actionbioscience.org lesson

To accompany the peer-reviewed article by Jeffrey Chanton, Ph.D.:
"Global Warming & Rising Oceans" (Oct. 2002)
http://www.actionbioscience.org/environment/chanton.html

Global Warming: Life in a Greenhouse (Aug. 2003)

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Grades & Levels:

- **Handout 1:** high school (general/advanced)
- **Handout 2:** high school (AP) - undergraduate (year 1-2)

Time Recommendations:

- 1-2 class periods for article review
- up to 2 weeks for projects

NSES (USA) Content Standards, 9-12:

- NSES 1.2. Unifying Concepts & Processes: evidence, models & explanation
- NSES 1.3. Unifying Concepts & Processes: change, constancy & measurement
- NSES 3.5. Physical Science: conservation of energy & increase in disorder
- NSES 3.6. Physical Science: interactions of energy and matter
- NSES 4.5. Life Science: matter, energy & organization in living systems
- NSES 5.1. Earth & Space Science: energy in the earth system
- NSES 7.1. Science in Personal/Social Perspectives: personal and community health
- NSES 7.4. Science in Personal/Social Perspectives: environmental quality
- NSES 7.5. Science in Personal/Social Perspectives: natural & human-induced hazards
- NSES 7.6. Science in Personal/Social Perspectives: local, national & global challenges

Note: View the NSES content standards on this site to choose other curricular applications for additional activities at: http://www.actionbioscience.org/educators/correlationcharts.html

Learning Objectives: Students will…

- learn how the concepts of global warming & greenhouse effect have been developed and evaluated
- investigate the evidence that scientists have used to support these concepts
- examine the effects of global warming on ecosystems and climate
- explore ways that people can help to lessen future global warming

Key Words Include:
atmosphere, carbon dioxide, climate, climate change, coastal erosion, energy efficiency, fossil fuels, glaciers, global temperature, greenhouse effect, heat, industrial revolution, infrared radiation, oceans, rainfall, sea ice, sea level, vehicle emissions

Preparation

Article Discussion:

- Distribute or ask students to download and read the article "Global Warming & Rising Oceans," by Jeffrey Chanton, Ph.D., at http://www.actionbioscience.org/environment/chanton.html
- Follow the reading with questions about the article provided on page 2.

Student Handout 1 or 2:

- Activities can be assigned as an individual or group project to be done in class or at home.
- Refer students to the "Useful Links" section in the *Educator Resources* section found at the end of the Chanton article. These links help students with their activities or provide a course for research information.

For Educators: Article Discussion

About the article by Jeffrey Chanton, Ph.D.: "Global Warming & Rising Oceans"

http://www.actionbioscience.org/environment/chanton.html

Content Questions:

1. What is "the product of our industrial respiration"?
2. What are oil, gas, and coal made from?
3. What happened to the human population during the industrial age?
4. What is the name of the process you described in question 3?
5. What does the atmosphere do for our planet?
6. Define the following terms: ppm, CO_2, IR, centigrade, latitudes, and ecosystems.
7. Describe the role that CO_2 plays in controlling the earth's heat balance?
8. What are the 2 factors that cause sea levels to rise?
9. What are some examples that show that oceans are rising?
10. How much has the sea level risen in the last 18,000 years?
11. What is the projected increase in the CO_2 over the next 100 years?
12. What effect will the increase in CO_2 have on the global temperature?
13. What are signs that people may see indicating global warming trends?
14. How does increased CO_2 affect plant growth and nutritional value of plants for animals?

Extension Questions:

1. How does the size and type of road vehicle affect our global climate?
2. What does the temperature graph in Chanton's article show? Be ready to describe the results of that graph in a class discussion. Draw a straight line through those points that has, as best as possible, as many points above the line as below the line.
3. Describe the kinds of data that are needed to document global warming trends.
4. Hypothesize how global warming may affect the following:
   a) human health
   b) agriculture
   c) tourism and recreation
   d) marine animal migrations and food supply

Global Warming: Life in a Greenhouse
Student Handout 1

1. Describing Global Warming

Make a poster on *one* of the following topics that would be suitable for putting up on a wall in your school:

a) Dr. Chanton describes the greenhouse effect as being similar to a car's interior heating up on a sunny day. Make a poster using the illustration of a car in the sunlight and describe how this is similar to the way the earth is warming from increased CO_2.

b) Illustrate the different ways that rising oceans can impact people's lives. Explain on the poster the factors causing global sea level rise.

2. Taking Your Community's Temperature

Find out from your local radio station or weather center if there are records of yearly temperature averages for your community or region over the past years. Research how many years of data would be required to show a trend due to short-term variability in the temperature data. Make a poster with a graph of those years' temperatures. Explain if, how and why temperatures have been changing in your region.

3. Convincing the Skeptics

Prepare a radio debate with three team members:

- The host prepares questions for two guests.
- One guest takes the role of a skeptic that is not convinced that a change in a few degrees will make a difference in the global environment.
- The other guest takes the role of a supporter of the idea that global warming is a dangerous trend.

Present the radio script live in class or record it on audiotape for the class.

4. Forming National Policies

On July 31, 2003, the U.S. Senate passed a new national energy policy, resulting in the "first major overhaul of U.S. energy policy in a decade" (*New York Times*, July 31, 2003). For students in the United States, find out more about that bill and what it means for the consumption of fossil fuels. For students in other countries, find out what your government's policies are concerning fossil fuel consumption.

5. Being a Climatologist

Imagine you are a climatologist with an international organization that tracks global weather changes. What kind of data would you need to gather for your case about global warming to present at a scientific meeting? Present and discuss with a group of students an outline of the talk you intend to give.

6. Taking Action!

Dr. Chanton states in his article that "there is no immediate fix to the problem [global warming] other than to curtail our use of fossil energy." What are some ways that you use fossil energy? Prepare a report based on this research:

- For a week, keep a log of every time you drive or ride in a car, van or truck. Record or estimate the number of miles.
- Find out the approximate miles per gallon that the vehicle gets, then estimate the number of gallons of gas used for your travel activities.
- How many of those trips could have been done with other forms of transportation (bike, walk, bus, other public transportation)?
- Extrapolate your use of gas over a year.
- Estimate the amount of gas you might have saved over the year if you had used the other forms of transportation.

Global Warming: Life in a Greenhouse
Student Handout 2

1. Debate the Issues
Despite the compelling evidence of many scientists, not everyone is convinced that a change in a few degrees will make a difference in the global environment. Divide into 2 groups with differing viewpoints, one group believing in global warming and the other group disputing the concept. Research your group's viewpoint from data in a library or on the Internet.

2. Show the Data
Make a poster on *one* of the following topics that would be suitable for a science fair:

a) Where are the hotspots for temperature change in the world? Explore the Internet for maps about global warming throughout the world. Where is temperature change the most dramatic? How does your country or region compare to other parts of the world? In your poster, describe the conditions in your area and compare them to the rest of the world.

b) Design a graph that shows the increasing worldwide human population. Add to that graph, data points on changes in worldwide CO_2 concentrations. Both sets of data can be found on the Internet by searching for human population growth and carbon dioxide concentrations. Also show on the graph the point when the industrial revolution started. Describe in your poster the relationship between the industrial revolution, increases in the human population, and changes in CO_2 concentrations.

3. Energy Sources – A Panel Discussion
Form four groups with each group representing local experts on *one* of the topics below:

a) Where fossil fuels come from and how they are distributed throughout the world.
b) How fossil fuels are formed.
c) How abundant these resources are and how quickly they are replaced.
d) Political and economic issues associated with fossil fuel resources.

Convene a panel made up of one representative from each group (the student representative can be periodically changed to give more students a chance to sit on the panel). The panel will give a presentation on the issues and arguments about the worldwide demands and availability of fossil fuels. Consider inviting another class from your school to join in the audience.

4. Alternative Choices
Dr. Chanton states in his article that "there is no immediate fix to the problem [global warming] other than to curtail our use of fossil energy." Using *one* of the following topics, prepare a report to present to a small group or your entire class.

a) Dr. Chanton mentions the need to develop "alternative energy sources." What are some of these sources? Research alternative energy sources on the Internet and in your library. Pick *one* source and make a poster about how it makes energy and what the advantages and disadvantages are for that energy source.

b) What are the ways that you use fossil energy? For a week, keep a log of every time you drive or ride in a vehicle and record or estimate the number of miles. Find out the approximate miles per gallon that the vehicle gets, then estimate the number of gallons of gas that your activities required you to use. Extrapolate your use of gas over a year. Next, ask yourself "How many of those trips could have been done with other forms of transportation (bike, walk, bus, other public transportation)?" Estimate the amount of gas you might have saved if you had used the other forms of transportation. Using population census data for your age group in your country, determine how your yearly fuel usage/savings data would look if applied to all young people in your age group.

c) The fuel that we use in vehicles is a major contributor to increased CO_2 in the atmosphere. But there are some new types of fuel being developed for cars, e.g., hybrid (gas-electric power) and hydrogen fuel cells. Choose an alternative energy vehicle and make a poster describing the advantages and disadvantages of its new fuel type and how soon it might be available to the general public.

5. Ecosystem Impacts

Prepare a report on *one* of the following species or animal groups. Describe how the animal/species has been affected by global warming. You may want to include information about its distribution, behavior, and survival relative to changing climate or sea levels. Be ready to summarize the findings in your report to the rest of your class.

a) Polar bears
b) Western toads and golden toads
c) Salmon and trout
d) Arctic tundra plants
e) Elephant seals
f) Penguins
g) Antarctic sea birds
h) Marmots