

Global Warming Exercise

- As long as the earth endures, seedtime and harvest, cold and heat, summer and winter, day and night, shall not cease.

 - Genesis 8:22 from the New Revised Standard version of the [Bible](#)

- The IPCC (Intergovernmental Panel on Climate Change, a group of more than 2,500 scientists) has provided the world community with first class assessments of the soaring temperatures the world is facing, the devastating impacts of these rises and the ways in which we can try and avoid the worst effects of global warming. We now know climate change is real and the hand of humankind in this warming is becoming clearer and clearer.

 - Klaus Toepfer, executive director of the United Nations Environment Programme (UNEP),
Environment News Service 2 Apr 01

- There is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gasses is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth.

 - The Oregon Petition

 - Dr. Frederick Seitz, past president of the National Academy of Sciences

- At its core, global climate change is not about economic theory or political platforms, nor about partisan advantage or interest group pressures. It is about the future of God's creation and the one human family. It is about protecting both "the human environment" and the natural environment. It is about our human stewardship of God's creation and our responsibility to those who come after us.

 - U.S. Catholic Bishops, *Global Climate Change: A Plea for Dialogue, Prudence, and the Common Good*, July 2001

- With all of the hysteria, all of the fear, all of the phony science, could it be that man-made global warming is the greatest hoax ever perpetrated on the American people? It sure sounds like it.

 - U.S. Sen. James M. Inhofe

 - Chairman, Committee on Environment and Public Works

- It is unlikely that human beings can "really influence the *overall climate* . . . [because] there are one million tons of air per capita for every person [sic] on earth."

 - Dixy Lee Ray and Lou Guzzo, 1993

- In the Old Testament book of Genesis, the prophet Joseph listened to an account of one of the Egyptian Pharaoh's dreams and warned that seven "fat years" would be followed by seven "lean years." He urged the Pharaoh to store grain as a hedge against the adversity to come. With his dream interpretation, Joseph became the first to write a scenario for variable climate -- as well as a plan for dealing with it.

 - Francesca Lyman, *The Greenhouse Trap*, 1990

Everybody talks about the weather, but nobody does anything about it.
-attributed to Mark Twain (1835–1910)

Energy from the sun drives the climate and warms the surface of the earth. But some of the sun's energy is reflected back into space. Greenhouse gases in the upper atmosphere trap some of that reflected energy and return it to the earth, thereby warming the lower atmosphere and the earth's surface. This works much like the windows of a greenhouse, which receive heat and energy from the sun through the glass, but then trap the heat inside, preventing dissipation. Greenhouse gases, such as water vapor, carbon dioxide, methane, and ozone, occur naturally in the atmosphere, and the greenhouse effect has made the surface of the earth inhabitable. The entire global system has been in a state of equilibrium, which keeps the earth's temperature relatively constant over time and prevents the earth from overheating.

Human activities, however, also produce some of these greenhouse gases and, consequently, can lead to higher concentrations of the gases in the upper atmosphere. The question is whether or not human activities will increase greenhouse gases to the point where the earth's climate system falls out of its natural equilibrium. In this paper, we focus on carbon dioxide, CO₂. The fossil fuels burned to run cars, heat homes, and power factories are responsible for about 98% of the U.S. CO₂ emissions. But are the levels of CO₂ in the atmosphere really increasing on a global scale? And if they are, is this strong evidence of man-made global warming?

Measurements of carbon dioxide have been made from ice cores in Greenland and Antarctica. These measurements indicate that before the industrial revolution, CO₂ levels were stable at about 280 parts per million. But carbon dioxide levels have been increasing in the twentieth century. Since 1958, C.D. Keeling, T.P. Whorf, and the Carbon Dioxide Research Group at the Scripps Institution of Oceanography have been monitoring CO₂ levels on the Mauna Loa in Hawaii. The table below gives Keeling's data for CO₂ concentration at 5 year intervals, beginning in 1960. The concentrations are given in parts per million (ppm).

Year	Carbon Dioxide Concentration
1960	317
1965	320
1970	326
1975	331
1980	339
1985	346
1990	354
1995	361
2000	369

Data source: <http://cdiac.esd.ornl.gov/trends/co2/sio-mlo.htm>

Initial Mathematical Work:

Before you write your essay, begin to analyze the data. Some initial mathematical work will get you started.

- Let t represent the number of years since 1960 and $f(t)$ represent the carbon dioxide concentration. Enter the data into a spreadsheet and use the spreadsheet to construct a scatterplot of the data. Begin to think about what the data tell you.
- Select two points from the scatterplot to determine a line that will be a good trend line for the data. Use these two points to find a linear model that describes the CO_2 concentration as a function of t , the number of years since 1960.
- Use the spreadsheet to graph the linear model on the scatterplot. Recall that the data will appear on the graph, as discrete points, and then the model will be superimposed as a line. This gives a good visual check of the fit of your model. Does your model produce an accurate trend line for the data?
- To answer the following questions, you will need to extend your graph out into the future. Spend some time making your graph look nice by providing a title for the graph, labeling the axes, constructing a helpful legend, and choosing pleasing shapes and colors. Remember that both the table and the graph from the spreadsheet will be copied into your paper.
- Use the graph to approximate the answers to the following:
 - predict the CO_2 concentration in the year 2020.
 - predict the year in which the CO_2 concentration will reach 500 ppm.
- Use the linear model (the equation) to approximate the answers to the following:
 - predict the CO_2 concentration in the year 2020.
 - predict the year in which the CO_2 concentration will reach 500 ppm.

Be sure to incorporate the answers to the above questions in your discussion of the linear model in your paper. The mathematical details involved in deriving your model and in answering the final questions should be presented in an appendix to your paper.

Thinking about the Weather: Drawing Conclusions on Global Warming

As human beings, we must make decisions constantly, about our personal lives, our communities, and our world. We form opinions rapidly, to give us some measure (illusion?) of control in a complex world. However, all of us have a tendency to draw conclusions so quickly that we may not even understand what we base those conclusions on. We frequently say, “I just felt that way” or “I just know it,” but we don’t really examine why we feel that way or how we know it.

In this paper you are asked to examine, in a meticulous way, both the data you do know and the conclusions you can draw from them and what you don't know or would have to find out, in order to reach certain broader conclusions on the controversial topic of global warming.

You are to use, as the basis for your discussion, the data on CO₂ and the model you developed for the data. You will not need any further research on the subject, as your goal here is to examine your own logical thinking process in relation to reaching a couple of possible conclusions. Listed below are several generalizations that represent various schools of thought about global warming. Read them carefully and choose a couple to examine more closely. You may also choose from the quotations listed earlier, which also represent or imply certain conclusions about global warming.

The Generalizations:

- There is little or no evidence that global warming is real.
- * Global warming is a major environmental crisis.
- Since carbon dioxide accounts for only 10 percent of the natural greenhouse effect, it doesn't matter if its concentration doubles.
- If global warming *is* occurring, there's probably not much we can do about it anyway.
- With better smog inspections for cars, carbon emissions have actually decreased over the last couple of decades.
- Global warming is just part of natural warming and cooling cycles.
- As the largest national source of CO₂ emissions in the world, the U.S. has a responsibility to the rest of the world

You may also use in your paper, as assumptions (ideas that are accepted as true without further proof) the following ideas. The majority of the scientific community accepts them.

- The greenhouse effect is the heat-trapping atmospheric blanket over the planet that influences the earth's climate and keeps temperatures at levels comfortable for life as we know it.
- Greenhouse gases, which include CO₂, play some role in the greenhouse effect.
- Burning of fossil fuels, such as gasoline, coal, natural gas, and diesel, releases CO₂ into the atmosphere.

Writing Your Paper:

Your essay will, of course, have an introduction with a thesis, 3 or 4 nicely developed body paragraphs, and a conclusion. You will also attach an appendix, showing the detail of your mathematical work, at the end of the paper.

The introduction: There are a number of strategies you could use here, depending on how creative you feel. You could give a short background on the topic of global warming. You could discuss decision making in general, bridging to the difficulty of making a decision on this particular topic. You could describe some situation you've heard about in the news that may possibly relate to global warming (hurricanes come to mind). You could give a personal anecdote about a situation in which you jumped to a conclusion that you later found was wrong, because of inadequate information or faulty logic. These are just a few ideas—there are undoubtedly other good ones. Remember that you will then need to transition to your thesis, which will let the reader know your purpose in the paper but will not (if you are examining your thinking carefully) draw a really strong conclusion about the existence (or non-existence) of global warming. Instead, you will qualify your statements to reflect the accuracy of your thinking (using words like “probably,” “seems likely,” “possibly”). You may even just let the reader know that you intend to examine what you know or would need to know in order to draw a conclusion about global warming. A thesis statement might include wording such as “I will examine here both what the data on CO₂ emissions on Mauna Loa seem to indicate and what further information would be needed to draw larger conclusions about global warming” or “Although the trend indicated by data on CO₂ emissions on Mauna Loa is clear, further information would be needed to conclude that global warming is a real concern.”

First body paragraph: Here you should examine your data on CO₂ concentrations and present the mathematical model you have developed. Explain where the data came from, any significance you find in its source, how you developed your model, and (very importantly) what it (the model) definitely tells you. A table of the data and a graph showing the data and model, all carefully labeled, should be included. You should also discuss, qualifying your statements carefully, what the model seems to indicate (but does not prove). Perhaps you see that your model could lead toward, or be consistent with, more than one possible conclusion.

Further body paragraphs: In each of these, you will introduce a quotation or generalization from the lists above. Especially in the case of the quotations, be certain to explain the conclusion implicit in the wording, as sometimes it is not stated clearly or directly. Explain how the conclusions you draw from your model seem to be consistent or inconsistent with the generalization—or perhaps simply not applicable in any way. It will not prove any of them, though. Remember to be wary of claiming “proof,” as proving is very hard to do. Discuss what more you would need to know in order to prove (or confirm) or disprove the conclusion. You might have some ideas about how you would get information you would need. If you are looking at a conclusion that seems to rest on belief rather than logic and fact, discuss that situation also. What are the limits of such reasoning in terms of scientific issues?

Conclusion: Here you should summarize what you have learned from your examination of data and logic in this paper. Perhaps you can come back to your introductory strategy in some way, to give a particularly satisfying conclusion.

Of course, edit your final draft carefully.

Sources: Ehrlich, Paul H. and Anne H. Ehrlich. *Betrayal of Science and Reason*. Washington, D.C.: Island Press, 1996.
Pompe, Jeffrey J. and James R. Rinehart. *Environmental Conflict: In Search of Common Ground*. Albany, NY: SUNY Press, 2002.