

Student Activity Sheet: Global Warming Research

Background: Carbon dioxide and other gases in the atmosphere act somewhat like the glass walls of a greenhouse. Radiation from the Sun goes through, but some of the heat that would normally be radiated back into space is trapped, raising the air temperature inside. Some scientists theorize that this effect, the *greenhouse effect*, could cause *global warming*, resulting in dramatic and rapid global climate changes. Other scientists disagree with this conclusion. Many scientists look at information and observations differently, and they do not always agree with each other about what the data really means.

Part A: Analyzing the Issue: One way to evaluate two sides of an issue is to determine whether the statement proposed by the scientists and the media are facts, hypotheses, theories or beliefs.

- Read each of the statements below about global warming and decide which kind of statement it is.
- Identify each as either a fact, hypothesis, theory or belief. In the space next to each statement, write the letter that corresponds to each type of statement.

A. Fact----- Supported by data observations;

B. Hypothesis---- Predictions of experimental results based on previous data;

C. Theory ----- Explanation that fits a large body of observations and are based on conclusive scientific experimentation;

D. Belief ----- Opinion related to a person's values;

1. _____ On average, the Earth will become warmer as a consequence of the greenhouse effect. Warmer conditions will probably lead to more evaporation and precipitation overall, but individual regions will vary, some becoming drier and other wetter.
2. _____ Human beings add CO_2 to the atmosphere mainly by burning fossil fuels like coal and oil. Deforestation is the second largest contributor to increasing atmospheric CO_2 .
3. _____ The NASA Goddard Institute for Space Studies (GISS) computer model has been used to calculate the possible temperature increase during the next 50 years in response to gradual increases in greenhouse gas concentrations, taking into effect the ice core data for the past 200,000 years. The simulation shows a change of two degrees, which would make Earth warmer than it is thought to have been in the past.

4. _____ The greenhouse effect will warm the oceans and partially melt glaciers and other ice, causing sea levels to rise. Ocean water will also expand if it warms, contributing further to sea level rise.
5. _____ There is evidence that average surface air temperatures have increased worldwide by about one-half degree Celsius since 1850. The CO₂ in the atmosphere has increased nearly 25 percent since the early 1800s.
6. _____ People should not worry about global warming because nature has a system of checks and balances that will negate the greenhouse effect.
7. _____ Predictions about the role that clouds and oceans play in the heating and cooling process of the Earth's atmosphere are not completely understood and scientists' predictions vary.
8. _____ There is nothing that can be done to prevent global warming because any action would require the cooperation of all nations, many of whom are at war with each other.

Part B: Debating the Issue: Participating in a debate will help you to become familiar with the arguments on both sides of an issue. Below is an outline of the important steps for organizing a constructive debate. In this case, the issue is:

Should people should take steps to reduce global warming?

1. Preparation:

You will be debating the greenhouse effect in groups of four.

- Two members will take one side of the issue and the other two will take the opposing side.
- Prepare your position statements by gathering and analyzing the facts about the topic.
- You should begin by reading the position statements that are included at the end of this activity.
- Obtain more information from library, databases and other references.
- Write each statement that supports your position on an index card to use for easy reference during the debate.

2. Presentation:

The two team members on each side will present their case, while the other listen.

- Opposing team members may speak only to ask clarifying questions.
- Opposing team members cannot challenge the other team's statements.
- After the first pair in finished, the other pair presents.

3. Challenge:

Each side will challenge the other's arguments, insist on facts and point out any flaws in their presentations.

- No name-calling, put-downs or physical displays of emotion are allowed.

4. Switch:

Each side now prepares a new set of arguments and presents the strongest case they can for the opposite side, repeating the debate by arguing the opposing point of view.

5. Group Discussion:

As a group, decide which arguments are most valid from both sides.

- Write a statement resolution that incorporates the best thinking of the entire team.

6. Group Report:

As a group, prepare a written summary report.

- Choose one issue that you debated and disagreed about and write down that statement.
- Write a resolution statement that provides the group consensus about the problem, whether it exists, what may be the results globally, and what can be done about it.
- If no agreement can be reached, discuss the areas of agreement and disagreement, including reasons listed under your resolution section.
- All team members must sign the report and record the dates they were present to work on the project, if it extends more than one class period.

POSITION STATEMENT #1

NASA FACTS, Goddard Space Flight Center, Greenbelt, MD, NF-182 6/96

Globally, as the concentrations of atmospheric CO₂ rise, temperature will increase and other climate characteristics will probably change as well:

- On average, air surface temperatures around the world will increase. When the climate has adjusted to the doubling CO₂ concentration, researchers estimate an average temperature increase of 3-8 degrees C. The GISS computer model is close to the high end of this range.
 - Overall, rain, and perhaps snow (at high altitudes) may increase, but this trend may not appear everywhere. Snow cover may recede.
 - Conditions locally may differ from global averages in temperature, amounts of rain and snow and the frequency or severity of major storms. Scientists cannot yet produce good estimates of future changes in regional climates because their tools are not sophisticated enough to forecast changes in regional conditions.
 - There has been little increase of global temperature in the past 50 years, suggesting that there may be other factors influencing climate. The Upper Atmosphere Research Satellite will contribute further to the study of the greenhouse effect with the Earth Observing System Satellite (EOS).
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POSITION STATEMENT #2

World Climate Review, Vol.2,#2, Winter 1994, Dept. of Environmental Sciences, University of Virginia

- "Global warming continues on hold" was a press release about 1993 temperatures from the National Climate Data Center. According to Thomas Karl, global temperatures measured by ground level thermometers averaged 0.2 degrees C above the mean for the 1951- 80 period. This is an amount that no one but scientists would notice and hasn't differed much during many of the years in the 20th century.
- Scientists have been predicting a disaster, claiming that gases from cars, power plants and other factors are creating a greenhouse effect that will boost temperatures dangerously high over the next 75 years or so. But is 1994's weather is any indication, shouldn't we start worrying about an ice age instead?
- Bigger trees are the result of an increase in photosynthesis during the day and a decrease in the amount of physiological respiration during the night.
- MYTH: Coastal cyclones and hurricanes are getting worse because of global warming. Since the jet stream powers coastal cyclones, global warming will weaken the jet stream and should diminish the number of cyclones.

POSITION STATEMENT #3
World Wildlife Fund Atlas on the Greenhouse Effect

- The 1980s was the hottest decade ever recorded. It included the 6 warmest years since measurements have been taken. Over the last century, the global climate has warmed between 0.3-0.6 degrees C.
 - No one can be sure if this is a result of pollution gases or a natural variation in the climate. In May 1990, 300 of the world's top experts, reporting for the official United Nations Intergovernmental Panel on Climate Change (IPCC), said they were "certain that man-made emissions are substantially increasing the atmospheric concentrations of the main greenhouse gases" and "these increases will lead to a warming of the Earth's surface".
 - Their best estimate was that by the year 2020 the world will, on average, be 1.3 degrees warmer than now, rising to 3 degrees C warmer by 2070. A rise of 3 degrees C would make the world warmer than it has been for the last 2 million years. Sea levels will rise as the world gets warmer because the heat will melt ice caps and glaciers and expand the water in the ocean basins causing sea levels to rise by more than 1 meter. This would make 200 million people homeless. Food production will be disrupted and wildlife will be in danger.
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POSITION STATEMENT #4
Richard Lindzen, Meteorologist at M.I.T.

- The water vapor gas information suggests that dense, low level clouds do not let the sunlight penetrate to the surface so the temperatures would cool. The models don't always match the results.
- Everyone wants to see a better environment, but you can't mix environmental advocates and scientific results. Often issues of this type, like global warming, are largely political in nature and not scientific concerns at all.