Kristen Cacciatore
ECOS 597
November 15, 2003

ESCI Lesson Plan

<u>Frameworks References</u>:

Physics Learning Standards for a Full First-Year Course in Grade 9 or 10
3. Heat and Heat Transfer
Broad Concept: Heat is energy that is transferred between bodies that are at different
temperatures by the processes of convection, conduction, and/or radiation.
3.1 Explain the relationship among temperature change in a substance for a given amount
of heat transferred, the amount (mass) of the substance, and the specific heat of the
substance.
6. Electromagnetic Radiation
Broad Concept: Oscillating electric or magnetic fields can generate electromagnetic waves over a
wide spectrum of energies.
6.1 Describe the electromagnetic spectrum in terms of wavelength and energy, and be able
to identify specific regions such as visible light.

<u>Essential Questions</u>:

What is global warming? What causes it? How do we know if it is happening here?

<u>Learning Objectives</u>:

Students will:
- o Know that UV and visible light from the sun strike the Earth and are reflected off the
  surface as infrared (heat) waves.
- o Understand that some but not all of the gases naturally present in the Earth's atmosphere
  absorb infrared waves and reflect them back towards Earth again, thus warming the air
  and surface.
- o Know that these gases are called greenhouse gases, since they act like glass in a
  greenhouse (or in a car in the sun) and trap heat
- o Recognize that carbon dioxide CO_2 and methane CH_4 are the most important greenhouse
  gases.
- o Understand that CO_2 is consumed by plants for respiration and produced in large
  quantities by burning fossil fuels like gasoline, oil, and coal.
- o Realize that more CO_2 means more heat absorbed and reflected back to Earth, thus
  "global warming" or increased Earth surface temperatures.
- o Understand that human activities such as deforestation, driving cars, and operating power
  plants are responsible for the changing CO_2 amounts.
- o Know that local average temperature has increased significantly over the last ninety
  years.
- o Understand the meaning of basic statistics including mean, median, and range.
- o Know how to use statistics to answer questions about data.
- o Know that CO_2 levels in the atmosphere have been steadily rising for the past 130 years.

Students will be able to:

- o Correctly answer 4 out of 5 questions about global warming on a short quiz.
- o Correctly input data into their graphing calculator.
- o Use the calculator to calculate the mean, median, and range for a data set on their calculator.
- o Correctly answer three questions in which they correctly compare their data analysis to their partner's analysis.
- o Write a paragraph in which they explain their opinion about whether global warming is occurring
- o Set-up a coordinate graph with designated parameters, scale, axes and units.
- o Correctly plot 12 of 15 points on their graph
- o Draw a smooth best-fit curve that approximately represents plotted data
- o Extrapolate 10 data points from their curve.
- o Input data error-free into a Microsoft Excel spreadsheet.
- o Plot data on an XY graph in Microsoft Excel.
- o Correctly answer 4 of 5 questions using their graph.

Assessment: Via multiple-choice quiz, homework assignment and graph presentation

Rubric and Answer Key: See attached

Introduction/Background:

In this three-part lesson, students first participate in a class discussion about prior knowledge of global warming. Then they view an interactive multimedia clip giving an overview of the global warming phenomenon from the EPA Global Warming for Kids website in the large group setting, followed by further discussion. Next they view the same clip on their own on an Internet-connected computer. This portion is assessed via a five-question quiz on the website.

In the next part of the lesson, students statistically analyze mean temperature data from Blue Hill Weather Observatory for two twenty-year time periods, 1891-1910 and 1981-2001. After comparing the data from the two time periods, they use these analyses to answer questions about climate change in our local area over the last twenty years. This portion is assessed via a homework assignment consisting of questions about their analysis and inferences they draw from it.

The third part of the lesson involves graphing data on atmospheric CO_2 concentrations by hand and extrapolating from this known data to the future. Next students transfer their data to Microsoft Excel and graph it on the computer. They then use these graphs to answer a series of questions in which they are asked to make future predictions about CO_2 levels. This portion of the lesson is followed by students' presentation of their graphs and predictions to the whole class along with more group discussion.

This lesson is designed for students in a basic-level ninth-grade physical science course, but could be used in a middle-level science course. No specific knowledge of scientific concepts or ideas relating to the learning standards cited is required before beginning the lessons, nor is fluency on Microsoft Excel a prerequisite. Familiarity with coordinate graphing systems, plotting points, and drawing curves is necessary and has been covered in students' math classes.

Lesson:

Day 1
1. Ask students if they have heard of global warming or the greenhouse effect. What have they heard? What do they think about these terms and ideas? Write responses on the board.
2. Show Global Warming animation from http://www.epa.gov/globalwarming/kids/animations.html
3. Ask students how the information in the animation relates to their prior conceptions on the board and address any misconceptions during the discussion.
4. Hand out question sheet (see attached) and ask students to answer the questions while viewing the animation at their personal station.
5. Students then take the 5 question quiz offered on the website and record the correct answers on their sheet.

Day 2

1. Ask students if they think the weather here in Dedham is getting warmer over the years? Is global warming happening here?
2. Tell them we are going to look at real data from Blue Hill Observatory and see if we can see any warming between the last twenty years the twenty years from 1891-1910.
3. Assign each student a month and one of the two time periods.
4. Hand out data sheets with temperature data.
5. Demonstrate how to input data into their graphing calculators.
6. Demonstrate how to analyze the data on the calculator for mean, median and range.
7. Ask students what they know about mean, median, and range. Clarify and provide correct definitions.
8. Have students work in pairs based on month to compare their values for the two time periods.
9. Discuss results of these comparisons.
10. Hand out question sheets and ask students to answer the questions for homework.

Day 3
Start off by telling students that, working in pairs, we are going to use real data on CO2 concentration collected at a laboratory over the last 130 years to try and predict how CO2 levels are going to change in the future.
11. Hand out rubric (see attached) and explain that each student pair will present their graph and predictions to the group the next day.
12. Hand out graphing instructions (see attached), rulers, and graph paper and ask students to complete part I.
13. Teacher should circulate amongst students to help with graphing and to ensure that graphs use proper scales and axes.
14. When students are done, demonstrate how to input data into Microsoft Excel on the LCD projector while students do the same in teacher-assigned pars at their work stations.
15. Demonstrate how to plot the data on an XY scatter graph and have students do the same.
16. Ask students to complete the part II questions.

Day 4
1. Student pairs present graphs and predictions. Teacher should write year 2050 CO2 predictions in parts per million on the board.
2. After all pairs present, teacher should initiate a discussion around why the predictions vary so much given that everyone used the same data.
3. Teacher connects the variation to the current debate over the future impact of global warming.

Materials:

- o LCD projector & computer with Internet connection
- o Internet-connected computers for all students
- o Graphing calculators for all students
- o Microsoft Excel program
- o Graph paper
- o Ruler for each student
- o Blue Hill Weather Observatory temperature data

Accommodations:

For a student with a graphomotor learning disability or dysgraphia, I would provide a template graph with axes already numbered and labeled. For a student with dyslexia, I would provide rounded data that was easier to graph and graph paper with larger squares.

Bibliography:

American Chemical Society. Chemistry in the Community. Dubuque, Iowa: Kendall Hunt, 1988.

Blue Hill Weather Observatory. Mean temperature data 1891-1910 and 1981-2001. Obtained November 14, 2003 via email transmission of .txt file.

"Global Warming Processes". Online animation. EPA Global Warming For Kids Website. November 3, 2003. http://www.epa.gov/globalwarming/kids/animations.html

Massachusetts Department of Education. Science & Technology Curriculum Frameworks. Malden, MA, 2003

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Summary Handout

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Massachusetts Department of Education. Science & Technology Curriculum Frameworks. Malden, MA, 2003

GLOBAL WARMING QUESTIONS

Directions: Answer these questions in complete sentences while you view the Global Warming Movie at your workstation.

1. Where do the yellow rays come from? What are they?

2. Where do the red rays come from? What are they?

3. What happens when an infrared ray strikes a molecule of greenhouse gas?

4. Why is having some greenhouse gases near the earth a good thing?

5. What is one of the most important greenhouse gases?

6. What happens when people cut down trees and burn them?

7. What are two things people do that increase thee amount of greenhouse gas in the atmosphere?

8. Why does more greenhouses gas in the atmosphere leas to the Earth being warmer?

9. How much would the Earth's temperature have to go up before there could be serious problems caused by the warming?

10. What are two problems that could be caused y global warming?

Directions: After you are done answering these ten questions:

1. Choose the "take the global warming quiz" button on the website.
2. Answer the five questions.
3. When they are done, there is a button the screen says, "Press here for your score".
4. You must show Ms._____ or Ms. _____ this screen with a score of 80% or 100% and we will initial. You can retake the quiz if you need to.

Teacher's Initials:_____   80% OR 100%