

Climate Change: What does the data say?



STANDARD COURSE OF STUDY CORRELATIONS:

Science, Grade 7, Goal 3: The learner will conduct investigations and utilize appropriate technologies and information systems to build an understanding of the atmosphere.

3.03 Conclude that the good health of environments and organisms requires: the monitoring of air quality; taking steps to maintain healthy air quality; and stewardship.

Earth Science, Goal 5: The learner will build an understanding of the dynamics and composition of the atmosphere and its local and global processes influencing climate and air quality.

5.03 Analyze global atmospheric changes, including changes in CO₂, CH₄, and stratospheric O₃, and the consequences of these changes.

INTRODUCTION TO LESSON: Students will use graphs to analyze data and better understand the correlation between CO₂ and climate change.

BACKGROUND FOR TEACHER: Earth is a dynamic planet, and change in its climate is not a new phenomenon. The video references graphs that show a significant difference in pre-industrial climate fluctuations (pre-1780s) and modern climate fluctuations. According to the U.S. Environmental Protection Agency's data on climate change, some of the causes of pre-industrial climate change include changes in Earth's orbit, changes in the sun's intensity, and volcanic activity. These causes, or drivers, of climate change can also create feedback that amplifies its initial effect. Examples of feedback include changes in ocean currents and changes in atmospheric greenhouse gases brought about by the heating or cooling of Earth's surface. Both types of feedback can cause further change in climate. For background information on the graphs on each data sheet, see the EPA Web site on the science of past climate change (<http://www.epa.gov/climatechange/science/pastcc.html>).

MATERIALS

- ☀ Two signs bearing the words "Strongly Agree" and "Strongly Disagree"
- ☀ Color copies of Data Sheet 1 (Past Climate Change) and Data Sheet 2 (Recent Climate Change) for each pair of students
- ☀ Overhead projector (optional)
- ☀ *An Inconvenient Truth*, *The Great Global Warming Swindle* and/or other films with different points of view about climate change (optional)

PREPARATION

- ☀ Make signs.
- ☀ If you can't make color copies of the data sheets, use an overhead projector to display the graph on Data Sheet 2.
- ☀ For the "Elaborate" exercise, if Internet access is not available in the classroom, print information from the suggested Web resources beforehand.

engage > Move chairs and desks to the side of the classroom. Post "Strongly Agree" and "Strongly Disagree" signs on opposite side of the room. Read the following statement:

"Climate change is a natural phenomenon."

Tell students if they agree with the statement to move toward the "Strongly Agree" sign. If they disagree, they should move toward the "Strongly Disagree" sign. Students can stand somewhere in between if they have doubts.

Once everybody has taken a stand, ask a few students from each category to share their views. Students should give at least one reason for their opinion.

Repeat the exercise using the following statements:

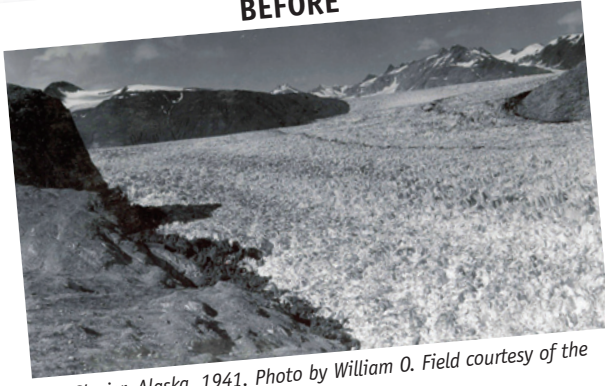
"Human activity has an impact on climate change."

"Analyzing data on past climate change can help us better understand our current situation."

explore > Move desks so that students can work in pairs. Hand out sets of data sheets to each pair. Pairs should work together to analyze the graphs and answer the questions on each sheet

explain > Have students share their written observations. After reviewing the data, revisit the statement *"Climate change is a natural phenomenon."* Ask if any

BEFORE



Muir Glacier, Alaska. 1941. Photo by William O. Field courtesy of the National Snow and Ice Data Center.

AFTER



Muir Glacier, Alaska. 2004. Photo by Bruce F. Molnia courtesy of the National Snow and Ice Data Center.

students have changed their original opinions. Students should give reasons for changing (or not changing) their opinions.

If time permits, have them explain their responses to the second and third statements.

elaborate> Do at least one of the following activities:

- Ask students: How do we know that Earth’s climate has fluctuated over thousands of years? Have them work independently or in groups to research how the study of snow, ice and permafrost can help answer this question. Students should produce an information sheet to educate others about what they have learned. Using text and images, the information sheet should explain what the cryosphere is and how ice can be used as an indicator of climate change. It should also include a timeline showing how far back in time ice can be used to study Earth’s climate. These resources will aid students’ investigation:
 - Understanding the Cryosphere: <http://nsidc.org/sotc/>
 - Timeline Resource: <http://niel.usgs.gov/timeline.htm>
 - Glacier Photos: http://nsidc.org/data/glacier_photo/repeat_photography.html
- Watch and discuss excerpts from movies with opposing viewpoints on climate change. Possible choices are *An Inconvenient Truth* (2006) and *The Great Global Warming Swindle* (2007).

evaluate> Have students reflect, in writing, on the data found in the graphs. Prompt them with questions. For example: What insights do the data give into climate change? Ask them to list any questions that the climate change data raised for them.

Have students turn in their data sheets and reflections. Assess the students’ understanding of the data by observing the work done in pairs and by evaluating their independent reflections.

Teacher’s Notes:



BEYOND THE CLASSROOM

Contact a local university or museum to find experts who use technology to study climate change. Arrange a visit to the expert’s institution to see the technological tools and evidence from any field-work. Another option is to arrange a visit with a meteorologist at a local TV station.

Additional Resources:

The U.S. Environmental Protection Agency (EPA) climate change page contains excellent links to information about climate change and the greenhouse effect • <http://www.epa.gov/climatechange/index.html>

U.S. EPA climate change kids site • <http://epa.gov/climatechange/kids/index.html>



Data Sheet One

Past Climate Change

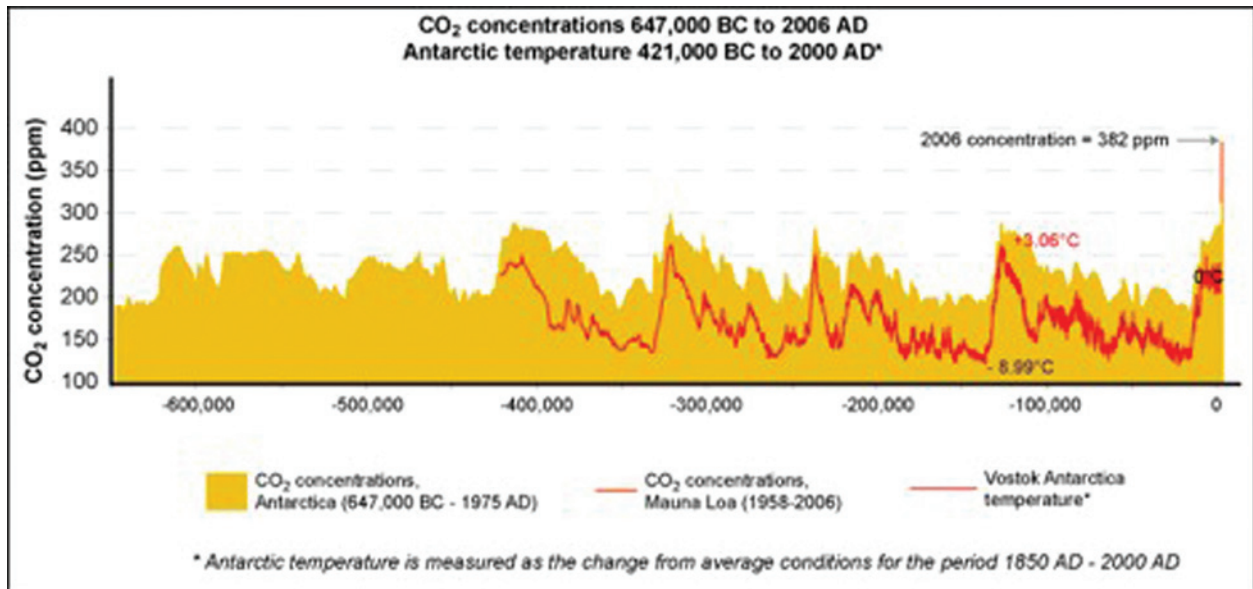
DIRECTIONS

- ☉ Analyze and discuss the graph with your partner.
- ☉ Answer the questions on a separate piece of paper.

Partner 1: _____

Partner 2: _____

Date: _____



Note: The years on the horizontal axis are recorded in years “before present” or BP. Source: EPA Web page on climate change: <http://www.epa.gov/climatechange/science/pastcc.html>

1. What range in years does this graph cover?
2. What is measured on the left vertical axis? Why is it important to measure this chemical to analyze climate?
3. Where is temperature data recorded in the graph?
4. What is the difference between a glacial and an interglacial period? Which period are we in now? How many glacial periods does this graph show from 0 to 400,000 BP (before present)?
5. Beginning 400,000 years BP (before present), how would you describe the relationship over time between the temperature and CO₂ concentrations?
6. Based on the 2006 recording of CO₂, what conclusions might scientists make about temperature expectations?

Data Sheet Two: Recent Climate Change

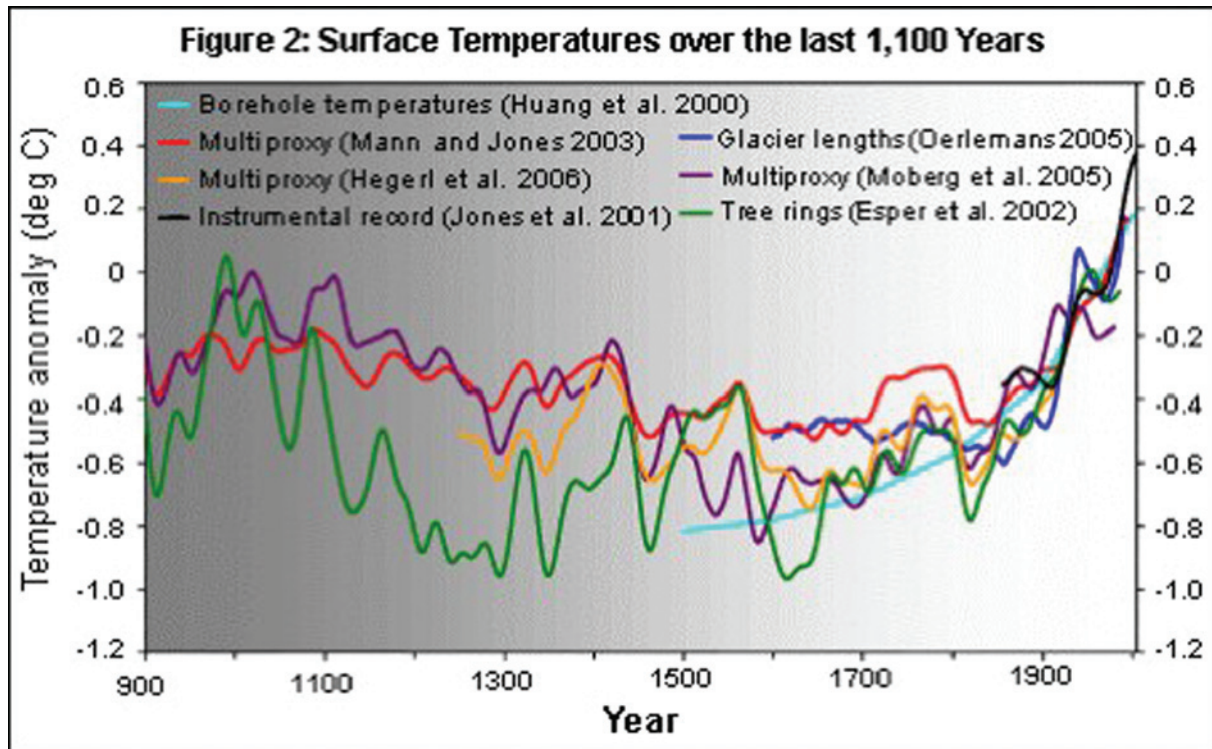
DIRECTIONS

- ☉ Analyze and discuss the graph with your partner.
- ☉ Answer the questions on a separate piece of paper.

Partner 1: _____

Partner 2: _____

Date: _____



Source: Surface Temperature Reconstructions[®] (2006) by the National Academy of Sciences

1. What information does the graph contain? *Hint: Look at the title and the axes.*
2. What patterns do you see in the data?
3. The colors in the graph represent data collected from various sources. What is the source of the data from the black line? _____ Why is it helpful to have data from this source as well as other sources shown together on this graph?
4. Do you think this graph supports the claim that atmospheric trends actually started changing around the beginning of the Industrial Revolution (circa 1780)? Why?
5. What additional information, if any, would you like included in this graph to aid your understanding of climate change?