]

Home Heating

On average, how many miles does your household put on your car(s) per week? Pick closest amount.

- 200 miles (10,400 miles/year)
- 400 miles (20,800 miles/year)
- 600 miles (31,200 miles/year)

9,800 lbs./year
19,700 lbs./year
29,500 lbs./year

Transportation

Which of the following scenarios best describes your household's waste disposal practices?

- We don't recycle at all.
- We recycle about half of all recyclable materials (paper, plastics, glass).
- We recycle everything we can.

6,000 lbs./year
12,000 lbs./year
24,000 lbs./year

Waste Disposal

On average, how much does your household spend on electricity each month? Pick closest amount.

- \$40
- \$80
- \$120

11,800 lbs./year
23,600 lbs./year
35,400 lbs./year

Electricity Use

On average, how much does your household spend on natural gas or fuel oil each month? Pick closest amount.

- \$25
- 05\$
- 00T\$

1,500 lbs./year
3,900 lbs./year
6,300 lbs./year

Global Warming — What's Your Score?

Climate Change, Wildlife, and Wildlands

Global Warming Wheel Card

Side 2
[outside]

Global Warming — What Can You Do?

If you took all of the actions on this wheel card, you could save 22,800 pounds of carbon dioxide (CO₂) annually and \$1,000 from your annual home energy bill and gasoline costs.

ACTIONS YOU CAN TAKE



Resources

U.S. Environmental Protection Agency website: www.epa.gov/globalwarming

ENERGY STAR® website: www.energystar.gov.

Summary of assumptions used in this wheel card: www.epa.gov/globalwarming/climatelink/ and look for the greenhouse gas calculator.

POUNDS OF CO₂ YOU CAN SAVE



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Global Warming Wheel Card

Side 2
[inside]



Name: _____

Date: _____
Class Period: _____

The Kyoto Protocol: Pre-Activity Worksheet

Ask a family member to help you figure out the answers to the following questions. We will use these answers next class to calculate your household's carbon dioxide footprint.

Waste Disposal

1. About what percentage of your household's waste do you recycle?

_____ %

Transportation

2. Approximately how many miles does your household put on your car(s) per week?

_____ Miles

Home/Water Heating

3. On average, how much does your household spend on natural gas or fuel oil each month?

_____ \$

Electricity Use

4. About how much does your household spend on electricity each month?

_____ \$

Name: _____

Date: _____

Class Section: _____

The Kyoto Protocol: Calculations and Conclusions

One of the gases addressed by the Kyoto Protocol is carbon dioxide (CO₂). The protocol states the recommended annual CO₂ emission per person to be about 5.5 tons (1 ton = 2000 pounds). Make a hypothesis about the amount of CO₂ you produce each year. Do you think you meet the Kyoto Protocol?

Hypothesis:

Data: What's Your Score?

Category	Your Estimate Household Amount	Pounds of CO ₂ Emitted Per Year
Waste Disposal (percentage of waste you recycle)	%	
Transportation (miles per week)	miles	
Home Heating/Water Heating (\$ per month)	\$	
Electricity Use (\$ per month)	\$	

Take your data and divide it by the number of people in your household to find your individual score.

Yearly Household Total (lbs. of CO ₂)	Number of People In Household	Your Individual Total (lbs. of CO ₂)

Name: _____

Date: _____

Class Section: _____

Now turn your Global Warming Wheel Card over and see what changes you can make in your everyday life that will reduce your carbon dioxide footprint.

Data: What Can You Do?

Category	Actions You Can Take	Pounds of CO ₂ Saved Per Year
Waste Disposal		
Transportation		
Home Heating/Water Heating		
Electricity Use		

Again, take your data and divide it by the number of people in your household to find your individual score.

Total Saved (lbs. of CO ₂)	Number of People in Household	Your Individual Amount Saved (lbs. of CO ₂)

Conclusion Questions

1. According to your household total, does your family follow the Kyoto Protocol's carbon dioxide recommendation?

Name: _____

Date: _____

Class Section: _____

- 2. In which category did your household have the highest carbon dioxide emissions?**

- 3. How do you think you can lower that amount?**

- 4. In the second part of the calculations, what amount of carbon dioxide were you able to save?**

- 5. How do you think family's totals in less developed countries would be different from households in the United States? Why?**

- 6. Some countries have agreed to the Kyoto Protocol, but do not compel their citizens to follow its rules and do not implement its regulations. What kind of suggestions would you give to those governments?**

- 7. Would you suggest some kind of compromise?**

- 8. Do you think that the Kyoto Protocol is truly achievable for countries?**