MiSP ECOLOGY/POLLUTION — GLOBAL WARMING
Teacher Guide, L1 - L3

Introduction

This unit can be used by Living Environment Regents, Earth Science Regents, and intermediate-level eighth grade courses. It can be part of an ecology / human impacts unit of study. Global warming can be controversial so the unit deals mainly with data. Teachers can spend time discussing whether or not the recent warming trend is caused by human activity and can discuss possible solutions. It is important to underscore that the greenhouse effect is real, good for living things, and "natural." Of course, too much of a good thing is not necessarily good.

Standards

ILST Core Curriculum — Major Understandings:
Standard 4 Living Environment 7.1e, 7.2b, 7.2c, 7.2d
Standard 4 Physical Setting 2.1a, 2.2r
Living Environment Core Curriculum — Major Understandings:
Standard 4 6.3c, 7.1b, 7.1c, 7.2a, 7.2c, 7.3a
Physical Setting / Earth Science Core Curriculum — Major Understandings:
Standard 4 2.2b, 2.2d

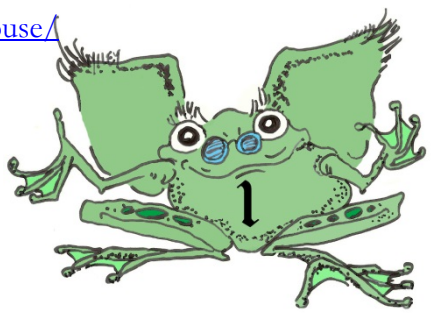
Learning Objectives: After completing this unit, the students will be able to:

- List greenhouse gases
- Explain the greenhouse effect and why it is important to life on Earth
- Interpret a graph that shows the change in Arctic ice coverage
- Plot and interpret two graphs: time versus carbon dioxide concentration and time versus average world temperature
- Determine and use the unit rate of change for carbon dioxide concentration and average world temperature from 1960 to 2005 (L2)
- Determine and apply the formulas for the lines on the two graphs: time versus carbon dioxide concentration and time versus average world temperature.

Day 1 — Greenhouse Effect and Global Warming

Resources:

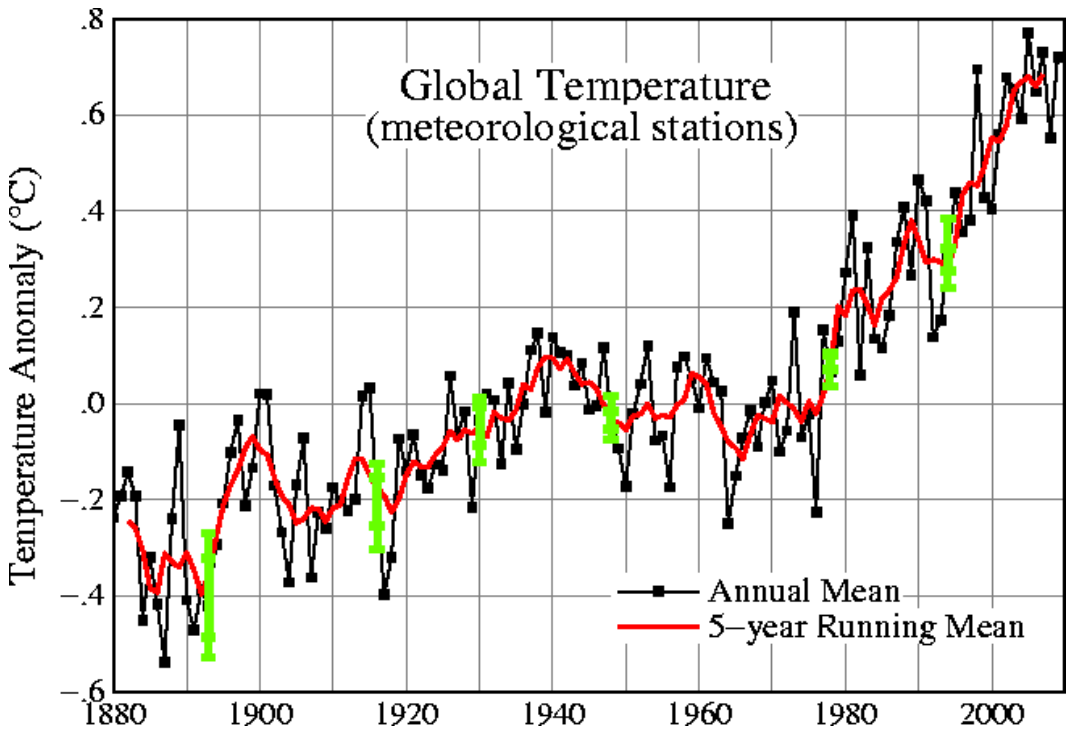
- Video (on the controversial side; for possible use as an introduction)
  http://www.youtube.com/watch?v=S1ffgR1BxaE
- Global Warming Explanation
  http://earthguide.ucsd.edu/earthguide/diagrams/greenhouse/



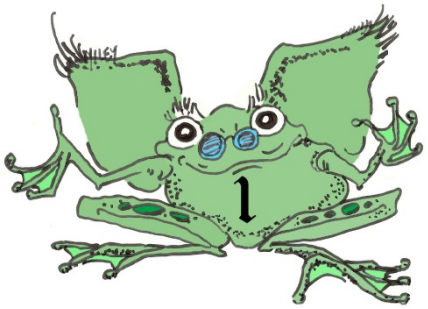
- NOAA Global Warming Frequently Asked Questions
  http://www.ncdc.noaa.gov/oa/climate/globalwarming.html#q3
- Teachers' Guide to High Quality Educational Materials on Climate Change and Global Warming
  http://hdgc.epp.cmu.edu/teachersguide/teachersguide.htm
- Kids vs. Global Warming
  http://kids-vs-global-warming.com/Science.html
- Visualizations — Climate Predictions
  http://www.gfdl.noaa.gov/visualizations-climate-prediction

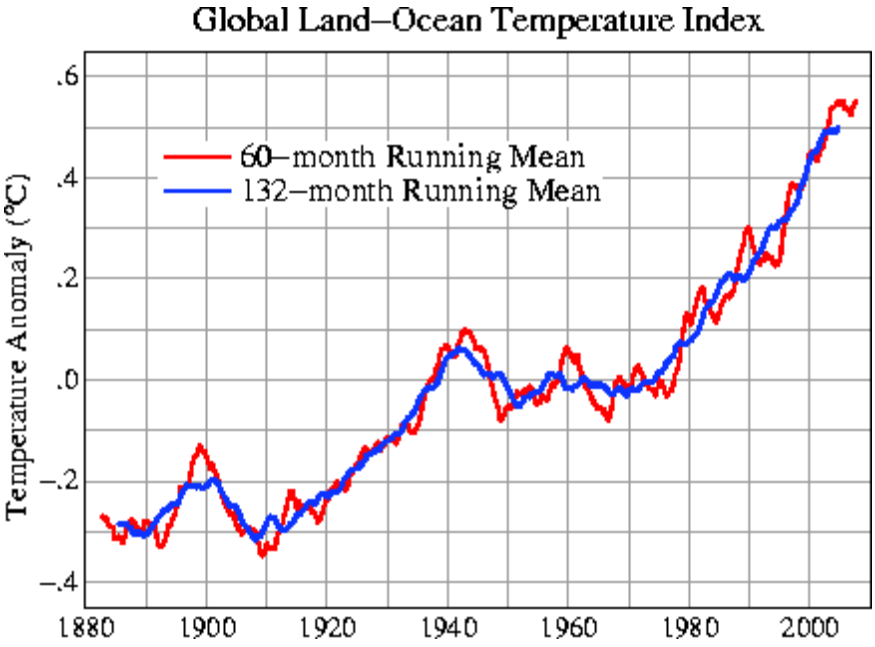
Day 1 discussions should include:

- The makeup of the atmosphere — layers and gases present
- The greenhouse effect: what it is and why it is important to life on Earth
- Greenhouse gases
- Human impact on the amount of greenhouse gases
- Possible impacts of global warming
- An overview and discussion of the issue of global warming. The following graphs or similar ones may be used:



Source: http://data.giss.nasa.gov/gistemp/graphs/





Source: http://www.columbia.edu/~mhs119/Temperature/

Question of the Day:

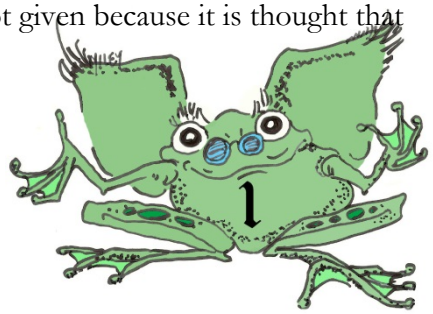
Carbon dioxide gas (CO_2) is not the most important cause of the greenhouse effect — water vapor is. So why is much of the conversation about global warming focused on carbon dioxide?

Day 2 — Polar Ice Extent

Sources

Information — National Snow and Ice Data Center
September ice: http://nsidc.org/news/press/20091005_minimumpr.html
General information about sea ice: http://nsidc.org/seaice/
Main website: http://nsidc.org/seaice/

Many phenomena that occur as a result of global warming have been identified. One is the extent of polar ice, especially in the Arctic. The possibility of ice-free summers has been raised. The plight of the polar bear is a popular media focus. Worksheet #1 presents September Arctic ice data. September is the low point of ice extent. Students will use the data to answer a series of questions. The graph does not have vertical gridlines but each year is represented as a data point on the graph. The *x*-values on the graph can be determined by counting the dots from 1979. Levels 2 and 3 require the students to calculate the slope of the best-fit line. They should be directed to choose two ordered pairs that fall on or close to the line. Examples are (1983, 7.5 million sq. Km), (1989, 7.1 million sq. Km), and (1999, 6.3 million sq. Km). A data table is not given because it is thought that



the students need practice reading graphs such as these. At level 3 the students use the unit rate of change and one of their ordered pairs to calculate the *y*-intercept. This presents a challenge in that the *y*-axis does not intersect the *x*-axis at (0,0). The students will probably need guidance with this assignment. The instructions direct them to renumber the *x*-value of their ordered pair, using 1978 as the 0 point. Later in the worksheet when they use the equation for the line to predict an *x*-value, they will need to add 1978 to the value they calculate.

Teachers may want to read the introduction with the students and supplement that selection with other information and graphics from the National Snow and Ice Data Center (or other resources).

Question of the Day:

Why should people on Long Island be concerned with the changing amount of sea ice many miles north of where they live?

Days 3 and 4 — Is There a Connection Between Global Warming and Carbon Dioxide?

Sources

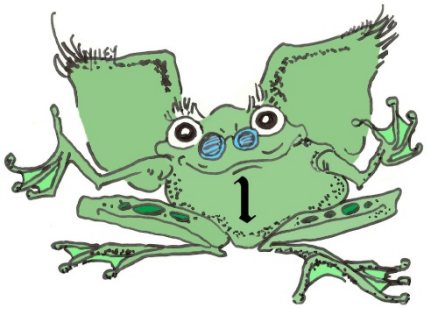
Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy (http://cdiac.ornl.gov/)
Goddard Institute for Space Studies (http://data.giss.nasa.gov/gistemp/)

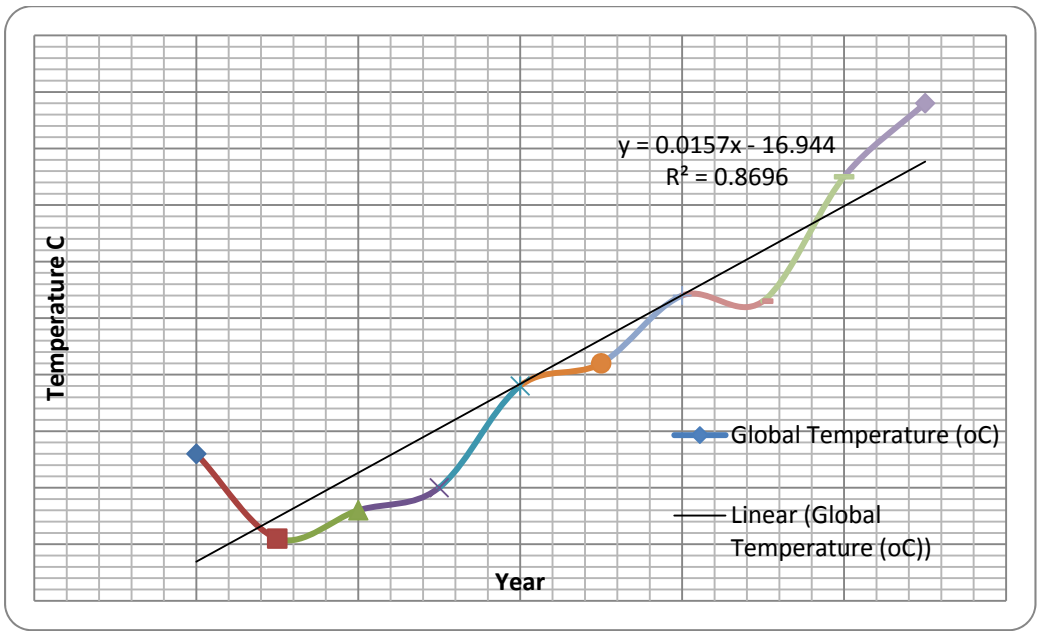
Challenges for the students will occur (especially at level 1) when they graph the temperature data. Teachers are probably accustomed to seeing global temperature data as a graph of temperature anomalies (the anomalies are to the 1951-1980 base/average temperature, which is 14°C.The MiSP Ecology/Pollution — Global Warming unit utilizes the actual average temperatures, based on a running five-year average to smooth out the data.

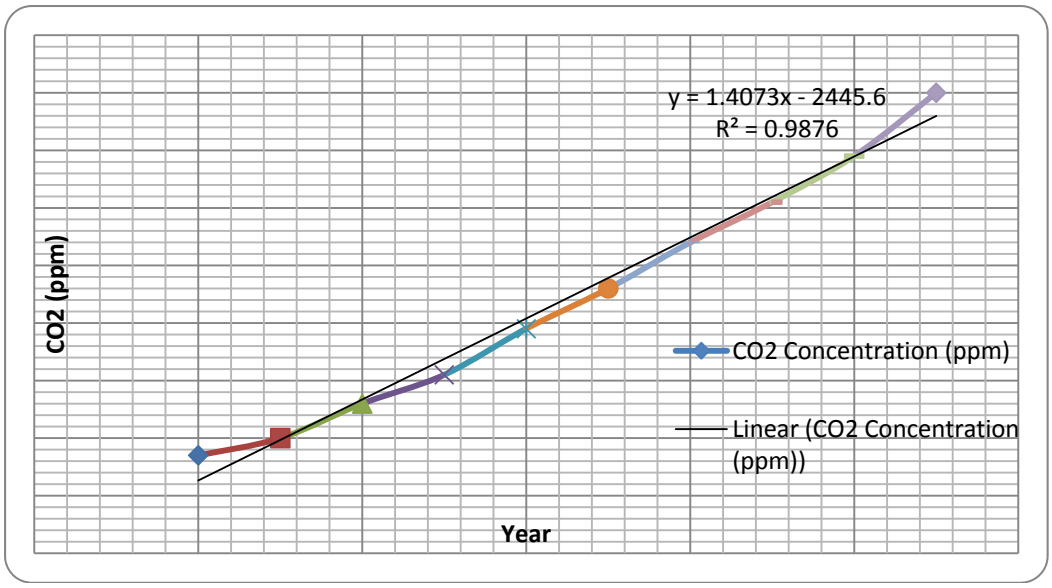
Also, comparing the two sets of data has to be done with caution. They are two very different sets of data.

At level 2 the students are instructed to find the unit rate of change (slope) of the best-fit line. Because the students' individual lines will vary somewhat, they should be instructed to choose two data points that are on or close to their best-fit line to use as their ordered pairs to determine the slope.

For level 3, review the explanation of using 1960 as year 0. The students may need help with understanding the need for this conversion. Consider telling all of the students to start their *x*-axis with 1960 to simplify the line equation. When the students are determining the *y*-intercept, it may be easier to display an example graph with best-fit line for all of the students to use. Then the class can pick the same data points to use for the *y*-intercept calculation.







Day 5 - Assessment

Administer the appropriate level assessment: *MiSP Ecology/Pollution — Global Warming Assessment.*