TURN DOWN THE HEAT: A GLOBAL ISSUE

Master Teacher: Andrea Cantu

Grade Level: 6-8

Time allotment: Three 45-minute class periods.

Overview: The greenhouse effect is a natural occurrence that keeps the earth at a temperature that can sustain life. The problem occurs when man produces more greenhouse gases than nature intended. Since the industrial revolution, the increased production of greenhouse gases is now causing global warming.

Through the activities presented in this lesson, students will become familiar with the terms greenhouse effect and global warming. Students will record data from a greenhouse effect simulation and perform an experiment simulating the melting of the arctic ice cap. Students will list things they can do to diminish production of excess greenhouse gases. Students will search pre-selected web sites to reinforced concepts presented in the video and to acquire further information on the subject.

Subject Matter: Science and Technology

Learning Objectives:

Students will be able to

- Label the layers of the atmosphere:
- Define greenhouse effect and global warming;
- Analyze data from global warming Arctic simulations;
- Graph data from Dobson ratings from the Arctic;
- List sources of the four major greenhouse gases;
- List ways to diminish production of excess greenhouse gases;
- Gather further information on greenhouse effect and global warming via the web.

Standards

From the National Science Education Standards, grades 5-8

1) The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different properties at different elevations. (NSES D)

2) Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes. (NSES F)

Media Components

Video
Ecospeaks-Coming to an Understanding, Episode 101: The Greenhouse Effect

Web Sites

EPA Global Warming Site
http://www.epa.gov/globalwarming/
This site focuses on the science and impacts of global warming or climate change, and on actions by governments, corporations, and individuals.

Global Warming is Happening
http://www.enviroweb.org/edf/ishappening/index.html
this site discusses historical climate changes, human impacts on global warming, and sources of greenhouse gases.

Pace University School of Law Energy Project
http://www.law.pace.edu/env/energy/globalwarming.html
this site is a source for information on the global warming debate.

NASA's Global Change Master Directory
http://gcmd2.gsfc.nasa.gov
this site contains an online card catalog of data sets covering various scientific areas of global change research.

What is a Dobson Unit?
http://jwocky.gsfc.nasa.gov/teacher/basics/dobson.html
this site discusses dobson units used in ozone research.

Materials

For the class

- Two 3 liter bottles
- 500 ml of potting mix per bottle
- 1 thermometer per bottle
- 200 ml of water per bottle
- 1 – piece of plastic wrap for one bottle
- Heat lamp or grow light

For each group of four students:

- Two 500 ml beakers (plastic is preferred)
- 200 ml of water for each beaker
- 1 – piece of plastic wrap for one beaker
- 4 ice cubes per beaker
- 1 Ziploc freezer bag
- 1 thermometer per group

For each student:

- Greenhouse effect student packet
- 1 copy of the Dobson Units Data (class set)
- Pen and pencil

Prep for Teachers

Prior to the teaching, bookmark all Web sites used in the lesson. Cue the videotape to the appropriate starting point. Prepare the handouts for each student. Organize lab supplies.

Introductory Activity:

The following simulation will prepare your students for the concepts of greenhouse effect and global warming.

Step 1: Preparation of the greenhouse effect simulation

Cut off the tops of 2-three liter bottles. Fill each bottle with 500ml of potting soil. Pour 200ml of water into bottle. Tape or hang a thermometer to the inside of each bottle in such a way that the degrees can be seen from the outside. Cover one bottle with plastic wrap. Secure the edges of the plastic wrap to the outside of the bottle with tape. Place both bottles under a heat lamp or grow light.

Step 2: Begin the simulation

Distribute student greenhouse effect packets. Have students record temperature readings every 15 minutes. Continue recording data for two class periods. Students will graph their data.

Step 3: Analysis of data

Discuss the following questions with your students. Why did the temperature in the covered bottle rise? (Heat is trapped in the covered bottle and thus the temperature rises and is then maintained.) Why does the temperature in both bottles level off over time? (Each bottle reaches its maximum temperature. The amounts of heat given off in each bottle is determined by the heat source, in this case the light.) How is the covered bottle like a greenhouse? (The covering of a greenhouse holds in heat, as does the plastic wrap over the bottle.)

Learning Activities

Step 1: **Focus for media interaction**

Provide your students with a FOCUS FOR MEDIA INTERACTION, say "You observed a greenhouse effect simulation. In this video you will list the natural greenhouse gases and tell why they are important. In the video they use an analogy that an onion is to skin as the earth is to _____. Record your answer in the space provided in question 1. "

Insert *Ecospeaks – Coming to an Understanding*, 101 The Greenhouse Effect

START the tape with the following words on the screen: Part I: The Greenhouse Effect.

Step 2: Greenhouse effect

PAUSE the video when Dr. Millie Hughes-Fulford (the narrator) appears on the screen and says "Scientist describe the earth's atmosphere as if it were in several different layers." **SAY**, "In the analogy, the onion's skin is like the earth's atmosphere. In the following clip you will answer questions 2 and 3 by listing the layers of the atmosphere and recording the location of the ozone layer." With a dry erase marker write the word "ozone" on the screen between the mesosphere and stratosphere visual. Erase the writing when the labels of the atmosphere disappear. **PLAY** the tape until you hear and see the narrator say, "What would the earth be like without an atmosphere?" **PAUSE** the tape. **SAY**, "What are the four layers of the earth? (troposphere, stratosphere, mesosphere, thermosphere) Where is the ozone layer located? (between the stratosphere and the mesosphere) Listen for the answer to question #4. **PLAY** the tape until the video displays a gray picture of the moon on the screen. The narrator says, " So an atmosphere is really necessary to support human life." **PAUSE** the tape. **SAY**, "Without an atmosphere, what would the earth be like? (the moon) Questions 5-7 deal with speed of solar radiation and what the layers of the atmosphere absorb. Record your answers."

FAST FORWARD the tape until the screen shows Dr. Ralph Ciscerone and he says, "Sun light travels to the earth at an amazing speed." **SAY**, "How fast does sun light travel? (186,000 miles/second) What does the thermosphere and mesosphere absorb? (gamma and x-rays) What does the ozone absorb? (ultraviolet

radiation) Listen for the answers to questions 8-11." **PLAY** the tape until a cartoon scene appears with a bear sitting on the right of the screen and revolving red arrows on the left. Dr. Ciscerone says, "These chemicals absorb part of the heat energy that leaves the earth." **PAUSE** the tape. **SAY**, "What fraction of the solar beams are absorbed by earth? (2/3) What is another name for infrared radiation? (heat waves) What are the trapped gases called? (greenhouse gases) What are the four natural greenhouse gases? (methane, water vapor, carbon dioxide, nitrous oxide) In this next clip, listen for how much cooler the earth would be without greenhouse gases. Record your answer on #12. You will see a question on the screen, give an hypothesis for your answer. At the end of the video answers will be given to questions #13 and #18. **MUTE** the sound when the words "science challenge" appear on the screen. **PLAY** the tape until the entire question is printed on the screen. The question is "If the world population continues to grow, do you think that will make a difference in the amount of greenhouse gases in the atmosphere?" **PAUSE** the tape. Say "How much cooler would the earth be without greenhouse gases? (60 degree Fahrenheit)

Step 3: Global Warming

FAST FORWARD the tape until the screen shows a cartoon visual containing a box with water in it. The narrator says, "Measurements taken over the last hundred years indicate that the average global temperature has increased any where from a ½ to 1 degree Fahrenheit." **SAY**, "For #14, record the level the sea has risen in the last 100 years. Listen for another name for global warming and to how far back in time scientist can study CO_2 levels from ice cores. Record you answers to questions 15 and 16." On the board, write the chemical formulas for methane (CH_4), Carbon dioxide (CO_2), Nitrous oxide (N_2O), and chlorofluorocarbons (CFCs). **PLAY** the tape until the words methane, N_2O, and CFC scroll up the screen. The audio is, "Many scientist believe these increases come primarily from human activity." **PAUSE** the tape. **SAY**, "How high has the sea risen in the last 100 years? (4-8 inches) What is another name for global warming? ("enhanced" greenhouse effect) How far into the past can scientist study CO_2 levels from ice cores? (160,000) In this next section of the video record on #17 some sources of greenhouse gases". **PLAY** the tape until Dr. Ciscerone says, "That's more debatable". **PAUSE** the tape.

FAST FORWARD the tape and **MUTE** the sound when the words "science challenge" appear on the screen. **PLAY** the tape until the entire question is printed on the screen. **RESUME SOUND** The question is "If the polar sea ice melts, what

do you think will happen?" **SAY**, "Scientists disagree about the effects of global warming and what should be done. Scientists do agree that the earth is warming. What do you think about global warming? (Have students discuss this issue for a few minutes.) What are some sources of CO_2? (deforestation, burning of fossil fuels) N_2O? (fertilizers, industrial processes) CH_4? (growing of rice, burning of fossil fuels, leaks from natural gas operations, livestock) CFCs? (solvents, refrigerants, production of foam) For question #17, List things you can do to decrease production of excess greenhouse gases. In this segment of the video, questions #13 and 18 will be given. **STOP** the tape when the video is silent with the words "The End" printed on the screen. **SAY**, "What things can you do about preventing excess greenhouse gases?" (conserve energy, recycle, drive less, carpool or use public transit, walk and/or bicycle, insulate, plant trees) Were your hypothesis about questions 13 and 18 close to the correct answer? What aspect of increased population will cause increased greenhouse gases? (increase in products and services) Which pole will melting have an effect on the planet? (Antarctic) Why?" (runoff from the land will cause sea level rise)

Culminating Activity

The following activity will give students a better understanding of the polar caps melting. Through this simulation, students will realize that the Antarctic melting would cause a rise in sea level. Say, "Let's see for ourselves if question number 18 is correct. We will conduct a sea ice melting simulation. While we are conducting our experiment we will be searching the web for answers to questions about global warming. We will be on the EPA's website where we will search the following areas relating to global warming: 1) Impact, and 2) Climate."

Step 1: Setting up the simulation

Each group member has a specific job. (Materials gatherer, Investigator, Reporter, Clean Up) These jobs rotate every lab. After the material gatherer has collected supplies, the Investigator will add 500ml of water to each beaker. Next four ice cubes and a thermometer will be added to each container. One beaker will be placed in a Ziploc bag. Both beakers will be set out in the sun.

Step 2: Begin the simulation

Have students record temperature readings every 15 minutes. Continue recording data for two class periods. Students will graph their data.

Step 3: Analysis of data

Discuss the following questions with your students. Did the level of the water in the beakers rise? (No, because the ice displaced its weight in the water, therefore: the water did not rise in the beaker.) Were the results of this activity similar to the experiment using the liter bottles? (Yes, the cover container had a higher temperature than the uncovered one. Once again the containers temperature leveled off.) The Arctic is frozen ocean. The Antarctic is frozen land. How would the melting of the Antarctic affect sea level rise? (The runoff from the land would cause a rise in the sea level.)

Step 4: Web Search

Bookmark the EPA website on global warming. Have students answer the web questions on their greenhouse gas worksheet.

Cross-Curricular Extensions

LANGUAGE ARTS
Write a story about the affects of global warming from a fish's point of view.

ART
Draw pictures of the earth as it may appear in the future due to global warming. Consider that some animals may have adapted to survive the new harsher environment.

MATH
Find current Dobson Unit Ratings and plot the data on a graph.

Community Connections

a. Have a local Keep (City) Beautiful speak to the class about pollution relating to global warming

b. Have a local botanist speak about the effect of global warming on plant productivity.

GREENHOUSE EFFECT WORKSHEET

Introductory Activity: Greenhouse Effect Simulation

Time Temperature Draw a graph of your data below

(Min.)	Covered	Uncovered
0	_____	_____
15	_____	_____
30	_____	_____
45	_____	_____
60	_____	_____
75	_____	_____
90	_____	_____

1. Why did the temperature in the covered bottle rise? _____

_____

2. Why does the temperature in both bottles level off over time? _____

_____

3. How is the covered bottle like a greenhouse?_____

_____

Learning Activity

1. Earth : _____ as Onion : Skin
2. Layers of the atmosphere

_____ - warms Least dense
_____ - cools down
_____ - 8 to 30 miles thick
_____ - 7-8 miles thick Most dense

Earth

3. Where is the ozone layer located?_____.
4. Without the Atmosphere, the Earth would be like the _____.
5. How fast does solar radiation travel through space to the earth? _____.
6. The top layer of the atmosphere absorbs _____.
7. Mid in the stratosphere the process of ozone formation absorbs _____.
8. The earth absorbs _____ of the solar beams.
9. Radiated heat energy out into space is called infrared radiation or _____.
10. These heated up gases give off their own heat called _____.
11. Name the four natural greenhouse gases. _____, _____, _____, _____.
12. Greenhouse gases create thermal equilibrium. Without greenhouse gases, the earth would be _____ cooler.

13. If the world population continues to grow, do you think that will make a difference in the amount of greenhouse gases in the atmosphere? Explain.

_____

_____

14. How high has the sea risen over the last 100 years?
    _____
15. What is another name for global warming?
    _____
16. Ice cores are used to analyze CO_2 levels for the past _____ years.
17. Name some of the sources of the following:

    a. CO_2 _____ b. CH_4
    _____

    c. NO_2 _____ d. CFC
    _____

18. If the polar sea ice melts, what do you think will happen? Explain.

_____

19. List ways in which you can reduce the production of greenhouse gases.

_____

_____

Culminating Activity: Polar Ice Simulation

Time (Min.)	Temperature Covered	Uncovered	Draw a graph of your data below
0	_____	_____	

15	_____	_____
30	_____	_____
45	_____	_____
60	_____	_____
75	_____	_____
90	_____	_____

1. Did the level of the water in the beakers rise? Explain. _____

_____

2. Were the results of this activity similar to the experiment using the liter bottles?

Explain.

_____

3. The Arctic is frozen ocean. The Antarctic is frozen land. How would the melting of the Antarctic affect sea level rise?

_____

GLOBAL WARMING WEB SEARCH

Search the following site for the answers to the questions below:
http://www.epa.gov/globalwarming/publications/reference/ipcc/summary/page2.html

2. Nature of the Issue

1. What is predicted to be the increase in temperature and sea level by the year 2001? _____

4.1 Ecosystems

2. What would floods and droughts do to water quality?
_____

3. What regions would be particularly at risk from climate change?
_____

4.3 Food and Fiber Production

4. What other factors put fisheries at risk?
_____

a. *Coastal Systems*

5. What percent of the world's population live in coastal zones?
_____

6. How would coastal areas be affected?

   _____

4.5 Human Health

7. What diseases are increasing worldwide?

   _____

8. How would climate change affect human health?

   _____

9.

   _____

6.2 Polar Regions

9. What is the difference between the Arctic and Antarctic?

   _____

10. Name some changes that will occur in the Arctic Ecosystem.

    _____

11. What type of radiation would adversely affect primary productivity and fish productivity?

    _____

12. Due to global warming, what changes would occur in North America's Ecosystem?

    _____

13. Where are 50% of North American waterfowl supported?
    _____

Climate

To get to the climate section, scroll to the bottom of the document and select home. Once you are at the home page select climate.

1. Would life exist, as we know it, without the natural greenhouse effect? Explain.

   _____

2. Since the industrial revolution increase in concentration of CO2 has increased _____%, N2O ____%, and methane has doubled.

3. What is the main reason for the increase in greenhouse gases?
   _____

4. In the changing climate section it states that the sea level has risen _____ inches over the past century.