



## MARINE CONSERVATION SCIENCE AND POLICY SERVICE LEARNING PROGRAM

**Climate change** is a change in the statistical distribution of weather over periods of time that range from decades to millions of years. It can be a change in the average weather or a change in the distribution of weather events around an average (for example, greater or fewer extreme weather events). Climate change may be limited to a specific region, or may occur across the whole Earth.

### MODULE 4: MARINE ISSUES

#### SECTION 4: CLIMATE CHANGE

#### SUNSHINE STATE STANDARDS

SC.912.E.7.7, SC.912.E.7.9, SC.912.L.17.4, SC.912.L.17.8,  
SC.912.E.6.6, SC.912.L.17.12, SC.912.L.17.20,  
SC.912.L.18.12, SC.912.N.4.2



#### OBJECTIVES

- Define climate change
- Describe the causes and impacts of climate change
- Investigate how the greenhouse effect contributes to climate change
- Debate whether or not climate change is occurring
- Take a position on climate change and support it with facts and research

#### VOCABULARY

**Greenhouse gas-** The gases present in the atmosphere which absorb infrared radiation and reduce the loss of heat into space and therefore contribute to global temperatures through the greenhouse effect.

**Greenhouse effect-** The process by which a planet is warmed by its atmosphere; the effect produced as greenhouse gases allow incoming solar radiation to pass through the

Earth's atmosphere, but prevent most of the outgoing infrared radiation from the surface and lower atmosphere from escaping into outer space.

**Climate change** – the buildup of man-made gases in the atmosphere that trap the sun's heat, causing changes in weather patterns on a global scale

**Sea level rise**- the rise and fall of sea levels throughout time in response to global climate and local tectonic changes.

**Gas emissions**- gases created and emitted through natural processes and human activities

## **BACKGROUND**

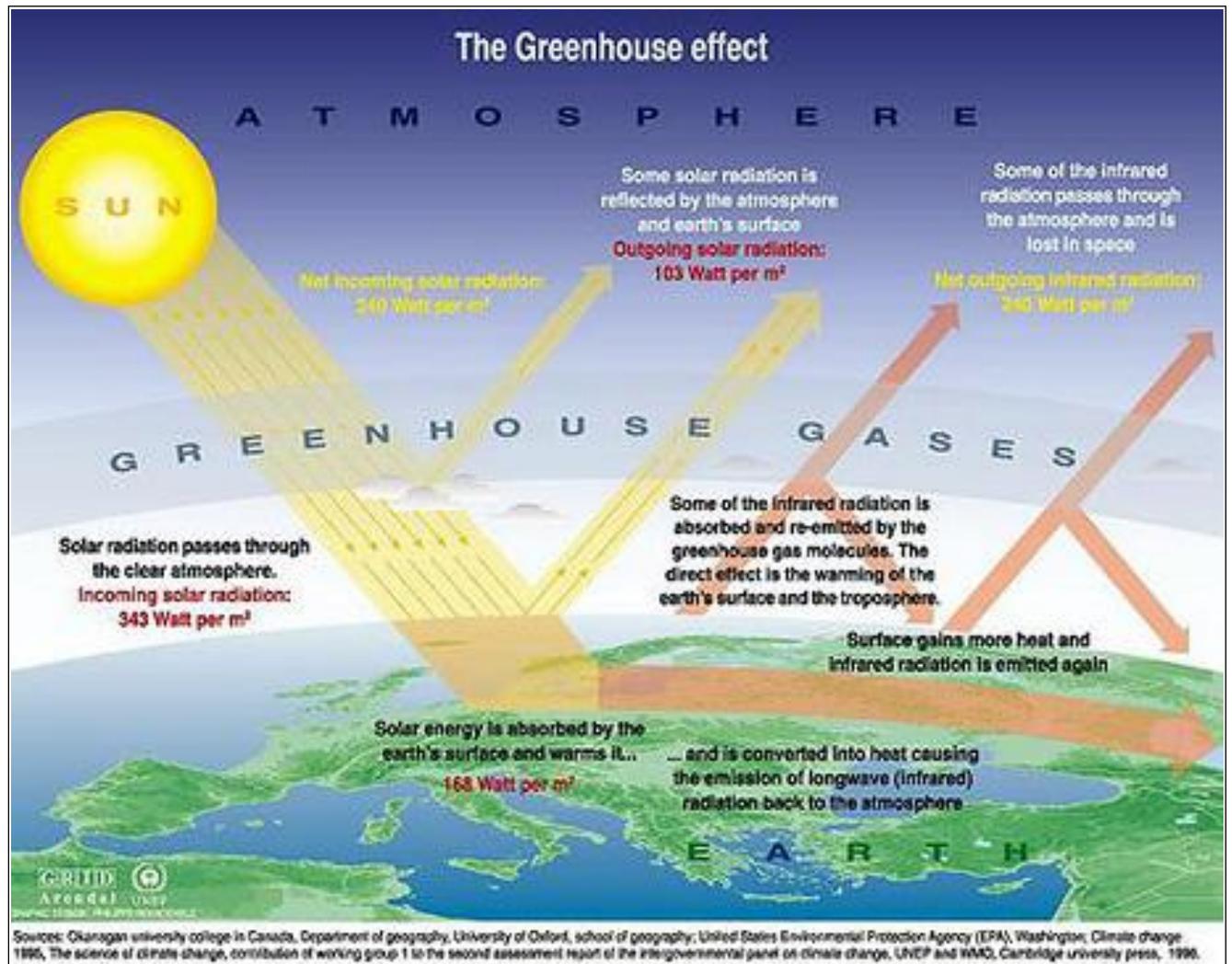
Global warming is the increase of the average temperature in the atmosphere and oceans over time due primarily to human influences. Since the late 19th century, scientists have monitored the fluctuations in temperature and studied global warming theories and trends to determine the causes and to assess the extent to which they are due to human activity. The greenhouse effect is largely caused by human-generated carbon dioxide (CO<sub>2</sub>) and, to some extent, by increases in solar activity. The term "global warming" is used to imply a human influence while "climate change" is most often used in association with changes in climate with no easily identifiable cause, such as the processes that produced the Ice Ages.

Current climate models based on estimates of increasing CO<sub>2</sub> and, to a lesser extent, by decreasing sulfate aerosols, predict that temperatures will increase by 1.4-5.8°C (2.5-10.4°F) between 1990-2100. This is a somewhat wide range; however, it is difficult to predict CO<sub>2</sub> emissions because of the number of variables involved. Some climate studies have shown that, even in the absence of the CO<sub>2</sub> emission variable, global climate will increase by 0.5°C (0.9°F) over the next one hundred years due to warming caused just by the ocean. In addition, models predict that sea levels will rise by about 10 cm over the next century.

Global climate change has been studied on a large scale based on analyses of global temperature fluctuations over thousands of years; for example, since the last Ice Age, which occurred approximately 12,000 years ago, global temperatures have been relatively stable. Studies on a smaller scale, however, show that temperatures in the lower troposphere have increased between 0.08 and 0.22°C per decade since 1979. Still, these modern day changes are not always linear, which has created a source of debate within the scientific community and the news media.

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change states that warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. Natural systems, including oceans and coasts, are being affected by regional climate changes, particularly by temperature increases. Besides rising surface water temperatures and sea level,

impacts are or will be associated with changes in the wave climate, circulation, ice cover, fresh water run-off, salinity, oxygen levels and water acidity.



Shifts in ranges and changes in algal, plankton and fish abundance have already been observed in high-latitude oceans. Besides these there are other effects that, based on published literature, have not yet become established trends as they are difficult to discern due to adaptation and non-climatic drivers. Sea level-rise is negatively contributing to coastal erosion, losses of coastal wetland ecosystems, including salt marshes and mangroves, and increasing damage from coastal flooding in many areas. These effects will be exacerbated by increasing human-induced pressures on coastal areas.

# ACTIVITY: THE CLIMATE CHANGE MYTH

*Students research some of the views on climate change from different sources and compare what people on both sides of the debate have to say.*

**DURATION:** 1 hour

## MATERIALS

- Copies of the Climate Change articles
- Climate Change Venn diagram

## PROCEDURE

1. Write the terms “greenhouse effect and “climate change” on the board
  - Ask students to define the terms
  - Compare similarities and differences in the students’ definitions
  - Combine their definitions together into ones that are the most accurate and be sure to clear up any misconceptions.
2. Ask students to hypothesize about how the world’s climate could change over the next 100 years if humans do nothing to limit the levels of the greenhouse gas emissions.
  - Allow them to also make predictions about the effects such changes could have on humans
  - Students should brainstorm and create a list of their ideas. Write some of these on the board
3. Pose the following question to students: “In your opinion, has human activity caused the world’s climate to change over the past 100 years?” Let students think about this quietly.
4. Break students into small groups of 3-4 students per group
  - Distribute copies of the Climate Change Articles and also direct students to <http://www.pbs.org/wgbh/warming/debate/> (you can also print and make copies if limited computer access in the classrooms).
  - Instruct students to read and discuss the different articles.
  - Students should note specific facts and other in-depth details.
  - Students should also pay attention to the varying views and perspectives, and give their own opinions
5. Distribute copies of the Climate Change Venn Diagram
  - Students must use what they have just read and discussed to complete this graphic organizer.
  - Allow volunteers from each group to share their work.

6. Explain to students that since they have now explored a variety of perspectives on global climate change, they will take a position on the issue and support it with data.
  - Ask students to write a persuasive paper with 2-3 paragraphs to answer the following questions:
    - In your opinion, is climate change an imminent world threat? Why or why not?
    - Based on your opinion, what actions do you believe should be taken to address the global warming issue?
  - Remind students to support their opinions with specific information from the articles and their completed Venn Diagram
7. Ask for volunteers to share what they have written.

## DEBATING "GLOBAL WARMING"

"People can't directly sense global warming, the way they can see a clear-cut forest or feel the sting of urban smog in their throats. It is not a discrete event, like an oil spill or a nuclear accident. Global warming is so abstract that scientists argue over how they would know if they actually observed it." — "Breaking the Global-Warming Gridlock" by Daniel Sarewitz and Roger Pielke Jr., THE ATLANTIC, July 2000

The controversy over climate change has shifted focus over the years. The main debate now is one of interpretations of science. Frequently, the method of predicting future trends is based on computer modeling, and many scientists argue that there are too many variable factors to effectively see the big picture. While some scientists who believe human activity is to blame for global warming are ready to outline specific actions to prevent more damage, skeptics are looking for more evidence to warrant change.

Scientist John Harte, featured in NOW's segment "Warmer and Warmer," has been studying the actual effects of a warming planet for nearly 30 years in Colorado to provide that evidence. By simulating a warmer world over a contained area, Harte is "looking into the future" and he is concerned about what he sees. He explains, "We often hear criticism of global warming science from non-scientists who like to point out that there's uncertainty in the climate models, and that maybe the effect won't be as bad as we project. But what this scientific experiment is showing us is that if anything, our current climate models are underestimating the magnitude of future warming."

Many sources mark the Industrial Revolution as the beginning of current global warming. But while many scientists agree that air pollution at that time started the current trend and that human activity is to blame, others believe that climate change is part of the natural global progression, and that human activity will neither worsen nor improve our situation. Some experts have argued that the use of fossil fuels, although it may be a significant cause of global warming, is unavoidable in modern society.

Skeptical of global warming fears:	In favor of a global effort to reverse climate change:
"I believe that it is fair to say that the people once labeled as 'a small band of skeptics' — those who championed the position that warming would be modest and primarily in the coldest air-masses have won the day. Many of these same scientists are now forming a new environmental paradigm. It is that the concept of 'fragile earth' must be abandoned. And it asks the impertinent question: since when is everything that man does to the planet necessarily bad?"	"What would Winston Churchill have done about climate change? Imagine that Britain's visionary wartime leader had been presented with a potential time bomb capable of wreaking global havoc, although not certain to do so. Warding it off would require concerted global action and economic sacrifice on the home front. Would he have done nothing?... The uncertainty surrounding a threat such as climate

<p>- <b>Patrick J. Michaels, CATO Institute Congressional Testimony</b></p>	<p>change is no excuse for inaction. New scientific evidence shows that the threat from ozone depletion had been much deadlier than was thought at the time when the world decided to act. Churchill would surely have approved.</p> <p>- <b>"Blowing hot and cold," THE ECONOMIST, July 4, 2002.</b></p>
<p>"Scientists who want to attract attention to themselves, who want to attract great funding to themselves, have to (find a) way to scare the public...and this you can achieve only by making things bigger and more dangerous than they really are."</p> <p>- <b>Petr Chylek, Professor of Physics and Atmospheric Science, Dalhousie University, Halifax, Nova Scotia</b></p>	<p>"Addressing climate change is no simple task. To protect ourselves, our economy, and our land from the adverse effects of climate change, we must ultimately dramatically reduce emissions of carbon dioxide and other greenhouse gases. To achieve this goal we must fundamentally transform the way we power our global economy, shifting away from a century's legacy of unrestrained fossil fuel use and its associated emissions in pursuit of more efficient and renewable sources of energy. Such a transformation will require society to engage in a concerted effort, over the near and long-term, to seek out opportunities and design actions to reduce greenhouse gas emissions."</p> <p>- <b>Pew Center on Global Climate Change</b></p>
<p>"The Little Ice Age and the Medieval Warming that preceded it from 950 to 1300 AD stand out in every temperature record as the major weather events of the last 1,000 years, and they're a hefty problem for global warming advocates. If the world was warmer in 1200 AD than today, and far colder in the year 1400, why would we blame current temperatures trends on auto exhausts?" - <b>Dennis Avery, Center for Global Food Issues</b></p>	<p>"Emissions of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate."</p> <p>- <b>Summary for Policymakers, A Report of Working Group 1 of the Intergovernmental Panel on Climate Change</b></p>

# **A TRULY GLOBAL PROBLEM COSTS, STAKES, UNCERTAINTIES HIGH IN CLIMATE CHANGE DEBATE**

By Greg Botelho  
CNN

Thursday, October 13, 2005; Posted: 7:34 a.m. EDT (11:34 GMT)

**The Kyoto Protocol, an international treaty, was created to reduce global emissions and control global warming.**

**(CNN) -- While the recent implementation of the Kyoto Protocol marked a key milestone, international accord on how best to address climate change remains elusive, as doomsday scientific forecasts clash with thorny political realities.**

No one knows exactly how, when or where global warming will play out. And in diplomatic circles, the "who" and "what" may be most significant, as in which countries -- citizens and companies included -- will bear the greatest burdens to control greenhouse gas emissions.

"There are likely to be significant losers," said Richard Morgenstern, a senior fellow at Resources for the Future, an independent think-tank based in Washington. "It's hard to get a country to get significant reductions, and it is especially hard to get a country to act unless all its key economic rivals do."

Kyoto has been the debate's focus, exemplifying the issue's complexity and distinctiveness, since multinational talks began in earnest after the 1992 U.N. Framework Convention on Climate Change. The treaty, which requires nations to cut greenhouse gases to curb global warming, went into effect this February, after intense debate left it close to being scrapped.

More than 140 nations signed on, but the world's largest greenhouse gas producer, the United States, did not, with Under Secretary of State Paula Dobriansky citing an unfair economic onus. Even with perfect compliance, the treaty would lead to a 2 percent cut in greenhouse gas emissions -- short of the 50 to 80 percent drop experts deem necessary to

avert a crisis in the next 50 to 100 years.

Even supporters acknowledge Kyoto's limitations, most importantly, that it expires in 2012. But they call the system essential to start the process and learn how better to run international environmental treaty regimes.

"Even if these percentages are not enough to solve the climate problem, they do require substantial efforts," said Joke Waller-Hunter, executive secretary of the U.N. convention on climate change that oversees Kyoto. "It's an important ... first step that sets a lot in motion."

The debate revolves around assessments of risk, as they pertain to science and economics.

Some call the issue urgent and insist on immediate action, while others favor more research to better understand and new technology to better tackle the problem.

"The Earth's climate system is very complex, so nobody can say absolutely, without question, this is going to happen in five, 10, 50 years time," said Oran Young, a professor at the University of California's Donald Bren School for Environmental Science and Management.

### **Great Kyoto debate**

For years, some policymakers and scientists doubted whether temperatures were rising, and, if they were, that greenhouse gas emissions were to blame. Today, "consensus in the scientific community is virtually unprecedented" that global warming exists, Young said.

If left unabated, some scientists say climate change could elevate sea levels (meaning more flooding, fewer beaches and less land) and alter weather patterns (hurting agriculture and producing more extreme weather events), among other repercussions. The costs -- including effects on property values, insurance rates, food and water supplies -- would be in the tens or hundreds of billions of dollars, according to the United Nations and other organizations.

While most nations acknowledge the reality of climate change, questions persist about its pace, severity and expense -- both of fixing the problem now and paying for its effects later.

Talks are complicated by the fact that -- unlike the ozone layer, in which it was clear solar rays that got through cause cancer -- climate change's health effects are generally indirect. Moreover, politicians are being asked to shell out public money now to avoid crises that might only arise many election cycles in the future.

Given such challenges, many view Kyoto as an impressive accomplishment.

The protocol sets binding greenhouse gas limits on 38 industrialized nations and sets up apparatus such as "emissions trading," in which a country having trouble meeting its requirements can buy credits from others that exceed them. Another 106 signatories do not have mandatory requirements, but participate in the process and have incentives to curb emissions.

"The Kyoto Protocol is quite unique and innovative," said Waller-Hunter. "It has created a new commodity that can and will be traded: carbon. ... This system can [address the problem] in the most cost-effective manner."

Yet not everyone lauds Kyoto, most notably, the U.S. government.

The top U.S. official on the matter, Dobriansky, calls the treaty "unworkable," saying it puts a "significant and unnecessary burden on the U.S. economy"

in mandating a roughly 35 percent U.S. drop in greenhouse gas emissions by 2012. The Bush administration also faults the treaty for not sufficiently limiting emissions in China, India and other developing nations.

The White House touts "long-term" solutions -- spending nearly \$5.8 billion annually on research, creating new technologies and participating in international working groups "to understand climate change and develop diversified and flexible approaches to address it."

"This goal sets America on a path to slow the growth of greenhouse gas emissions and, as the science justifies, to stop and then reverse that growth," Dobriansky said in an e-mail to CNN.com while traveling in Europe.

### **U.S. action, inaction**

While calling the idea of negotiating with 180-plus nations "ridiculous" and Kyoto's targets "too

ambitious," Morgenstern criticizes the U.S. policy as "far short of aggressive."

"Clearly, there's no mandatory action; it's strictly voluntary initiatives," he said. "The State Department will tell you about all the great bilateral agreements in place. But ... that only means there's a bunch of meetings taking place."

Political pressure may be building. The McCain-Lieberman Climate Stewardship Act -- first raised (and rejected) in 2003, and set to be revived in 2005 -- would limit greenhouse gases in the power, transportation, industrial and commercial sectors. Besides Sens. John McCain and Joe Lieberman, fellow Sens. Jeff Bingaman, Chuck Hagel and Tom Carper have advocated more federal action, something many experts increasingly see as likely.

Some of the most significant moves have come on the state level. California, for instance, has led about 15 states that have set stricter emissions standards for cars. Nine northeast states formed the Regional Greenhouse Gas Initiative, a cap-and-trade system that allows states to buy credits if they do not meet emissions limits.

Individual companies also have stepped up, intent on helping the environment and/or promoting energy efficiency (thus, saving money). The Chicago Climate Exchange, for one, allows firms to trade emissions credits, with an eye on reducing greenhouse gases.

"At the very least, [such actions] signal to society and the world that a lot of Americans do see this as an issue of some urgency," Young said. "Here, the national government is not speaking, but lots of other players are."

Some world leaders, particularly British Prime Minister Tony Blair and German Chancellor Gerhard Schroeder, are prioritizing climate change -- a reflection, experts said, of growing public support in Europe for action (plus resentment of what critics view as U.S. unilateral moves in this and other instances).

"Blair has sought to link climate change to international security by suggesting that if the United States wants cooperation on international security and counterterrorism, then it should be more forthcoming," said Jonathan Wiener, head of the Duke Center for Environmental Solutions.

### **Different approaches**

While championing Kyoto, Waller-Hunter does not discount the U.S. thinking -- especially if America continues to participate earnestly in talks -- saying new ideas could be beneficial.

"[The U.S.] has chosen a different path to address climate change: They prefer a long-term to a short-term approach," she said. "All approaches ... are being followed and assessed."

With major, likely contentious negotiations on the horizon to address the issue beyond 2012, ideas are bountiful. Wiener, part of U.S. negotiating teams in the early 1990s, advocates that the

White House forge a binding accord -- setting greenhouse gas limits -- with China and other developing nations. Morgenstern says the process -- limited to top emitters -- should start now, with an emphasis on finding new technologies and systems.

"There may not be a magic pill," Young said. "There may well be certain players -- nations, states, companies -- that address the issue in different ways." One possible, positive upshot of Kyoto: establishing the real costs of reducing greenhouse gases. Great Britain's economy has thrived as it has addressed global warming, said Chris Rolfe, head of the Canadian-based West Coast Environmental Law Association.

Advocates say such efforts could be cost effective in the long-term, saving money by using renewable energy more and making existing energy supplies more efficient.

But while public sentiment and individual action can factor in, experts say politicians will play the biggest role in determining how well and how soon the climate change issue is addressed.

"To make a major dent ... requires a treaty regime that's not only good for the planet, but also in the interest of each of those countries individually," Wiener said. "It's not surprising to me that it's taken a long time to reach an agreement."

Waller-Hunter said she was "somewhat optimistic" that the world could come together and effectively combat climate change, as long as the issue remains high on the political agenda.

"Action now is essential," she said. "Otherwise, the problem will become unsolvable. Every year that goes by, the task becomes more difficult."

While nations have come together in the past on environmental issues, notably the ozone layer and acid rain, experts say that most everything is amplified in this debate: the stakes, the costs and the uncertainties.

"The capacity of human beings to take actions have truly global consequences is a new thing," said Young. "This is a big challenge, and it requires some real effort to open up dialogue."

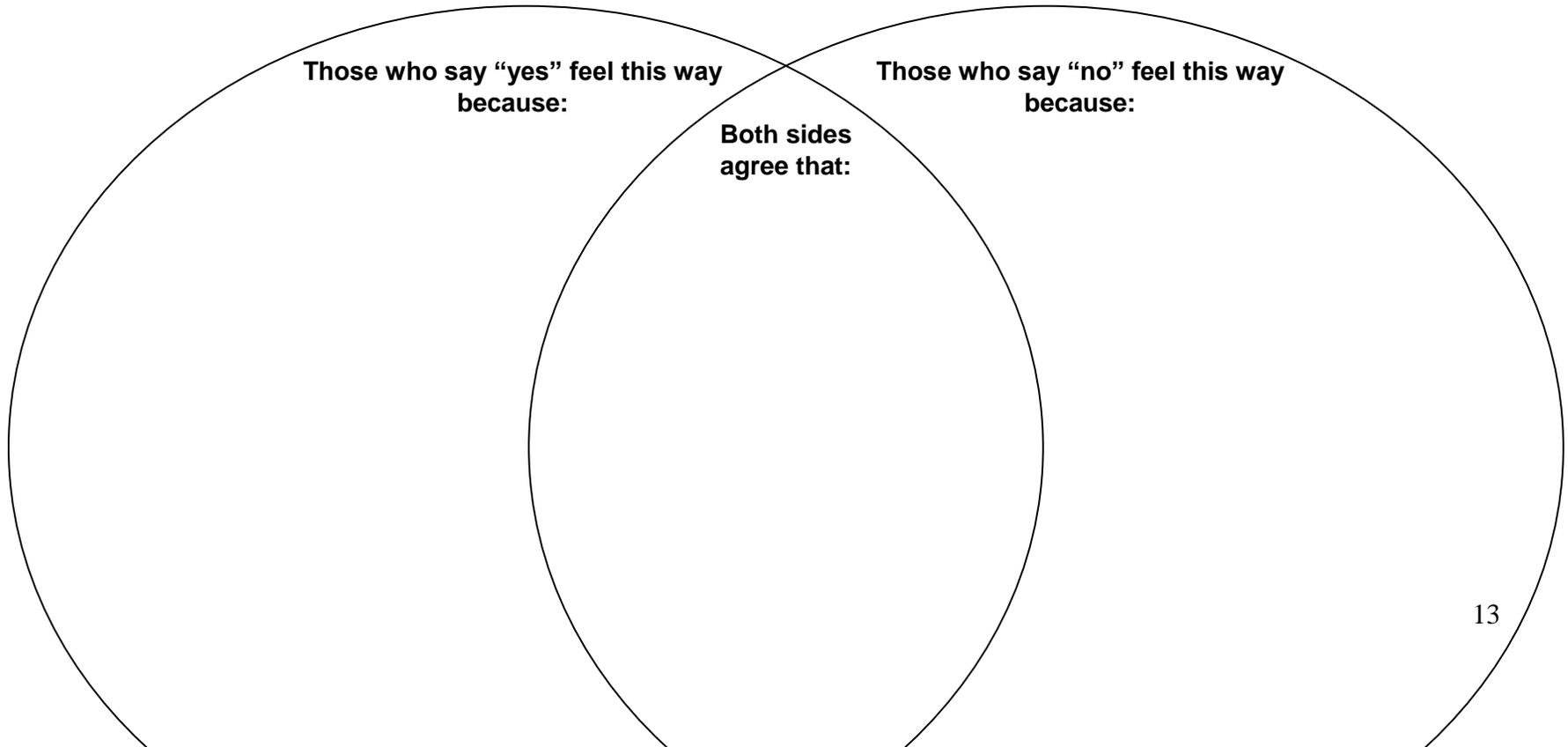
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## CLIMATE CHANGE VENN DIAGRAM

**Directions:** Answer the question below using the Venn Diagram to record what people on both sides of the climate change debate say about human responsibility for this issue. Be sure to note specific facts that support the different perspectives, and use the back of this paper to record more in-depth details as needed.

**Question:** Has human activity caused the world's climate to change over the past 100 years?



# ACTIVITY: DEBATING CLIMATE CHANGE

*Students examine some of the issues that make Climate Change a complex topic.*

**DURATION:** 1 hour

## MATERIALS

- Myths and Facts Statement Cards
- Myths and Facts Explanation Sheet
- Tape
- Climate Change Debate Cards

## PROCEDURE

1. Before class begins, write the words “Myth” and “Fact” on opposite sides of the board.
2. Place students into groups of 4 or 5
  - Have each student choose a Myth or Fact Statement card
  - Within their groups, students will share their statement and decide whether it is a myth or fact.
3. After all groups have discussed each statement, ask each student to read their cards aloud and to place it on the dry erase board under “Myth” or “Fact”
  - Once all students have identified their statement as one or the other, review each statement with the class using the explanation sheet.
  - Encourage students to share their ideas and thoughts.
4. Remind students that Climate Change is a highly debatable issue. Lead a quick discussion using the following as guiding questions.
  - What were some of the reasons given that support the case for climate change being a factor of human activity?
  - What were some of the reasons given that disagree with this, and instead feel the climate change is a natural event that is not caused by humans?
  - Which view do you believe?
5. Explain to students that they will now have the opportunity to consider some important questions and concerns that are related to the Climate Change Debate
  - Give each group 3 Climate Change Debate cards
  - The groups should read the cards, then discuss and debate the issues posed by the cards, including providing the best answers or solutions if a specific question is asked.
  - Groups should then choose the card that they feel is the most important.
6. Ask each group to present their most important card.
  - They should include:
    - The discussion points brought up by members of their groups

- Why they felt this was the most important issue.
    - The final answer or point they all agreed on or hope to get across
  - Encourage the other groups to ask questions or to challenge their responses to get a good classroom discussion going.
7. After each group has presented, take a poll of the students:
- Who believes that climate change is caused by humans and should be a cause for concern?
  - Who thinks that climate change is a natural event and is being blown out of proportion?
  - Who has a completely different opinion from the two put forth?

**ALTHOUGH HUMANS AS A WHOLE HAVE SURVIVED THE ERRATIC CHANGES IN TEMPERATURE, FROM DROUGHT, STRETCHES OF WARMTH AND COLD AND MORE, ENTIRE SOCIETIES HAVE COLLAPSED FROM DRAMATIC CLIMATIC SHIFTS.**

**GLOBAL WARMING CAN'T BE HAPPENING BECAUSE SOME GLACIERS AND ICE SHEETS ARE GROWING, NOT SHRINKING.**

**AS THE OZONE HOLE SHRINKS, GLOBAL WARMING WILL NO LONGER BE A PROBLEM.**

**GLOBAL WARMING AND THE OZONE HOLE ARE TWO DIFFERENT PROBLEMS**

**THE EARTH'S CLIMATE IS ALWAYS CHANGING AND THIS IS NOTHING TO DO WITH HUMANS.**

**CARBON DIOXIDE ONLY MAKES UP A SMALL PART OF THE ATMOSPHERE AND SO CANNOT BE RESPONSIBLE FOR GLOBAL WARMING.**

**RISES IN THE LEVELS OF CARBON DIOXIDE IN THE ATMOSPHERE ARE THE RESULT OF INCREASED TEMPERATURES, NOT THE OTHER WAY ROUND.**

**GLOBAL WARMING WILL CAUSE MORE STORMS AND OTHER WEATHER EXTREMES.**

**WE CAN ADAPT TO CLIMATE CHANGE — CIVILIZATION HAS SURVIVED DROUGHTS AND TEMPERATURE SHIFTS BEFORE.**

**ALMOST ALL SCIENTISTS AGREE THAT CLIMATE CHANGE IS HAPPENING AND WARRANTS IMMEDIATE ACTION.**

**THE TWO MAIN CULPRITS THAT PUT GREENHOUSE GASES UP INTO THE AIR ARE THE BURNING OF FOSSIL FUELS AND THE CLEARING OF RAINFORESTS.**

**SCIENTISTS TELL US WE ONLY HAVE A SMALL WINDOW OF OPPORTUNITY TO REDUCE THE THREAT OF CLIMATE CHANGE.**

**CLIMATE HAS ALWAYS CHANGED, AND IT ALWAYS WILL.**

**EVERY ASPECT OF CLIMATE SCIENCE IS THE SUBJECT OF VIGOROUS DEBATE.**

# **CLIMATE CHANGE: MYTH OR FACT? EXPLANATION SHEET**

## **THE MYTHS:**

**MYTH:** Water vapor is the most important, abundant greenhouse gas. So if we're going to control a greenhouse gas, why don't we control it instead of carbon dioxide (CO<sub>2</sub>)?

Atmospheric levels of water vapor cannot be controlled by people, but is instead determined by temperature. The warmer the atmosphere, the more water vapor it can hold. Thus, the increases in temperature increase the amount of water vapor in the air.

**MYTH:** Global warming and extra CO<sub>2</sub> will actually be beneficial — they reduce cold-related deaths and stimulate crop growth.

Increased CO<sub>2</sub> may benefit more weedy species than desirable plants and crops.

**MYTH:** Global warming is just part of a natural cycle. The Arctic has warmed up in the past.

**MYTH:** The Earth's climate is always changing and this is nothing to do with humans.

Although warming has occurred in the past, the steady and continual increase in temperatures can be attributed to activities of humans.

**MYTH:** We can adapt to climate change — civilization has survived droughts and temperature shifts before.

Climate has changed in the past and human societies have survived, but today six billion people depend on interconnected ecosystems and complex technological infrastructure.

**MYTH:** Global warming can't be happening because some glaciers and ice sheets are growing, not shrinking.

Studies that have shown increases in ice mass only looked at the center of the glaciers, not at the edges, where the melting would occur. Satellite data has shown that glaciers are in fact melting and that the melting is accelerating.

**MYTH:** As the ozone hole shrinks, global warming will no longer be a problem.

These are 2 different problems.

The ozone hole is a thinning of the stratosphere's ozone layer, which is roughly 9 to 31 miles above the earth's surface. The depletion of the ozone is due to man-made chemicals like chlorofluorocarbons (CFCs). A thinner ozone layer lets more harmful ultraviolet (UV) radiation to reach the earth's surface.

Global warming, on the other hand, is the increase in the earth's average temperature due to the buildup of CO<sub>2</sub> and other greenhouse gases in the atmosphere from human activities.

**MYTH:** Carbon dioxide only makes up a small part of the atmosphere and so cannot be responsible for global warming.

**MYTH:** Rises in the levels of carbon dioxide in the atmosphere are the result of increased temperatures, not the other way round.

Atmospheric levels of CO<sub>2</sub> are determined by how much coal, natural gas and oil we burn and how many trees we cut down, as well as by natural processes like plant growth. Greenhouse gases like CO<sub>2</sub> warm the air, which in turn adds to the stock of water vapor, which in turn traps more heat and accelerates warming.

**MYTH:** Global warming will cause more storms and other weather extremes.

There has been no concrete evidence that this is true. Although we have had some years of extreme storms, there are also been some years of the opposite.

## **THE FACTS:**

**FACT:** Almost all scientists agree that climate change is happening and warrants immediate action.

Most respected scientific bodies have stated that global warming and climate change is occurring. However, many disagree about how that change is happening and how fast the warming is occurring.

**FACT:** Most of our individual lifestyle choices either directly or indirectly create emissions.

**FACT:** The global warming we are experiencing is not natural. People are causing it.

**FACT:** Although humans as a whole have survived the vagaries of drought, stretches of warmth and cold and more, entire societies have collapsed from dramatic climatic shifts.

**FACT:** Global warming and the ozone hole are two different problems

These are 2 different problems.

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Global warming, on the other hand, is the increase in the earth's average temperature due to the buildup of CO<sub>2</sub> and other greenhouse gases in the atmosphere from human activities.

**FACT:** The two main culprits that put greenhouse gases up into the air are the burning of fossil fuels (coal, gasoline, diesel, natural gas) and the clearing of rainforests (which store tremendous amounts of carbon).

**FACT:** Scientists tell us we only have a small window of opportunity to reduce the threat of climate change.

**FACT:** Climate has always changed, and it always will.

**FACT:** Every aspect of climate science is the subject of vigorous debate.

<p><b>Debate Card 01.</b> <b>We have no right to do this.</b></p> <p>We do not have the right to degrade the planet for future generations. Nor do we have the right to cause the extinction of other species.</p> <p>Do you agree?</p>	<p><b>Debate Card 02.</b> <b>Learning from our mistakes.</b></p> <p>Many developing countries have vast unused resources of coal, the most polluting fossil fuel.</p> <p>Having taken full advantage of our own coal resources, can we tell them not to use theirs?</p>	<p><b>Debate Card 03.</b> <b>The possibility of catastrophe.</b></p> <p>Even if scientists do not completely understand how the atmosphere affects temperature, does the scale of possible damage force us to take action?</p> <p>Or should we wait and see?</p>
<p><b>Debate Card 04.</b> <b>What will we leave for our children?</b></p> <p>Just as smoking now can cause cancer later in life, what we do now to the planet will affect future generations.</p> <p>Do we have a responsibility to future generations? Or should we expect them to take care of themselves?</p>	<p><b>Debate Card 05.</b> <b>Scared into apathy.</b></p> <p>'I ignore what I see in the media about climate change. I become scared and overwhelmed with the contrasting opinions, and believe the effects of climate change will not be felt for decades so it is not my problem.'</p> <p>Do you think this is a common feeling?</p>	<p><b>Debate Card 06.</b> <b>Sustainable living.</b></p> <p>There are many simple ways to adopt a sustainable lifestyle through building practices and energy use.</p> <p>Why aren't more people trying to change their personal impact on the planet?</p>

<p><b>Debate Card 07.</b> <b>I am an island.</b></p> <p>'I am an island. How I live has no current or future effect on other people, animals, plants, or the planet. The earth and the plants and animals on it are ours to use as we wish.'</p> <p>Do you think this is a common opinion?</p>	<p><b>Debate Card 8.</b> <b>Think of the children.</b></p> <p>'It's for the children. I want my grandchildren's children to enjoy the beauty of the planet and to feel secure and safe in its familiar weather patterns, crops and water supply—just as I have done.'</p> <p>Should my children's needs mean more than my own?</p>	<p><b>Debate Card 9.</b> <b>Maybe we're better off.</b></p> <p>Warming can lead to savings on the costs of heating fuel in Northern regions, bigger crop yields in Canada, and better cod fishing in Greenland.</p> <p>Could the gains of warming outweigh the losses?</p>
<p><b>Debate Card 10.</b> <b>Setting a good example.</b></p> <p>If all government buildings were required to be five star rated energy efficient buildings the savings in energy usage and greenhouse gas emissions would be enormous.</p>	<p><b>Debate Card 11.</b> <b>Require more energy efficient vehicles.</b></p> <p>Governments around the world should require better fuel efficiency in new cars because transportation accounts for almost 1/3 of CO2 emissions.</p>	<p><b>Debate Card 12.</b> <b>We have bigger issues.</b></p> <p>Poverty, terrorism, rising crime and other issues are more important than climate change.</p>
<p><b>Debate Card 13.</b> <b>Deal with our oil addiction.</b></p> <p>While we will continue to use fossil fuels for years to come we should not increase our drilling and oil consumption to meet our energy needs.</p> <p>The more fuels we burn, the more we bring about climate change. We need to invest in cleaner energy technologies.</p>	<p><b>Debate Card 14.</b> <b>Changing lives.</b></p> <p>The ultimate hope is that a meaningful solution to the climate change crisis could potentially be the beginning of a much larger transformation of our social and economic lives.</p> <p>Do you think people want this transformation?</p>	<p><b>Debate Card 15.</b> <b>When there's a will...</b></p> <p>Dire predictions notwithstanding, we can still act to ensure a livable world.</p> <p>It is crucial that we know this: we can meet our needs without destroying the Earth, our life support system, if we have the will to do so.</p>

<p><b>Debate Card 16. Human impact.</b></p> <p>We are a fundamental part of the planet. Even the water we drink has cycled through rivers, seas, clouds, rain, animals, plants and humans. What we do to the planet we do to ourselves.</p>	<p><b>Debate Card 17. Concerns of extinction.</b></p> <p>Extinction is absolute and final; it cannot be remedied or reversed. So should we worry about the extinction of all creatures, including small worms and snails?</p> <p>Or is human extinction our biggest concern?</p>	<p><b>Debate Card 18. The power of green – money or the environment?</b></p> <p>There is always large focus on money and economic growth.</p> <p>Do you think there has to be an economic impact to climate change before political interest is raised?</p>
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# **ACTIVITY: CLIMATE CHANGE AN IMMINENT WORLD THREAT?**

*Discover evidence to support your opinion on climate change.*

**DURATION:** 30 minutes, plus homework assignment

## **MATERIALS**

- Climate Change Projects Handout
- Various supplies based on projects students choose

## **PROCEDURE**

1. Distribute the Climate Change Project Handout
2. Invite students to choose a project from the Handout. Alternatively, students could design a project of their own with teacher approval. The goal of the project is for students to create something substantive that they can use to share their positions on climate change and to increase awareness about its related issues.
3. Allow students one class period to begin work on their projects, then assign a completion date.
4. When projects are completed, display student projects and/or have students present them to the class as a way of demonstrating their point of view on climate change issues.

# CLIMATE CHANGE PROJECT LIST

Consider the following questions: *In your opinion, is climate change an imminent world threat?*

**Directions:** If you answer YES to this question, then choose a project from the “YES” list to illustrate your point of view about what should be done to address climate change issues. If you answered NO, then choose a project from the “NO” list. **NOTE:** Feel free to develop project ideas of your own. Just get teacher approval on these BEFORE beginning your work to be sure they are appropriate.

## “YES” PROJECT IDEAS

- Create a game to teach others about practical ideas for reducing greenhouse gas emissions (e.g., drive a hybrid car, use less electricity).
- Conduct an experiment or make a scientific display illustrating the effects of greenhouse gases.
- Create an advertising campaign to promote awareness of what causes global warming and what people can do to limit greenhouse gas emissions.
- Write a fictional story or play illustrating the future effects of global climate change.
- Create a diorama or 3-D model of how your state or country might change as a result of global warming.
- Design a futuristic map of the world showing the effects of global climate change on the earth’s physical features, as well as on plant and animal life.
- Draw a food web showing how global climate changes affect the food chain/ecosystems.
- Create a map that shows the major countries that support the Kyoto Protocol. Develop hypotheses for how the U.S.’s refusal to participate in the treaty could affect foreign relations.
- Profile a renewable energy source and teach other students how it can be used (e.g., profile solar energy and how the average citizen can incorporate this into their everyday use). Create a display or working model of this energy source.

## “NO” PROJECT IDEAS

- Create a timeline or series of graphs or charts that show the varying climates the world has experienced since the time of the dinosaurs.
- Write a persuasive speech or letter to the editor that explains the need for further research into global climate changes.
- Create a series of charts or graphs that illustrate costs related to enforcing global warming laws such as the Paveley Law or the Kyoto Protocol.
- Design a display that shows the cost of developing and using renewable energy sources (e.g., solar energy can be used in homes, but there is an initial cost of set-up, as well as backup plans needed when the sun isn’t shining).
- Research current U.S. environmental policy and create a flyer explaining the Clear Skies Initiative and other strategies presented by President Bush that address global warming.
- Design a sign, poster, or brochure explaining the current Environmental Protection Agency plan for addressing global warming issues.
- Research what scientists who do not support conventional global warming theories say about changes in the earth’s climate and weather patterns and present these findings by creating a magazine-type story, a public service announcement, or a mini-documentary about your findings.

## **RESOURCES**

[http://en.wikipedia.org/wiki/Climate\\_change](http://en.wikipedia.org/wiki/Climate_change)

<http://www.epa.gov/climatechange/>

<http://www.climatechange.gov.au/>

[http://en.wikipedia.org/wiki/Global\\_warming](http://en.wikipedia.org/wiki/Global_warming)

<http://topics.nytimes.com/top/news/science/topics/globalwarming/index.html#>

[http://library.thinkquest.org/CR0215471/global\\_warming.htm](http://library.thinkquest.org/CR0215471/global_warming.htm)

<http://globalwarming.com/>