

Chapter 6: Climate Change on Earth

Student Worksheet

Objective:

Use data to understand the evidence for climate change.

Engage:

How do you think your classmates view the issue of climate change?

Estimate the outcome of these two questions below. That is, how many people will say *yes* and how many will say *no* to each question? After guessing, compare your guess to the class result.

1. Do you think global warming is happening? Yes or no.

Guess: Yes _____ No _____

Actual: Yes _____ No _____

2. Can you list at least two indicators of global warming? Yes or no.

Guess: Yes _____ No _____

Actual: Yes _____ No _____

Introduction:

Most of you go to the doctor about once a year, just to make sure you are doing well.

Doctors take your vital signs, chart your weight and height, check your pulse, temperature and more. It is important for doctors to keep records and study trends about their patients.

The situation is analogous for our planet. Scientists, and even the Earth itself, keep records about the Earth's history. It is important to notice trends that are out of the ordinary.

Scientists do not believe the current findings on climate are ordinary. Scientists believe the climate is changing due to increased greenhouse gases in the atmosphere.

Your Task:

Study the charts below to get an understanding of the data and how it is measured and collected.

Procedure:

Indicators of climate change: CO₂ Concentration, Global Temperature, Arctic Sea Ice, Land Ice, Sea Level

1. Carbon Dioxide Concentration: Look at figures 1 and 2 below and then answer the questions that follow.

PROXY (INDIRECT) MEASUREMENTS

Data source: Reconstruction from ice cores.

Credit: [NOAA](#)

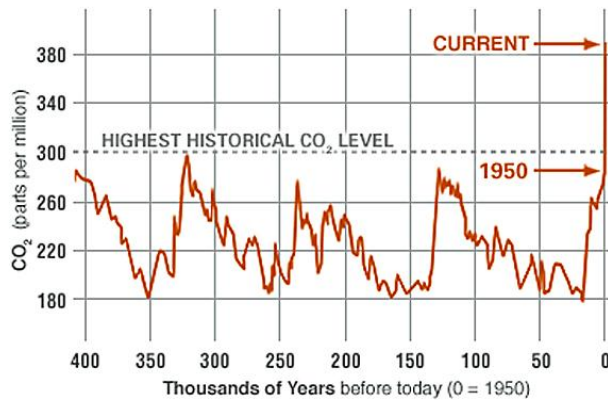


Figure 1 Ice core data showing CO₂ levels over the last 400,000 years.

NASA/NOAA

DIRECT MEASUREMENTS: 2005-PRESENT

Data source: Monthly measurements (corrected for average seasonal cycle). Credit: [NOAA](#)

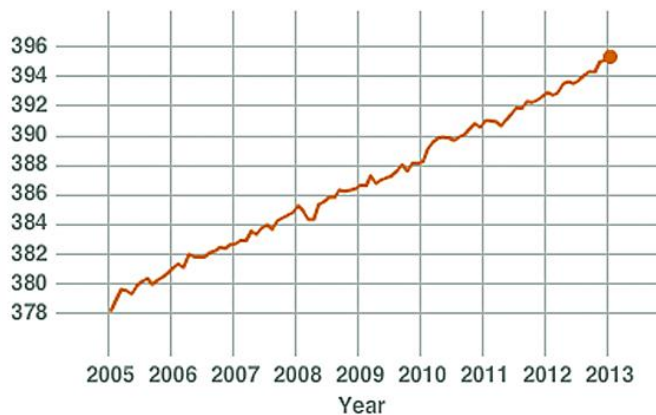


Figure 2: Air quality measurements taken over the last several years.

NASA/NOAA

- a. How are the two charts similar and different?

b. What is the overarching conclusion drawn by looking at the charts?

2. Global Temperature: Look at Figure 3 below and then answer the questions that follow.

GLOBAL LAND-OCEAN TEMPERATURE INDEX

Data source: NASA's Goddard Institute for Space Studies (GISS) This trend agrees with other global temperature records provided by the U.S. National Climatic Data Center, the Japanese Meteorological Agency and the Met Office Hadley Centre / Climatic Research Unit in the U.K. Credit: NASA/GISS

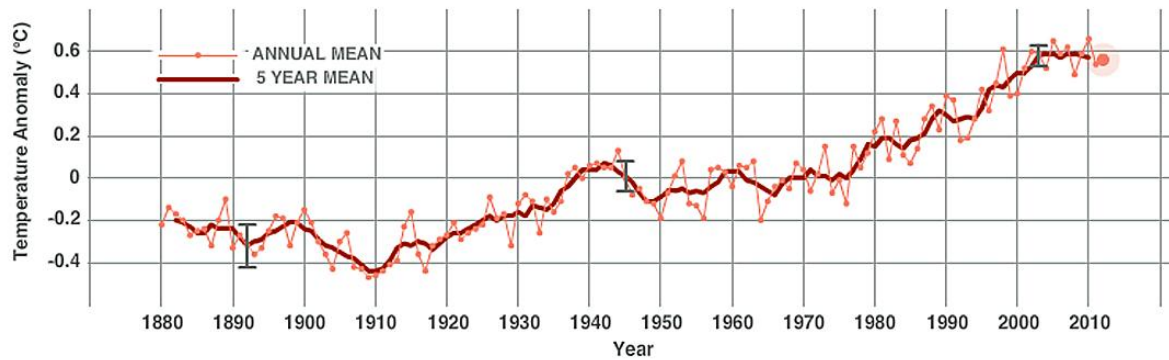


Figure 3: Temperature change over the past century.

NASA/GISS

a. In your own words give a simple, one sentence description of what the graph in Figure 3 shows.

b. About how much has the temperature increased since 1880?

c. Is this surprising? Why or why not?

3. Arctic Sea Ice: Study Figure 4 below and then answer the questions that follow.

AVERAGE SEPTEMBER EXTENT

Data source: Satellite observations.

Credit: NSIDC

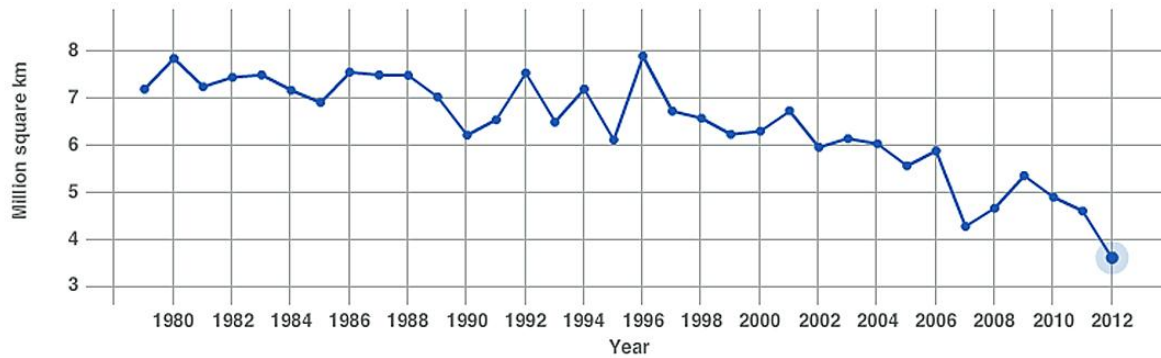


Figure 4: The decline in arctic sea ice

NASA/NSIDC

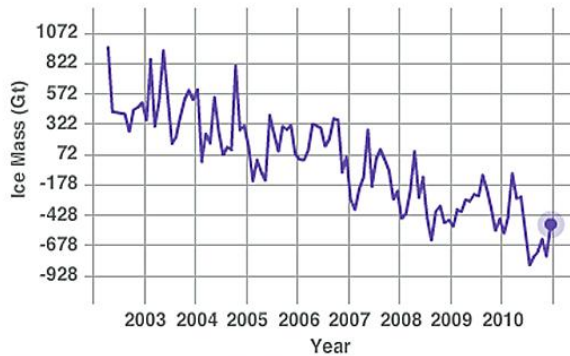
- What is the average sea ice coverage from 1979 to 1983?
- What is the average sea ice coverage from 2008 to 2012?
- What percentage of sea ice was lost between 1979 and 2012?
- Are the values reported at the maximum point of ice coverage or at the minimum? How can you tell?

- e. As sea ice decreases, the poles become less reflective. The darker seawater replaces the reflective ice. The high albedo, or reflectivity of the ice sends a lot of energy hitting Earth back out to space, but the darker seawater absorbs the energy. What are some possible implications of this?

4. Land Ice: Study Figure 5 below and then answer the questions that follow.

ANTARCTICA MASS VARIATION SINCE 2002

Data source: Ice mass measurement by NASA's Grace satellites.
Credit: NASA/University of California, Irvine



GREENLAND MASS VARIATION SINCE 2002

Data source: Ice mass measurement by NASA's Grace satellites.
Credit: NASA/University of California, Irvine



Note: In the above charts, mass change is relative to the average during the entire period. ([Reference](#))

Figure 5 NASA/University of California Irvine

- Is Greenland or Antarctica losing land ice faster?
- What is responsible for the repeating peaks and troughs on the graphs?

5. Sea Level Rise: Study Figure 6 below and then answer the questions that follow.

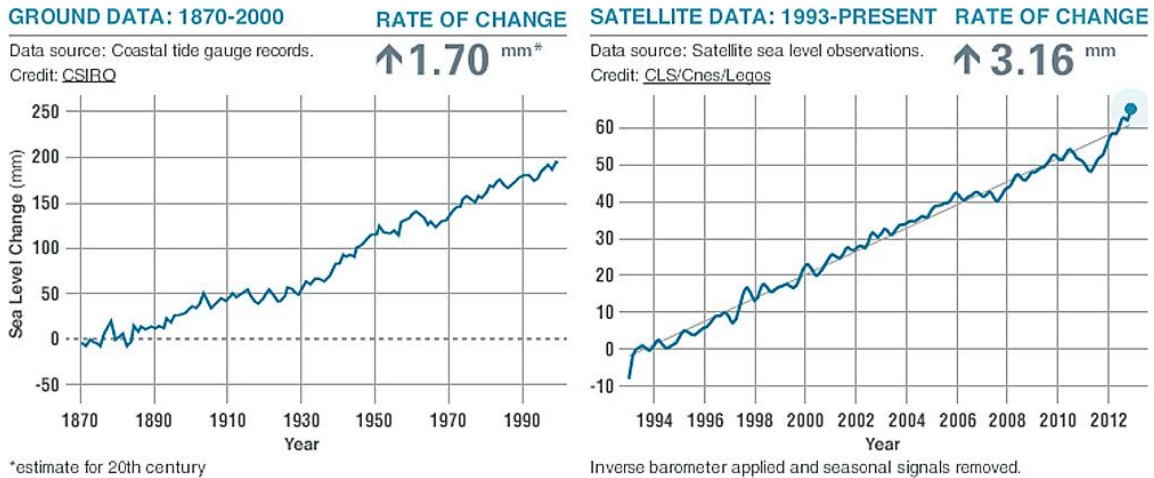


Figure 6 NASA/CSIRO

- Study the x and y -axes of the two graphs in Figure 6. Describe the differences between the two.
- Arctic ice melting does not cause a rise in sea level, but land ice melting does. Explain.
- Another contributor to sea level rise is the warming of the oceans. Why?

Conclusion:

- Which of the above indicators of global warming most surprised you?
- Over 97% of scientists believe climate change has human causes. Why do you think in 2010 only 57% of Americans believed this¹? (The 2011 numbers are closer to 70%.)

¹ Yale University/George Mason University study 2011

3. Hopefully you have been well informed about climate change before looking at the charts in this activity. Perhaps looking at these charts was your first exposure to the science of climate change. Regardless, this is just a jumping off point. There are many questions to explore and many plans to be made. No one can fix this problem for us. We have to all work together to make changes for our planet and our survival. What are some easy changes you and the people close to you can make?

4. What are some larger changes you would like to see in the nation or the world?

Extend:

- This activity focused on charts and data. Search the Internet for other photos or images that could accompany each graph to provide a different visual picture.
- Research the methods of obtaining the data for each of the above climate change indicators. In other words, how do we measure these levels?
- Make a list of greenhouse gases. Think of a way to easily reduce each one.

Resources for you:

- NASA has a great interactive site. Search under “climate”.
- The EPA website has a good list of frequently asked questions and answers. Search under “climate change”.
- The Nature Conservancy has a free carbon footprint calculator. Search their site under “carbon calculator”.