ehp ENVIRONMENTAL HEALTH PERSPECTIVES

OPEN ACCESS

THE KYOTO PROTOCOL: WHAT SHOULD WE DO?

Students learn about the Kyoto Protocol and discuss whether the United States should ratify the Kyoto Protocol. They use the information presented in the *EHP* news article "**Continental Divide: Why Africa's Climate Change Burden is Greater**" to learn how scientific data may be organized to frame the debate on controversial issues.

AUTHORS

Erin Hopper, NIEHS

Barry Schlegel and **Laura Hemminger**, University of Medicine and Dentistry of New Jersey

REVIEWERS

Susan M. Booker, **Banalata Sen, Heather Valli, Tanya Tillett,**and **Kimberly Thigpen Tart**, *EHP*

Liam O'Fallon, NIEHS

Stefani Dawn, University of New Mexico

DOI NUMBER

10.1289/ehp.scied007

ehp ENVIRONMENTAL HEALTH PERSPECTIVES

OPEN ACCESS

climate teacher

Overview

Grade Level: **9–12**

Subjects Addressed: Environmental Health, Biology, Health

Class Time: **1 -1.5 hours**

Students should read **Continental Divide: Why Africa's Climate Change Burden Is Greater** http://ehponline.org/article/info:doi/10.1289/ehp.113-a534

OBJECTIVE

By the end of this lesson students should be able to **explain** how scientific data may be organized to frame the debate on controversial issues; **describe** the primary reason given why the United States did not ratify the Kyoto Protocol; and **formulate** and defend a position on what the United States should do regarding the Kyoto Protocol.

MATERIALS (per group)

- 1 copy of the article **Continental Divide: Why Africa's Climate Change Burden Is Greater**
- 1 copy of the Student Instructions

VOCABULARY WORDS

Global climate change, Global warming, Greenhouse gases, Kyoto Protocol, Metric tons

Aligning with Standards

NATIONAL SCIENCE EDUCATION STANDARDS

Specific Content Standards

Unifying Concepts and Processes Standard

- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement
- Form and function

Science As Inquiry Standard

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Earth and Space Science Standard

- Energy in the Earth system

Science in Personal and Social Perspectives Standard

- Personal and community health
- Environmental quality
- Natural and human-induced hazards

SKILLS USED OR DEVELOPED

- Communication (note-taking, oral, written—including summarization)
- Comprehension (listening, reading)
- Critical thinking and response
- Graph reading
- Tables and figures (reading)

THE KYOTO PROTOCOL: WHAT SHOULD WE DO?

Background Information

Global climate change refers to how weather and temperature are changing throughout the world. It is generally accepted that the Earth's atmosphere is getting warmer, affecting global weather patterns. What is not universally accepted is what is causing this warming pattern. Most scientists are convinced that man-made emissions of greenhouse gases such as carbon dioxide are responsible for global climate change. In response, an amendment to the United Nations Framework Convention of Climate Change called the Kyoto Protocol was drafted in Kyoto, Japan, in 1997. The Kyoto Protocol is an international treaty that commits industrialized countries to reduce their greehouse gas (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) emissions by 2012. With the ratification by Russia, the treaty became effective 16 February 2005. As of August 2005, 153 countries had ratified the treaty. The United States and some other countries have not ratified the treaty because they believe the treaty is flawed. The United States government has said the requirement of the treaty would be too costly to implement and would not effectively deal with the problem of climate chanhe because many large polluters such as China are excluded from signing the treaty.

Prepping the Lesson

1. Download the article **Continental Divide: Why Africa's Climate Change Burden Is Greater** at **http://ehponline.org/article/info:doi/10.1289/ehp.113-a534**

2. Read the article **Continental Divide: Why Africa's Climate Change Burden Is Greater** and review the Background Information and Student Instructions.

3. Make copies of the Student Instructions and the article.

NOTES AND HELPFUL HINTS

- This lesson is most effective after the students are familiar with the topic. If possible, use it at the end of a unit on global climate change. To reduce classtime, have students read the article **Continental Divide: Why Africa's Climate Change Burden Is Greater** as homework in advance of lesson.
- A variation of the lesson could involve conducting the debate before the students complete the discussion questions. Have the students in each group decide which figures support their side of the argument.
- To extend the lesson, after completing Step 12, ask the students to think about other examples wherein the scientific data can be manipulated to support two different sides of an argument.
- If the debate is omitted, the lesson can be done as homework.
- Students could be asked to research the arguments for and against the man-made causes of global climate change.
- Conduct greenhouse experiments or experiments using carbon dioxide.
- Have the class research the forecasted environmental and health effects of global climate change where you live.

Implementing the Lesson

» Lead a brief discussion about global climate change.

» Hand out the Student Instructions and the article **Continental Divide: Why Africa's Climate Change Burden Is Greater**.

» In groups or as individuals, ask students to complete the questions on the Student Instructions and read the article.

» Conclude with a class debate and try to reach a class decision about whether or not the United States should sign the Kyoto Protocol. Split the students into two groups, with one group in favor and the other against the motion. For larger class sizes, each group can be further split into subgroups that are responsible for the opening remarks and rebuttal. An example of the debate scenario is presented below.

- 10 minutes: Both sides prepare opening statements (2 minutes each)
- 5 minutes: Each side delivers an opening statement
- 5 minutes: Both sides prepare rebuttals (2 minutes each)
- 5 minutes: Each side delivers a rebuttal
- 10 minutes: Open discussion and debate

» Conclude by presenting the students with an "After the Kyoto Protocol" scenario. Given that the protocol is set to expire in 2012, ask the students to devise some strategies for addressing global climate change. What should be the role of the United States? Should the US try to set an example for the rest of the world? Should the protocol be extended or replaced by a different treaty? What are some strategies besides a worldwide agreement that could help reduce greenhouse gas emissions? Depending on the class size, this discussion can be carried out in small groups or as an entire class.

Assessing the Lesson

Step 1

Using this information, do you agree or disagree with the position of the United States that the Kyoto Protocol is unfair? Explain.

There is no right or wrong answer to this question. Assess students' responses based on the quality of their arguments for their position. Be sure students accurately and logically refer to Figures 1 and 2 in the Student Instructions.

Step 2

Using this new information, has your position changed or remained the same in regards to the United States considering the Kyoto Protocol unfair? Explain.

Again, there is no right or wrong answer to this question. The issue is whether presenting carbon dioxide data per capita changes students' position on the issue. Assess students' responses based on the quality of their arguments for their position.

Step 3

Read the article Continental Divide: Why Africa's Climate Change Burden is Greater.

Step 4

Examine Figure 5 (Patz et.al). According to this fugure, which regions of the world are the largest emitters of CO_2? Which regions are likely to be affected most by global climate change?

The top panel of Figure 5 is a representation of the world map that shows the size of the countries as a proportion of the amount of CO_2 they release. The bottom panel is a similar representation based on mortality rates rather than CO_2 emissions. The trend is that countries that emit the greatest amount of CO_2 will be the least affected by the impacts of climate change and vice versa. Assess the students based upon their ability to explain what the figure depicts and their ability to connect it to the article **Continental Divide: Why Africa's Climate Change Burden Is Greater**.

Step 5

Based on the article, how many metric tons of carbon dioxide did Africa produce in 2002?

918.49 million metric tons. One metric ton = 1,000 kg

Step 6

What are the potential health effects in Africa attributed to global climate change?

» Drought-triggered famine

» Increased HIV/AIDS due to decreased immunity that is caused by poor nutrition and adverse living conditions

» Increased vectorborne diseases such as malaria, meningitis, dengue fever, and tickborne borreliosis

» Increased dust averaging 2.5 micrometers in diameter or less, which has respiratory and cardiovascular consequences

» Increased dust that carries bacteria, fungi, and chemical pollutants that adversely affect health

» Increased chances of war due to decreases in food supplies and population migration

» Increased disease in general due to poor nutrition and adverse living conditions

Step 7

What potential health effects in the US can be attributed to global climate change?

» Teachers can facilitate a discussion to enable students to extrapolate from their reading about Africa to possible climate change related health effects in the US.

» Acceptable responses include an increase in respiratory diseases and allergies due to increased air pollution, exposure to

allergens; rise in heat related illnesses and deaths due to increase in temperatures; increase in incidences of cardiovascular diseases and associated deaths due to poor air quality and heat-related stress; increase in water-borne illnesses; increase in vestor-borne and zoonotic diseases; increase in illnesses related to foodborne diseases and nutrition.

Step 8

One estimate states that $200 per year per person is how much it would cost to reduce CO_2 levels by 3% over 1990 levels, the amount necessary to bring the United States into compliance with the Kyoto Protocol. Would you be willing to pay an extra $200 per year to reduce CO_2 levels by this amount? Explain why or why not.

There is no right or wrong answer to this question. Assess students' responses based on the quality of their arguments for their position.

Step 9

If you wanted to defend the United States for not ratifying the Kyoto Protocol, would you present CO_2 emissions data per country or per capita? Explain why.

By presenting the carbon dioxide emission data per country, it makes it look like countries like China and India are a significant part of the problem that is not being addressed. This is the usual way the data are presented for those who wish to defend the position of the United States. By presenting the carbon dioxide emission data per capita, the size of the emissions are reduced for those countries that have large populations, such as China and India. Typically, per capita data are presented for those people who say the United States should bear a greater share of the cost of reducing carbon dioxide emissions.

Step 10

Consider the information in the article, including the potential effects of global warming and CO_2's possible contribution to global warming, and consider the CO_2 emissions and GDP data. Using this information, decide whether or not you are in favor of the United States ratifying the Kyoto Protocol. As part of a class discussion, be prepared to defend your position.

There is no right or wrong answer to this question. Assess students' responses based on the quality of their arguments for their position. Students should consider and discuss how the various factors (i.e., effects of global warming, CO_2's possible contribution to global warming, CO_2 emissions and GDP data) influence their position.

Step 11

The Kyoto Protocol is set to expire in 2012. Do you think the Kyoto Protocol should be extended? Do you think a new treaty should be implemented to monitor global greenhouse emissions? Should the new treaty differ from the existing treaty? Explain why or why not.

There is no right or wrong answer to this question. Assess students' responses based on the quality of their arguments for their position.

Step 12

Examine Figures 6 and 7 (Darmon et.al). Which representation of the data would you choose to publicize if you were a cereal manufacturing company? A dairy farmer? A vegetable grower?

These plots show the nutrient adequacy scores and nutrient density scores for fruits and vegetables and for other foods. The nutrient adequacy score is a representation of the number of nutrients that are present in a given weight of food (nutrients per gram). The nutrient density score is a representation of the number of nutrients that are present in a given number of calories of food (nutrients per calorie). Both scores were calculated based on 16 selected nutrients. The "fruits and vegetables" category contains fresh, canned, and processed fruits and vegetables but excluded dried fruits. The "other foods" category contains a large group of other foods, but excludes drinking water, alcoholic beverages, and added fats. It also included dried fruits and white potatoes.

The take-home message from these plots is that scientific data can be manipulated to support multiple sides of an argument. Cereal manufacturers and dairy farmers would likely choose to publicize Figure 6, but a vegetable grower would likely choose to publicize Figure 7. The students can also discuss which figure they think is a more reliable representation of the data.

REFERENCES

Patz J, Gibbs H, Foley J, Rogers J, Smith K. Climate Change and Global Health: Quantifying a growing ethical crisis. EcoHealth. Dec 2007;4(4): 397–405.

Darmon N, Darmon M, Maillot M, Drewnowski A. A Nutrient Density Standard for Vegetables and Fruits: Nutrients per Calorie and Nutrients per Unit Cost. J. Am. Diet. Assoc. 2005, 105: 1881–1887.

RESOURCES

Environmental Health Perspectives, News by Topic page. **http://ehp03.niehs.nih.gov/article/browsenews.action** Choose Climate Change/Global Warming.

A human health perspective on climate change. **http://www.niehs.nih.gov/health/docs/climatereport2010.pdf**

CIA, The World Factbook, Gross Domestic Product information, By country. **https://www.cia.gov/library/publications/the-world-factbook/rankorder/2004rank.html**

Energy Information Administration, U.S. Department of Energy, Summary of the report on the impact of the Kyoto Protocol on the U.S. energy markets & economic analysis. **http://www.eia.doe.gov/oiaf/kyoto/kyotobrf.html**

Energy Information Administration, U.S. Department of Energy, International Energy Annual 2006 World Carbon Dioxide Emissions from Use of Fossil Fuels. **http://www.eia.doe.gov/emeu/iea/carbon.html**

Global Warming: Early Warning Signs, clickable map of weather records and extremes across the world. **http://www.climatehotmap.org/**

International Energy Agency, CO2 emissions from fuel consumption. **http://www.iea.org/co2highlights/CO2highlights.pdf**

U.S. Environmental Protection Agency, Climate Change. **http://www.epa.gov/climatechange/**

Union of Concerned Scientists, Global Warming. **http://www.ucsusa.org/global_warming/**

UN Framework Convention on Climate Change. **http://unfccc.int/2860.php**

UN Framework Convention on Climate Change. Kyoto Protocol, **http://unfccc.int/kyoto_protocol/items/2830.php**