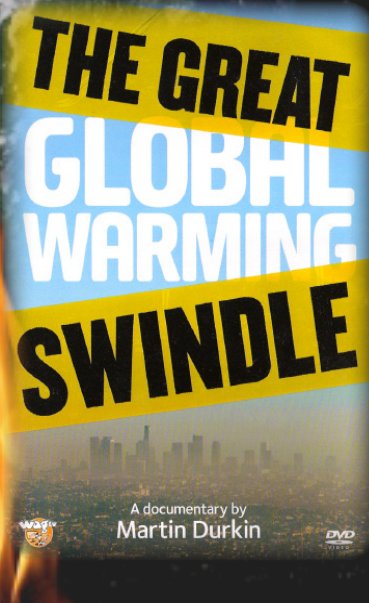
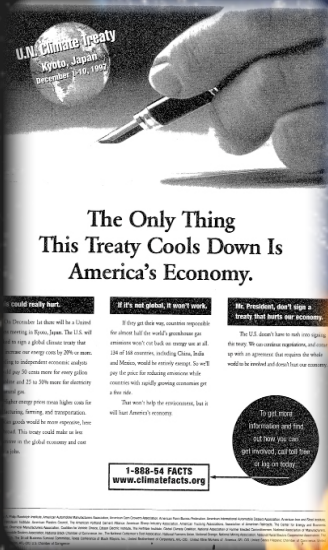
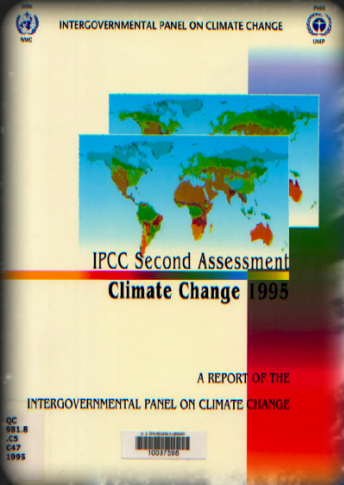


# MEDIA CONSTRUCTION OF GLOBAL WARMING

## A Media Literacy Curriculum Kit



**PROJECT  
LOOK  
SHARP**

**ITHACA  
COLLEGE**



# Media Construction of Global Warming

A Collaborative Project



[www.projectlooksharp.org](http://www.projectlooksharp.org)

#### **Mission Statement**

Project Look Sharp is a not-for-profit, mission-driven initiative committed to providing teachers with the training and materials they need to integrate media literacy, critical thinking, and 21<sup>st</sup> century learning into the curriculum.



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**Project Look Sharp provides staff development workshops and consulting.**

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## **About This Kit**

**Target Audience: High School & College – Science, Social Studies, English, and Media Classes.**

The kit includes *Teacher Guides* for all eight units, including all activities, readings, slide shows, film clips, journal articles, advertisements, and more. Lessons teach core knowledge about the science of climate change, explore conflicting views, and integrate critical thinking skills. Students will apply knowledge of climate change to a rigorous analysis of media messages through asking and answering questions about accuracy, currency, credibility, sourcing, and bias. Lessons address basic climate science, the causes of climate change, scientific debate and disinformation, the consequences of global warming, the precautionary principle, carbon footprints, moral choices, and the history of global warming in media, science, and politics.

All materials can be accessed for free on our website and are also available through mobile non-Internet based versions viewed on a digital media device. Digital devices include a master PDF as well as all specified media within lesson folders purchased from the Ithaca College Bookstore. Access the bookstore through our website.

### **FAIR USE NOTICE:**

The media documents in this kit are provided free of charge for the purpose of commentary, criticism, and education as provided by the Fair Use Clause of U.S. Copyright Act of 1976.

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## OVERVIEW OF THE KIT

# Media Construction of Global Warming

## Overview, Objectives, Pedagogy, and Practice

### Overview

While global warming may be the single most important issue of our time, the scientific and political controversies surrounding climate change present particular challenges for the classroom. This kit provides educators with the materials needed to engage high school and college students in a constructivist process of rigorously and independently analyzing and evaluating information while learning core knowledge about the science of climate change. Students will practice asking and answering questions about accuracy, currency, credibility, sourcing, and bias with a range of different media documents, including documentary film clips, journal articles, advertisements, and government documents.

Some lessons in this kit include handouts and media materials for teaching core knowledge about the science of climate change (Lessons #2, 4, 5, & 7). Other lessons focus more on the ways in which our views of global warming are influenced by media constructions (Lessons #1, 3, & 8). All of the lessons in this kit ask students to apply their knowledge of climate change to a rigorous analysis of media messages.

**Lesson #1: Introduction** frames the kit in one 40 minute class period by having students ask core media literacy questions about two short video clips that present conflicting arguments about global warming. Like the other lessons in this kit, it includes a lesson plan, media materials, transcripts, student handouts, and an extensive *Teacher Guide* with background information for the teacher, suggested questions, possible student answers, and additional information.

**Lesson #2: Global Warming: Fact or Myth?** relies on a student handout and an interactive slide show to teach core knowledge about climate science, the Earth's climate record, and evolving methodologies for determining global temperature. Students then analyze and decode two film clips that use the same hockey stick graph to argue opposite points. Finally, students will explore issues of trust and sponsorship in an activity concerning the credibility and bias of information about controversial scientific subjects like global warming. The lesson will take about 60 minutes.

**Lesson #3: Discourse or Disinformation?** continues to study the credibility of scientific information with a 90 minute lesson. It begins with a reading on scientific discourse, bias, and politics. Students then analyze a series of documents, including a scientific report edited by a government official, a documentary film clip, excerpts from a website, and two journal articles. The lesson concludes with a discussion about the ways in which one can seek more complex truths concerning scientific debates in the media.

**Lesson #4: What is Causing Global Warming?** explores conflicting claims on the causes of climate change in a 90 minute lesson. After leading a decoding of the advertisement *CO<sub>2</sub>: They Call it Pollution, We Call it Life*, the teacher leads students through slides about the greenhouse effect, the role of water vapor, greenhouse gases, the carbon cycle, and the role of anthropogenic CO<sub>2</sub>. Using transcripts and worksheets, students then analyze video clips from *The Great Global Warming Swindle* and *An Inconvenient Truth* and discuss which positions they agree with and why.

**Lesson #5: *Consequences*** is an in-depth lesson (approximately 3 hours total) that explores the anticipated and potential consequences of climate change. Students work in groups studying readings and analyzing print articles on seven different consequences of global warming (severe weather, sea level rise, etc.). As each group reports on their consequence, the rest of the class develops concept maps that are synthesized in an activity about feedback loops. Throughout the lesson, students reflect on the sources and credibility of information we receive about the consequences of climate change.

**Lesson #6: *The Precautionary Principle*** has students work in groups to identify the potential costs of different responses to the threat of global warming based on different future scenarios. They then take positions on the best policy responses. In a follow-up activity, students analyze and evaluate the perspectives of four different authors.

**Lesson #7: *Evaluating Carbon Footprints*** is a multifaceted lesson that will take approximately 3 hours of class time. After an introduction to carbon footprints, students work in groups with readings to understand the cradle-to-grave carbon implications for seven different products (cars, hamburgers, clothing, etc.). Each group also analyzes and evaluates a “green” ad for that product. Each group reports to the class, summarizing the supply chain footprint for their product, decodes the advertisement, and leads a discussion about the needs, wants, and lower carbon alternatives related to that product. Finally, the class discusses the environmental and moral implications of our modern consumer lifestyle.

**Lesson #8: *A History of Global Warming*** uses a reading and interactive slide show to teach media analysis skills while students learn the major scientific, political, and media landmarks in the history of human understanding and response to global warming.

### Objectives of the Kit:

- To teach core knowledge, vocabulary, and history of the science of climate change and the controversies surrounding global warming.
- To train students to ask and answer key media literacy questions about the sourcing, credibility, accuracy, currency, and bias of scientific information while understanding the limits of scientific certainty.
- To have students rigorously analyze, evaluate, synthesize, and take positions on a number of controversial scientific and moral issues.
- To engage all students in complex critical thinking and in the development of reading, listening, and visual decoding skills and attitudes that support life-long democratic citizenship.

### Learning Standards:

This kit addresses specific standards from the following:

#### Math, Science, and Technology (MST) Standards for Earth Science and the Living Environment:

- Students will access, generate, process, and transfer information using appropriate technologies. *Key Idea: Knowledge of the impacts and limitations of information systems is essential to its effective and ethical use.*
- Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science. *Key idea: Human decisions and activities have had a profound impact on the physical and living environment.*
- Students will apply the knowledge and thinking skills of math, science, and technology to address real-life problems and make informed decisions. *Key idea: Solving interdisciplinary problems relating to the issues of science/technology/society, consumer decision-making and the inquiry into phenomena.*

**National Council for the Social Studies (NCSS):**

- *Time, Continuity, and Change*: knowing what things were like in the past and how things change and develop.
- *People, Places, and Environments*: knowing why things are located where they are, how places and environments change, and what implications these changes have for people.
- *Culture*: knowing how belief systems, such as those related to human and environmental health, influence other parts of the culture.
- *Individual Development and Identity*: knowing how personal identity is shaped by one's culture, by groups, and by institutional influences.

**National Council of Teachers of English (NCTE):**

- Apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate print and non-print texts.
- Apply knowledge of media techniques, figurative language, and genre to critique and discuss print and non-print texts.
- Gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts).

**Partnership for 21<sup>st</sup> Century Skills:**

This kit also addresses many of the core learning skills that have been identified as essential skills for **21st Century Literacy**.

Specifically:

- Information and media literacy skills: analyzing, accessing, managing, integrating, and evaluating information in a variety of forms and media.
  - Critical thinking and systems thinking: exercising sound reasoning in understanding and making complex choices; understanding the connections, conflict, and change among systems.

**Target Audience – Adapting the Materials:**

While these lessons were written for upper-level high school and college environmental studies and science classes, they were designed to be adaptable to different grade levels. Science teachers should assess the level of background information their students need in order to analyze the media documents. The time it takes to deliver these lessons will vary depending upon the amount of background information needed by the students and the amount of discussion.

**Social Studies, English, and Media Studies:**

Teachers in these disciplines may be most interested in Lesson #1: *Introduction*, Lesson #3: *Discourse or Disinformation?*, and Lesson #8: *A History of Global Warming* to teach about the use of media in influencing public debate. Social studies teachers may also be interested in Lesson #5: *Consequences*, Lesson #6: *The Precautionary Principle*, and Lesson #7, *Evaluating Carbon Footprints* as they relate to public policy. English and media classes may also want to use the “green” ads in Lesson #7.

**Accessing Slides, Video, & Print Materials:**

All print and media materials for this kit are available for free on the Project Look Sharp website. These include the PowerPoint slideshows, video clips, and all print materials (PDF).

Mobile non-Internet based versions are available with the purchase of a digital media device, which includes the master PDF of the kit and all specified media within lesson folders. These can be purchased through the Ithaca College Bookstore. Access the bookstore through our website.

**[www.projectlooksharp.org](http://www.projectlooksharp.org)**



## OVERVIEW OF THE KIT

# Media Literacy and Democratic Citizenship

The founders of the United States articulated the need for a literate citizenship as core to the development of a deep and enduring democracy. We live in an age when the most influential messages about pressing social issues and events are delivered through mass media such as television, magazines, and the Internet. Most students use the Internet as their primary source of information, yet few have any formal training in assessing the credibility of information in websites. It is essential to the success of our democracy that young people consciously and consistently analyze and evaluate media messages. They need to be taught to seek out current, accurate, and credible sources of information; they need to understand the influence of media messages on their understanding of the world; and they need training in identifying and using various techniques for communicating messages in different media forms. Without these critical skills, we risk losing the diversity and freedom of thought that underpins a culture of true democracy.

## Collective Reading of Media Messages

This curriculum is based on the classroom practice of collective reading, in which the teacher leads the class through the process of decoding images, sounds, and text as a way of developing a range of critical thinking skills while teaching core knowledge. This constructivist approach encourages the development of moral reasoning as students clarify their own interpretations, listen to the analysis of their peers, and discuss ethical issues. Decoding of the documents in this curriculum will help train students to

consistently ask key critical thinking questions, assess scientific credibility, distinguish fact from opinion, analyze point of view and identify bias, and use evidence to back up a conclusion. The classroom decoding process is particularly effective in involving students who rarely share their opinions about print-based material, including students with reading disabilities, students who are visual learners, and students for whom English is a second language. The teacher should consider calling on students or going around the room to ensure participation by all students in the collective reading process.

## Encouraging Multiple Readings

Although the *Teacher Guides* for the media decoding sections of these lessons includes *Possible Answers* to the probe questions, the teacher should encourage multiple readings and a diversity of responses for interpretive questions. Some questions have only one right answer (e.g., “Who created this video?”) and students should learn to distinguish between objective and subjective questions. It is important that students give evidence in the document to explain their conclusions, including for interpretive questions. It is important that students recognize that all people do not interpret media messages in the same way. Depending upon each reader’s background, including life experience, age, culture, and political views, he or she may have very different interpretations of a particular text. The collective reading experience provides the opportunity to explore these differences and discuss the important concept that readers interpret messages through their own lenses.

**Reading Bias**

A major theme of these materials is the recognition that all media messages come from a particular point of view and have a bias that reflects the intent and perspective of the producer and sponsor. With these materials, teachers can train students to recognize bias and point of view. The teacher should encourage students to ask critical questions about any media messages encountered inside or outside the classroom using the *Key Questions To Ask When Analyzing Media Messages* found at [www.projectlooksharp.org](http://www.projectlooksharp.org).

**Bias in this Curriculum and in the Classroom**

This series of lessons, like all media, has a point of view and a bias. As teachers use the lessons, they may identify opinionated language, selective facts, missing information, and many other subjective decisions that went into constructing this view of history. The same questions the curriculum applies to other documents can be applied to this media construction: Who produced this curriculum, for what purpose, and what is its bias? Teachers and students could and should be asking critical questions about the editorial choices that went into constructing these lessons. For instance, why did we have an activity on the Cooney edits but not on “ClimateGate”? When using these materials, teachers should make their own decisions about what to include, what to edit, what to add, what questions to use, and what issues to avoid. All of these decisions, both by the creators and users of the curriculum, will influence the view of global warming that students receive. Teachers should encourage students to thoughtfully analyze and discuss the stories, perspectives, and biases celebrated and criticized within our own classrooms. Those skills and practices are core to an educated democratic citizenship.

**Additional Resources on Media Decoding**

- Key Questions To Ask When Analyzing Media Messages
- NAMLE Core Principles For Media Literacy Education in the U.S.
- Tips for Decoding

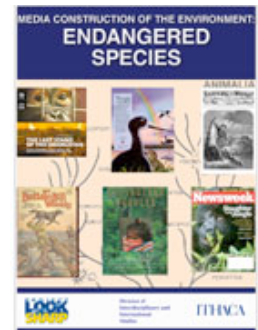
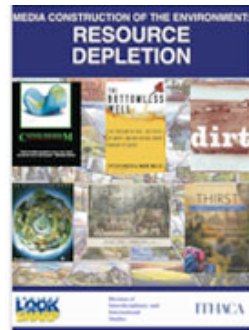
Download at [www.projectlooksharp.org](http://www.projectlooksharp.org)

**Fair Use of Media Documents**

The classroom critique of political and cultural documents (e.g. paintings, TV news clips, excerpts from films, Web pages) is essential to the development of core literacy skills in our media saturated democracy. To enable educators to fulfill the mission of teaching these core civic objectives, Project Look Sharp has created media literacy integration kits using a variety of different media documents for critical analysis in the classroom. The documents in this curriculum are presented for the purpose of direct critique and solely to be used in an educational setting.

For more information about Fair Use in media literacy education, go to the Media Education Lab at Temple University at [www.mediaeducationlab.com](http://www.mediaeducationlab.com).

**Media Literacy Environment Kits**



Each 185-page kit includes an interactive slide show analyzing the history of media representations from ancient America to today as well as video and print case studies.

[www.projectlooksharp.org](http://www.projectlooksharp.org)



# Lesson 1: Framing the Debate

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(access online or via Lesson 1 digital media folder)	
<i>The Global Warning</i>	
<i>The Climate of Fear</i>	



LESSON PLAN

# Framing the Debate



## Lesson Objectives:

- Students will explore their preconceptions of the question, “Is global warming really happening?”
- Students will identify the role that different types of media have played in shaping their opinions and perceptions about global warming.
- Students will begin developing critical media decoding skills and practice asking core media literacy questions.

## Vocabulary:

global warming, carbon dioxide, fossil fuels, hype, media literacy

## Media



Trailer from Leonardo DiCaprio’s 2007 documentary film *Global Warming* (retitled *The 11<sup>th</sup> Hour*), 4:08 min.



Glenn Beck’s 2007 TV special *Exposed: The Climate of Fear*, 1:55 min

## Materials Needed:

- Eight-page *Teacher Guide: Framing the Debate*
- Two-page *Student Worksheet* for decoding two video clips
- Two-page transcript for two video clips
- Two video clips (access online or via Lesson 1 digital media folder)  
*Global Warming (The 11<sup>th</sup> Hour)*, 4:08 min  
*Exposed: The Climate of Fear*, 1:55 min

## Time

35 min

## Lesson Procedures:

**Activity 1:** Writing and discussion activity about global warming and media using prompts in the *Teacher Guide*.

**Activity 2:** Distribute *Student Worksheet* and video transcripts and show the two video clips. Decode videos and lead discussion using the prompts in the *Teacher Guide*.



TEACHER GUIDE

## Framing the Debate

### Activity 1: Introductory Writing & Discussion

1. Organize and make copies for the class activities.
2. Introduce the lesson:

#### Lesson Introduction

This lesson will introduce a series of lessons that explore our own perceptions of global warming and the media constructions of the science and hype regarding climate change, as well as the roles of science, politics, and media in the shaping of public opinion.

3. Ask: **Take out a piece of paper and answer the question, "Does global warming exist?" Explain why you think this. What is your evidence?**
4. Have students share their answers with the class.
5. Ask: **Which of the following statements do you most agree with?**
  - A. Global warming is definitely happening.
  - B. Global warming is probably happening
  - C. Global warming is not happening.
6. Tally the results and write the number for each answer on the board.
7. Ask: **Where does your information about global warming come from?**
8. Write responses on the board. Divide media sources from other responses (i.e., parents). Explain the definition of media below.

#### Definition of Media

These sources (point to media sources on the board) are from the media. Media refers to any communication that is mediated by a form of technology where the person delivering the message is not in the same location as the person receiving the message. This includes messages from the Internet, books, magazines, newspapers, documentary films, TV shows, video games, advertisements, songs, and even T-shirts.



TEACHER GUIDE

# Framing the Debate

## Activity 2: Video Clips & Transcripts

1. Ensure that you have the media equipment available to play the video clips.
2. Introduce the lesson:

### Lesson Introduction

We are constantly being influenced by media messages, some about controversial topics. We will now take a look at two opposing media messages about global warming. Both of these video clips come from longer documentary films. The first one is the trailer for the film *Global Warning*. The film was written and produced by the actor Leonardo DiCaprio. The film was distributed in 2007 under the title *The 11th Hour*.

3. Distribute *Student Worksheet: Video Clip Decoding* and the two transcripts. Have students work individually or in pairs to log each film.
4. Read aloud the brief introductory excerpt before playing each film clip.
5. Play the film clip.
6. Have students write their answers on their worksheet after the showing of the clip.
7. Lead a discussion of the clips using the suggested teacher answers as a guide.
8. Utilize the transcripts and further questions for discussion.
9. Summarize with the *Activity Summary* section at the end of the *Teacher Guide*.



*The 11<sup>th</sup> Hour (Global Warning)*  
Trailer for Leonardo DiCaprio's Documentary  
4:08 min



**Film 1 Introduction**

This clip is the trailer for the film *Global Warning*. The film was written and produced by the actor Leonardo DiCaprio. The film was distributed in 2007 under the title *The 11<sup>th</sup> Hour*.

## Media Sample Questions & Answers

1) Who produced and who sponsored this message?

**Possible Answer:** This is a trailer for a movie written and produced by Leonard DiCaprio. It was sponsored by Global Green, Tree Media Group, and the Leonardo DiCaprio Foundation.

2) Who do you think is the target audience? What is your evidence?

**Possible Answer:** There are many possible answers to this question, including young people, people who like Leonardo DiCaprio, and so forth. Make sure that students back up answers with evidence.

3) What is its purpose?

**Possible Answer:** To promote the movie and to increase box office sales. To educate viewers about global warming. To promote attitudes and actions that address the threat of global warming. To scare viewers so that they will combat global warming.

4) What messages does it give about global warming?

**Possible Answer:** Earth's "perfect balance" is "breaking down" due to human civilization's "relentless consumption" and our "destructive addiction" to oil. Fossil fuel pollution is causing global warming. Scientists agree that global warming is one of the greatest challenges facing all of humanity. Weather- and climate-related catastrophes (storms, droughts, floods, etc.) are caused by global warming. Corporations and politicians are addicted to oil and are "resistant to change." We must support renewable energy and green technologies and elect politicians who support these views. We must learn more about global warming in order to save our planet. Probe for evidence for answers that are not clearly reflected in the text.



## Media Sample Questions & Answers

5) What techniques does it use to communicate those messages?

**Possible Answer:** The narration by a celebrity adds credibility and interest. Scary words and text about human's impact on the environment with collages of dark and red images segmented into fast-moving boxes are reinforced by dramatic techno music. Hopeful narration and text about what we can do to combat global warming with brighter, airy, and mostly blue images are reinforced by positive stringed music.

6) Are the messages accurate and credible? Why do you think that?

**Possible Answer:** Answers will vary. Some students may find the source, imagery, and content credible, while others see a lack of credibility. It is important to probe for reasoning and to let students debate each other about degrees of credibility.

7) What is left out of this message that might be important to know?

**Possible Answer:** There is still significant scientific debate about the causes of global warming. Not all scientists see the causes as anthropogenic; some believe the current warming trend is due to natural fluctuations in climate. It is not possible to prove that weather-related catastrophes such as droughts, floods, and hurricanes are definitively caused by global warming. There is likely to be a devastating economic impact if society abandons fossil fuel use. Even an immediate and dramatic shift from a fossil fuel economy may not be enough to stop the effects of global warming.

8) Who might benefit from this message?

**Possible Answer:** Those who support the message, including environmental groups and some politicians. Companies and individuals whose livelihood is tied to the existence of and fear about global warming. DiCaprio and the producers of the film. All living things (if the message is accurate).

9) Who might be harmed by this message?

**Possible Answer:** Those who oppose the message, including some corporate interests and politicians. Companies and individuals whose livelihood is tied to continued unregulated use of cheap fossil fuel energy. All people (if the message is wrong and the global economy suffers from unneeded regulation).



***Exposed: The Climate of Fear***  
**Glenn Beck's TV special**  
**1:55 min**



**Film 2 Introduction**

We will now watch and analyze a second video about global warming that takes a different perspective. You will view two minutes from *Exposed: Climate of Fear*. The two hour special was produced by TV and radio commentator Glenn Beck, former host of *CNN Headline News*. It was aired May 2, 2007, on CNN. You will answer the same questions for this segment.

## Media Sample Questions & Answers

**1) Who produced and who sponsored this message?**

**Possible Answer:** This was produced by TV commentator Glenn Beck and CNN. It was sponsored by CNN and its advertisers.

**2) Who do you think is the target audience? What is your evidence?**

**Possible Answer:** There are many possible answers to this question, including CNN viewers, people who like Glenn Beck, and so forth. Make sure that students back up answers with evidence.

**3) What is its purpose?**

**Possible Answer:** To increase ratings and bring advertising revenue for *CNN News*. To educate viewers about the media hype that may perpetuate myths about global warming. To promote attitudes and actions that question the reality of global warming. To promote Glenn Beck and *CNN News*, particularly with conservative viewers.

**4) What messages does it give about global warming?**

**Possible Answer:** The media generates irrational fear about global warming. Claims that severe weather are caused by global warming are false. Humans are not the sole cause of global warming. Scientists have been wrong about the climate in the past ("in the 1970s global cooling was the consensus").wers with evidence.

ING

## Media Sample Questions & Answers

5) What techniques does it use to communicate those messages?

**Possible Answer:** Emotional narration by a celebrity news broadcaster. Use of dramatic images from movies and TV news and intense music that stirs outrage at media manipulation. Juxtaposing alarmist TV news reports with commentary by experts (male authors with PhDs) suggesting that global warming is a product of media hype not backed by accurate science.

6) Are the messages accurate and credible? Why do you think that?

**Possible Answer:** Answers will vary. Some students may find the source, imagery, and content credible, while others see a lack of credibility. It is important to probe for reasoning and to let students debate each other about degrees of credibility.

7) What is left out of this message that might be important to know?

**Possible Answer:** A great majority of leading climate scientists, including over 2,500 who participated in the United Nations Intergovernmental Panel on Climate Change (the IPCC) are in agreement that the Earth's climate is warming due to a mixture of human and natural factors. Although it is not possible to prove that global warming causes certain weather events (storms, drought, etc.), the IPCC has identified evidence of increased tropical storm activity in the North Atlantic since 1970 due to warmer tropical ocean temperatures. In the 1970s, some scientists suggested the planet was cooling (not a consensus as stated in the film). Their projections were based on relatively primitive climate modeling. Today's models are far more precise and accurate in predicting climate change.

8) Who might benefit from this message?

**Possible Answer:** Those who support the message, including some industry groups and politicians. Companies and individuals whose livelihood is tied to unregulated fossil fuel use. Beck and the producers of the film. All people (if the message is accurate).

9) Who might be harmed by this message?

**Possible Answer:** Those who are attacked by Beck's message, including environmental groups, some politicians, and perhaps the media (though media typically like controversy and hype, even if it is about the media). Companies (solar energy, green technologies, etc.), environmental groups, individuals, and politicians whose livelihood benefits from fear about global warming and the call for more regulation of the energy industry.

All living things (if the message is wrong and global warming is a reality).

### FURTHER QUESTIONS

- » **Of the two video clips presented, did you trust one source more than the other? Why?**
- » **Why might you be more easily swayed by one bias over another?**
- » **Which media sources, in your opinion, offer the most accurate and credible information about global warming?**

### Activity Summary

Media both affect and reflect the societies in which we live. Like fish in water, we are often oblivious to the culture in which we swim. Media messages shape our ideas, our knowledge, and our beliefs. This curriculum, *Media Construction of Global Warming*, intends to help students develop a complex and informed understanding of global warming by critically analyzing and evaluating the media constructions that shape our perceptions of science and politics. Media literacy has become a core 21<sup>st</sup> century skill and is essential for any meaningful search for truth in our communications-saturated culture.

**Video Transcript 1:**  
***Global Warning Trailer***

**Transcript 1**

Picture this: a blue planet protected by a thin layer of atmosphere that keeps temperature, air, and water in perfect balance to maintain life. In the cold depths of space this planet is a virtual paradise, the only one known of its kind. And it is our planet, Earth.

But something is wrong. The life-sustaining systems of this planet are breaking down. What happened? Us. Human civilization and our relentless consumption has brought this planet to the brink. But specifically, our destructive addiction to one single resource may push us over the edge. And that resource is oil.

Oil is essentially ancient sunlight. Since the dawn of time, plants captured sunlight. After billions of years of decomposing in the earth, this focalized sunlight became a fuel: oil, coal, or gas. This ancient sunlight has become modern civilization's battery pack. The problem is, oil is a finite resource. We are running out of the very thing our society is dependent on in order to function.

But worse, our burning of fossil fuels has dumped over 700 billion tons of carbon pollution into the atmosphere as if it were a sewer. We are altering life on this planet as we know it. How? The accumulated pollution causes the atmosphere to trap much of the sun's heat. The Earth's surface temperature is actually going up. This is what is known as global warming.

Warming—that almost sounds inviting—that in a world 20 years from now we will be living in a tropical paradise where the extent of our problems will be pondering which SPF sunscreen to use. But don't be fooled. Thousands of climate scientists agree that global warming is not only the most threatening environmental problem but one of the greatest challenges facing all of humanity.

The 1990s alone have been the warmest decade of the millennium. Temperatures have already gone up by 1 degree Fahrenheit in the last century. Maybe that doesn't sound like a lot, but it is. It only took 4 small degrees to shift us out of the last ice age.

When you turn on the TV and hear about killer heat waves, extreme weather conditions, freak storms, drastic flooding of cities, rising sea levels, giant chunks of ice breaking off in the Antarctic, coral reefs bleaching and dying... make the connection. It is global warming and climate change.

In the face of this disaster, what have the big corporations and politicians done about it? Unfortunately, not enough. The fact is that they have gained too much money and power off our addiction to oil. This makes them dangerously resistant to change. But are we?

We must demand a separation between oil and state. We can get off oil and slow down global warming. We can use energy more efficiently and support renewable and clean energy sources and new green technologies that don't burn carbon, like hydrogen fuel cells, wind, and solar power. We can vote for leaders who care about protecting your health, the air, and the environment. We can support non-profits that are making a difference. We can be environmentalists.

So get educated, stay educated, so that we can think for ourselves. Join the fight to save this unique blue planet for future generations.

*Global Warning* sponsored by: Global Green, Tree Media Group, Leonardo DiCaprio Foundation  
Created by: Leonardo DiCaprio, Tree Media Group  
Produced by: Tree Media Group, Birch Studio.

**Video Transcript 2:**  
**Clip from *Exposed: Climate of Fear***

**Transcript 2**

**GLENN BECK (host):** You are not going to believe this, but sometimes fear makes people act irrationally. Luckily, we have the media to put things into perspective, because nothing ever gets over-hyped on television. The truth is that a show like tonight's, trying to cut through the hype, isn't sexy. With global warming the ratings are in the disaster and the media know it.

**BECK (VOICE OVER):** Severe storms, devastating hurricanes, and massive walls of sea pummeling major cities. These are the kinds of extremes that movies like *The Day After Tomorrow* propagate about global warming. Even Jake Gyllenhaal isn't safe. This you know is fake. But you hear similar stories from less convincing actors and no cool special effects. But you still get all the drama.

**TV REPORTS:** "This week's grim report about global warming and a looming climate catastrophe," "extreme weather from drought to heavy rain and cyclones," "the seas are rising, hurricanes will be more powerful like Katrina, and polar bears may be headed towards extinction."

**UNIDENTIFIED MALE:** "We don't see that happening, tornadoes are not increasing, the frequency of hurricanes is not increasing."

**TV REPORT:** "The world is heating up fast and we have ourselves to blame."

**PATRICK MICHAELS** - PhD Author Meltdown: "I'm going to tell you something about the media and global warming you don't hear real often—It's not all your fault, OK?"

**TIM BALL PhD** - Natural Resources Stewardship Project: "The problem with the media is that it has essentially become a business and everything has to become more sensationalized."

**TV REPORT:** "This just isn't hype and scaremongering. Global warming is real."

**UNIDENTIFIED MALE:** "The fear element drives the media and the media drives the hype."

**CHRIS HORNER** - Politically Incorrect Guide to Global Warming: "Fear is part of the equation now."

**TIM BALL:** "When I started out in the 1970s, global cooling was the consensus."



6) Are the messages accurate and credible? Why do you think that?

7) What is left out of this message that might be important to know?

8) Who might benefit from this message?

9) Who might be harmed by this message?



# Lesson 2: Global Warming: Fact or Myth?

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LESSON PLAN

# Global Warming: Fact or Myth?



PowerPoint  
Slide Show



Video Clips

## Lesson Objectives:

- Students will develop a clear definition of global warming.
- Students will review sources of data that are used to reconstruct the Earth's climate record and will identify discernable, cyclic patterns.
- Students will understand that Earth's climatic systems are dynamic and ever changing.
- Students will recognize agreement among various data sets and methodologies that have been used to determine the Earth's climate history and temperature record.
- Students will understand the debate concerning whether the temperature spike that has occurred recently is an anomaly.
- Students will identify bias found in media portrayals of the science of global warming.
- Students will develop a personal answer to the question, "Is global warming happening?"

## Vocabulary:

**age of instrumentation, proxy data, hockey stick graph, IPCC, sponsorship, global warming, ice core data, bore hole pollen data, tree ring data, coral core data, ocean sediment core data, scientific corroboration**

## Media



Slide show: *Global Warming, Fact or Myth?*  
15 slides



Video 1: *The Truth About Global Warming* (2008),  
2:49 min



Video 2: *Climate Catastrophe Cancelled* (2005),  
3:30 min

## Materials Needed:

- 17-page *Teacher Guide: Global Warming: Fact or Myth?*
- Four-page *Student Reading: The Temperature History of the Earth*
- Two-page *Student Worksheet: Decoding Two Video Clips*
- Two-page *Student Worksheet: Trust and Sponsorship*
- Slide show: *Global Warming, Fact or Myth?*, 15 slides (access online or via Lesson 2 digital media folder)
- Video clips (access online or via Lesson 2 digital media folder)
  - The Truth About Global Warming*, 2:49min
  - Climate Catastrophe Cancelled*, 3:30 min

## Time

60 min

**Lesson Procedures:**

1. Distribute the *Student Reading: The Temperature of the Earth*, for students to read as homework or in class.
2. **Activity 1:** Lead students through slide show, reviewing key information from the background reading, probing for understanding, and presenting new information using the *Teacher Guide*.
3. **Activity 2:** Introduce video activity. Lead students through decoding of the two video clips using information in the *Teacher Guide* and the *Student Worksheet, Activity 2*, on decoding the video clips.
4. **Activity 3:** Distribute *Student Worksheet, Activity 3: Trust and Sponsorship*. Lead discussion of credibility, sourcing, and bias using questions in the *Teacher Guide*.
5. **Activity 4:** Lead the *Take a Stand* activity using the questions in the *Teacher Guide*.

TEACHER GUIDE



PowerPoint Slide

# Global Warming: Fact or Myth?

## Activity 1: Slides #1-3

→ Project the documents

EXPLAIN

This lesson will explore the relationship between the Earth's climate history and more recent trends concerning the average temperature of our planet. In doing so, we will become familiar with a variety of techniques used to arrive at figures representing average global temperatures extending into the distant past.

EXPLAIN

We will grapple with the question, "Are recent trends in global temperature unprecedented in our climatic history?"

EXPLAIN

As we explore this question, we will encounter opposing viewpoints represented in popular media. These representations raise the question, "How do we know whom to believe when scientists disagree on the answers to highly technical and potentially cataclysmic questions?"

### SLIDE #1

*Media Construction of Global Warming*

Lesson 2

**Global Warming:  
Fact or Myth?**

### SLIDE #2

Are recent trends  
in global temperature  
unprecedented  
in our climatic history?

### SLIDE #3

How do we know who to  
believe when scientists  
disagree on the answers to  
highly technical and  
potentially cataclysmic  
questions?

**TEACHER GUIDE**

**Slides #4-5**

**SLIDE #4: BACKGROUND INFORMATION**

This graph represents information from two ice core records created by independent research teams in different parts of Antarctica. The temperatures shown in these graphs were derived indirectly using oxygen isotope ratios from the ice cores and corroborated by independent teams and different data sources (Abelard, 2007).

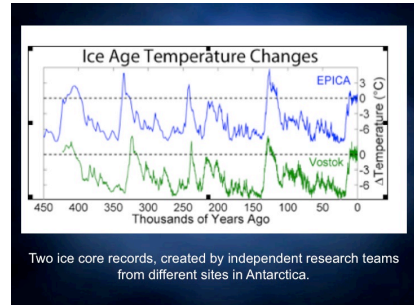
**EXPLAIN** Take a moment to familiarize yourself with this chart; it was in your reading.

**QUESTION** **Based on the information presented in this graph, what conclusions can we draw about the Earth's climate over the past 450,000 years?**

**POSSIBLE ANSWERS** The temperature on our planet has changed constantly throughout the period of time depicted.

The process of temperature change follows a fairly regular pattern, with temperatures oscillating within certain high and low points that are relatively constant throughout this period of history.

**SLIDE #4**



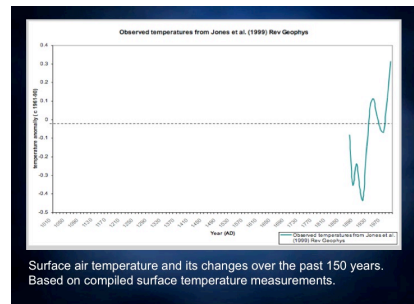
**SLIDE #5: BACKGROUND INFORMATION**

This graph shows surface air temperature and its changes over the past 150 years based on compiled surface temperature measurements (Jones et al., 1999).

**QUESTION** **From what source(s) of information was this graph derived? What limits its scope?**

**POSSIBLE ANSWER** The data for this graph came from direct surface temperature measurements around the Earth. This type of data has only been gathered since the mid-1800s.

**SLIDE #5**



TEACHER GUIDE

# Slide #6

## SLIDE #6: BACKGROUND INFORMATION

This graph shows Arctic temperature proxies for 1600-1990 from a compilation of Paleoclimate records from lake sediments, tree rings, glacier ice cores, and marine sediments (Overpeck et al., 1997).

EXPLAIN

This graph represents a temperature reconstruction.

QUESTION

**Why is it referred to as a reconstruction? Upon what sources of data is it based?**

POSSIBLE ANSWER

This graph is derived from a number of different proxy data sources combined into one. Each source of proxy data requires its own methods of analysis. The researchers have used their analysis to construct a single graph that incorporates all of the various sources of information.

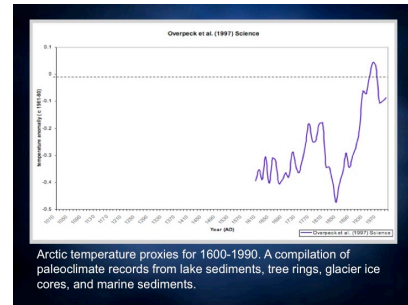
QUESTION

**To what degree does this proxy analysis agree with the instrumental record we just observed?**

POSSIBLE ANSWER

While one graph extends further back through time, both include periods of temperature increase and decrease while showing a general warming trend.

## SLIDE #6



TEACHER GUIDE

Slides #7-8

SLIDE #7: BACKGROUND INFORMATION

This graph shows temperature-sensitive Paleoclimatic multi-proxy data from 17 sites worldwide. Proxy sources include tree rings, ice cores, corals, and historical documents (Jones et al., 1998).

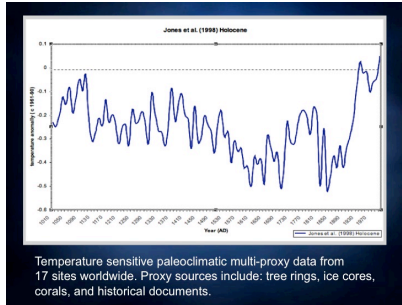
QUESTION

What was used to create this graph and what does it tell you?

POSSIBLE ANSWER

This is a multi-proxy graph using tree rings, ice cores, corals, and historical documents as sources of information, all combined into one graph. It indicates that temperatures were cooler over most of the past 1,000 years and that they have been rising recently.

SLIDE #7



SLIDE #8: BACKGROUND INFORMATION

This graph is a reconstruction based on multiple tree ring and ice core data sets (Mann et al., 1999).

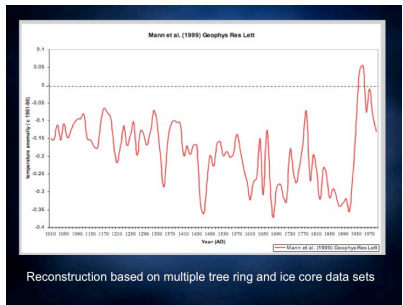
QUESTION

Once again, what was used to create this graph and what does it tell you?

POSSIBLE ANSWER

This graph uses tree rings and ice cores as its sources of data. It once again shows that surface temperatures were generally cooler over most of the past 1,000 years with a general recent warming trend. However, this analysis indicates a cooling trend during the most recent years starting in the mid-1900s.

SLIDE #8





TEACHER GUIDE

# Slides #9-10

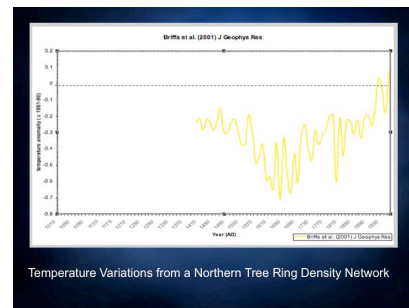
## SLIDES #9-10: BACKGROUND INFORMATION

Slide #9 shows a temperature variation graph from a northern tree ring density network (Briffa et al., 2001). Slide #10 is from proxy data such as tree rings, ice cores, and historical documents (Crowley & Lowery, 2000).

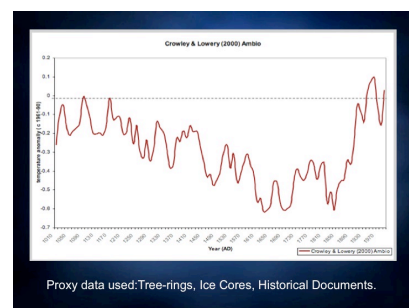
EXPLAIN

These are the last two temperature reconstructions we will be looking at. As you interpret them, continue to relate them to the other four temperature time graphs we have just observed.

### SLIDE #9



### SLIDE #10



TEACHER GUIDE

# Slide #11

## SLIDE #11: BACKGROUND INFORMATION

This graph shows Arctic temperature proxies for 1600-1990 from a compilation of Paleoclimate records from lake sediments, tree rings, glacier ice cores, and marine sediments (Overpeck et al., 1997).

EXPLAIN

This graph shows all of the previous graphs on the same set of axes.

QUESTION

**What general conclusions can be drawn from this composite?**

POSSIBLE ANSWERS

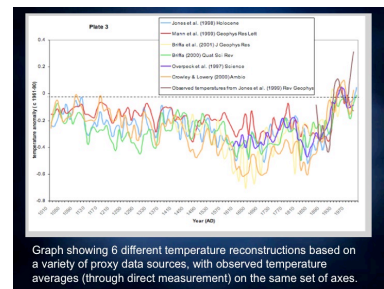
While each reconstruction offers a unique temperature history, all show very similar patterns.

The proxy (indirect) data analysis agrees closely with the direct temperature measurements since the age of instrumentation. This corroboration offers validity to the various proxy methods used.

For the last 1,000 years there has been a slow cooling of global temperature followed by an abrupt warming period beginning about 100 years ago.

We are currently experiencing a period of rapid temperature increase with 2005 as the warmest year on record.

## SLIDE #11



**TEACHER GUIDE**

**Slide #12**

**SLIDE #12 BACKGROUND INFORMATION**

This graph shows the year-by-year (blue curve) and 50-year average (black curve) variations of the average surface temperature of the northern hemisphere for the past 1,000 years (Jansen & Overpeck, 2007). Three climatologists originally constructed the graph in 1998: Michael Mann, Raymond Bradley, and Malcolm Hughes. It was featured in the 2001 report on global climate change, submitted by the Intergovernmental Panel on Climate Change (IPCC), a UN-affiliated panel composed of a large number of scientist representing institutions worldwide. This graph has become a target of contention for those who feel that global warming is being misrepresented by the IPCC (Page, 2009).

QUESTION

**Why do you suppose this graph has become known as the hockey stick graph?**

POSSIBLE ANSWER

The image of the hockey stick comes from the generally flat temperature history until recently (the shaft of the stick) followed by an abrupt turn upward (the blade of the stick).

QUESTION

**How does the hockey stick graph compare to the composite graph you just observed?**

POSSIBLE ANSWER

They are very similar. The grey shading in the chart above and below the dark blue line indicates degrees of uncertainty.

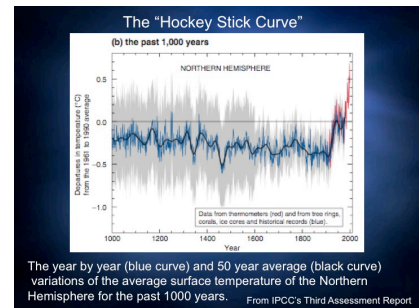
QUESTION

**Why does the degree of uncertainty decrease from left to right on the chart?**

POSSIBLE ANSWER

The further back one goes in time, the more uncertain the temperature reconstruction becomes. The degree of uncertainty becomes much less in the age of instrumentation.

**SLIDE #12**



TEACHER GUIDE

## Slides #13-14: Conclusion

EXPLAIN

It is clear from the information presented in your background reading that temperatures have varied continuously throughout Earth's history with many periods of both cooling and warming. The term global warming characterizes the current period of global temperature increase as unprecedented in the Earth's temperature history.

SLIDE #13



EXPLAIN

We will now analyze a few media representations about this question and look at ways in which different groups have used the media to communicate their views on this question.

SLIDE #14



TEACHER GUIDE



# Global Warming: Fact or Myth?

## Activity 2: Video Clip Decoding

1. Organize and make copies of the student worksheets for the class activity.
2. Ensure that you have media equipment set up to play the video clips.
3. Introduce the lesson:

### Lesson Introduction

In order to explore the ongoing debate over global warming, we will be analyzing short excerpts from two documentary films about global warming that use the “hockey stick curve.” The “hockey stick curve” refers to a climate reconstruction that produced the so-called hockey stick shaped graph, which showed that the 20th century was unusually warm compared to preceding centuries.

4. Distribute *Student Worksheets for Activity 2: The Truth About Global Warming and Climate Catastrophe Cancelled*. Have students work individually or in pairs to log each film.
5. Read aloud the brief introductory excerpt before playing each film clip.
6. Play the film clip.
7. Have students write their answers on their worksheet after the showing of the clip.
8. Lead a discussion of the clips using the possible answers in the *Teacher Guide*.



## *The Truth About Global Warming* 2008



### Film 1 Introduction

This 2.5 min clip is from the 2008 documentary film *The Truth About Global Warming*. The narrator, David Attenborough, is an acclaimed producer of nature documentaries, including *Life on Earth* and *The Living Planet*. He became Sir David Attenborough in 1985 when he was knighted by the Queen of England for pioneering work in this field.

## Media Sample Questions & Answers

1) What is the main point made about global warming in this excerpt?

**Possible Answer:** Global warming is caused by humans.

2) What scientific evidence is used to back up this conclusion?

**Possible Answer:** Professor Cox uses a version of the hockey stick graph and temperature models to show that natural factors (volcanoes and the sun) cause variation in global temperature, but that human factors (anthropogenic CO<sub>2</sub>) are linked to the recent temperature rise. He shows that natural models can account for temperature variation until 1970, but that models that take human factors into account must be included to explain the current warming trend.

3) What techniques do the filmmakers use to add credibility, authority, and power to the conclusions?

**Possible Answer:** Sir David Attenborough is introduced as a “legendary broadcaster.” He gains authority from his title (bequeathed by the Queen), his reputation, his fame, and perhaps his age and his British accent. Cox gains authority from his introduction as “Professor Peter Cox,” a “climate scientist.”

The camera lends authority and power to both Cox and Attenborough by filming them from below (looking up at them).

The size and complexity of the graph adds scientific authority.

Attenborough’s statement, “Well, there you have it, proof that climate change is caused by humans,” presents the conclusion as incontrovertible.

The music adds drama and power to the conclusion.



### *Climate Catastrophe Cancelled* Friends of Science, 2005



#### Film 2 Introduction

This 3 min clip is from the 2005 documentary film, *Climate Catastrophe Cancelled*. It was produced by the Canadian group Friends of Science. Students will compare the groups Friends of Science and the IPCC (source of the hockey stick graph) in the next activity, *Trust and Sponsorship*.

## Media Sample Questions & Answers

1) List three points the clip makes about climate change and global warming. For each point, list the evidence used in the clip to back up the claim.

2) List the ways in which the excerpt contradicts and undermines claims that current warming is unprecedented?

3) What questions do you have about these claims?

**Possible Answer:** The climate is always changing and has always changed. The temperature of the Earth was warmer in the past than it is now or is projected to be in the future even with global warming. The hockey stick graph is wrong.

**Evidence:** Statements from scientists, reconfigured temperature graph with higher temperatures for the 15<sup>th</sup> century, claims by professors Stephen McIntyre and Ross McKittrick that Mann's research was flawed, and a "computer programming error."

**Possible Answer:** The credibility of the IPCC report and graph are discredited through statements from the narrator, McIntyre, and McKittrick. "Mann's research was never audited," the hockey stick graph is "a computer programming error," "the data description was wrong." Many named and unnamed experts in the clip state that current warming temperatures are no higher than in the past and that this is what most scientist believed until recently. The narrator said, "although Mann's report was never audited, the United Nations and environmentalists promoted it as the smoking gun that recent warming was unusual."

**Possible Answer:** What is the scientific basis for discrediting Mann's research? Do other scientists agree that the unprecedented 20<sup>th</sup> century temperature rise in the hockey stick graph is a result of a "computer programming error" that has problems with the "data description"? What is the scientific debate about past temperature readings? Do leading scientists agree that the current global temperatures are "not out of bounds from the past"? Who sponsored and who produced this video, and for what purpose?





TEACHER GUIDE



Printed Documents

# Global Warming: Fact or Myth?

## Activity 3: Truth and Sponsorship

1. Organize and make copies of the *Truth and Sponsorship Student Worksheet* for the class activity.
2. Introduce the lesson:

### Trust and Sponsorship Activity

This next activity will help us to explore the credibility of conflicting information about global warming. At the end, you will be asked to take a stand on whether you think that global warming is a fact or a myth and to explain your reasoning.

3. Give students time to complete the handout before leading the following discussion:

Ask: **Based on what you have read in the handout and what you saw in the video clips, which group has more credibility / is more believable in their claims about global warming: the IPCC or Friends of Science? What is your reasoning?**

Lead a discussion focused on the question of credibility. This should include discussion of:

- The numbers of scientists involved in each group (IPCC – hundreds of scientists; FOS – a small advisory group)
- The importance of peer-reviewed science
- The purpose of each group (see the goals of each group on the handout)
- The sponsorship of each group (IPCC – the United Nations; FOS – unknown)
- The important role that marginalized ideas have played in challenging commonly held “scientific” beliefs that ultimately proved to be incorrect.

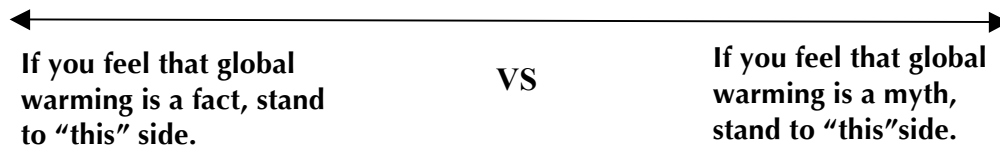


TEACHER GUIDE

# Global Warming: Fact or Myth?

## Activity 4: Take a Stand

1. Lead the “Take A Stand” activity. Clear part of the room where all students can stand in a line. Ask students to move to a space on the continuum reflecting their position on the following statement:



2. Lead a discussion calling on students at all places in the continuum.

Address the following questions:

- Ask:
- **What does the preponderance of the evidence suggest? Is near-consensus an accurate indicator of truth?**
  - **What do the majority of scientists think about this question? Is it best to follow the majority opinion? If not, what do you use as a guide? Is consensus an expected outcome of the scientific process? Give examples when scientific consensus was later proved wrong.**
  - **How do we make critical decisions based on science when science is fallible and debated?**
  - **Are we making decisions based on our own biases? What are those biases? Where do they come from?**
  - **What other factors come into play when making this decision?**

**Note:** If an entire side of the continuum is missing (e.g. global warming is a myth), the discussion can still be fruitful if there is enough disagreement (e.g. we do not yet know that global warming is a fact) to raise the key questions above. Probe for core differences between students’ reasoning.



**The Temperature History of the Earth**  
**What We Know and How We Know It**

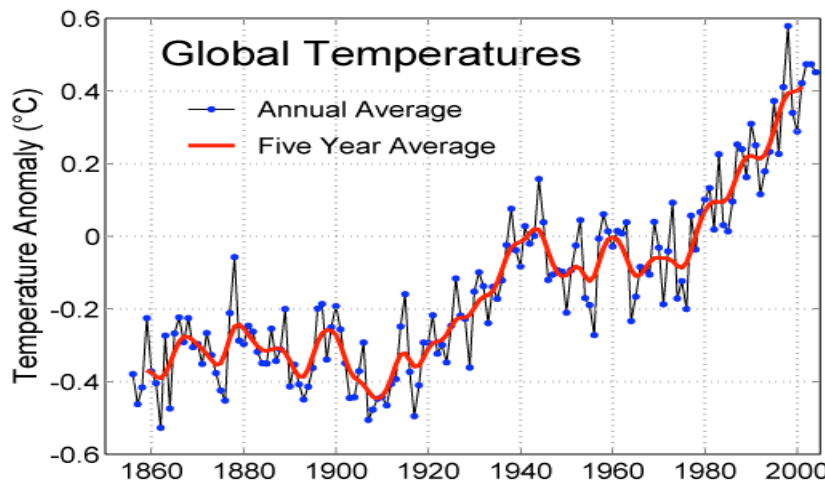
**Background Reading**

The average temperature of our planet has varied greatly over its 4.5 billion year history. Scientists agree that the Earth has experienced repeated periods of relative warm and cold and have identified a variety of mechanisms that have influenced these climatic shifts; among them, irregularities in the Earth’s orbit, extreme volcanic events, changes in the output of the sun, and meteor impacts. We are aware of this climate history both from direct measurements of temperatures taken worldwide and from indirect data analysis extending far into our planet’s history (Pidwirny, 2006).

I. The age of instrumentation:

The age of instrumentation refers to the period of our history for which direct measurements are available. With regard to climate change, this period extends back to the mid-1800s, from which time we have access to various networks of thermometer measurements used to calculate average global temperatures. Originally, temperatures were recorded regularly at a very limited number of locations around the world. Over time, the number of such data sites has increased and come to include both surface and ocean temperature readings. More recently, satellite data has become available concerning global temperature. Even with a great deal of temperature data available, an analysis producing a planetary average is an extremely difficult task (Pidwirny, 1969). Fig. 1 below represents one such analysis.

**Fig. 1: Full Instrumental Record Since 1860**



This image shows the instrumental record of global average temperatures as compiled by the Climatic Research Unit of the University of East Anglia and the Hadley Centre of the UK Meteorological Office. Data set HadCRUT3 was used, which follows the methodology outlined by Brohan et al. (2006). Following the common practice of the IPCC, the zero on this figure is the mean temperature from 1961-1990.

While the graph indicates a clear trend in global temperature since 1860, it offers no indication of how this past century and a half compares to the long-term temperature patterns of our planet’s past.

II. Proxy data analysis: The period before instrumentation:

In order to determine temperatures before measurements were being taken directly, scientists have developed strategies to determine temperatures indirectly using what are called proxy data. The sources of these data are diverse and include ice cores, tree rings, sediment cores from bogs and oceans, and analysis from coral skeletons and stalagmites. From each of these widely varying methods, scientists have been able to develop ways to generate indirect temperature data over long periods of time.

A proxy is a type of substitute. In the context of global temperatures, proxy data stand as substitutes for direct temperature measurements for the period before instrumentation. A wide variety of different types of proxy temperature data have been identified (Pidwirny, 2006).

**A. Written Histories:**

Written histories from various parts of the world have been used as indicators of average temperatures in the past. For instance, historic documents established that the Vikings first settled Greenland just before 1000 A.D. (Brown, 2000) while that part of the world was experiencing a relatively mild climatic period. Similarly, agricultural records such as those concerning French grape harvests offer useful comparative data concerning changes in climate over time in that part of the world.

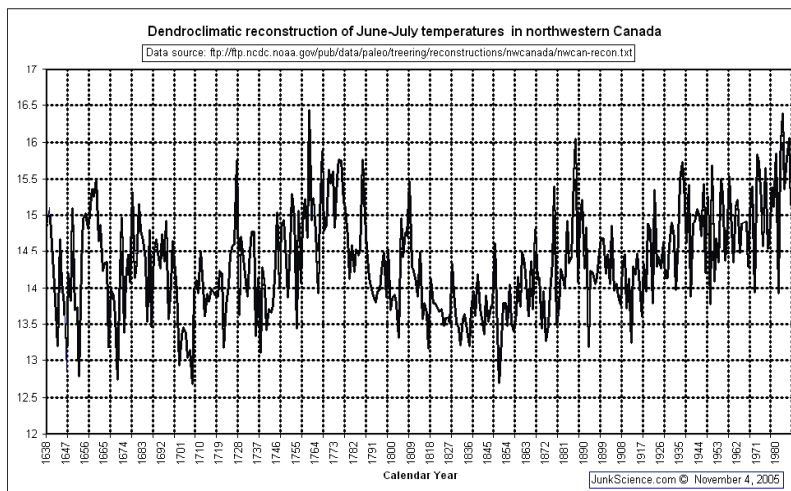
**Where else might written histories offer indications of changes in the climate of the past?**

**B. Tree Ring Data:**

Trees record their growth in annual rings that can be read. The oldest trees still living on the planet hold information about past climates extending back over a thousand years. The relative thickness of annual rings is influenced by a variety of factors, including availability of water, nutrients, temperature, and CO<sub>2</sub>. Scientists known as Dendrochronologists have worked to develop a means of determining the specific influence of temperature in this history, thereby extracting historic temperature data from tree ring records (Miller, 2005). (See Fig. 2)

**Fig. 2: Tree-Ring Data Temperatures Since 1638**

Dendroclimatic reconstruction of June-July temperatures in Northwestern Canada



Dendroclimatic reconstruction of June-July temperatures in northwestern Canada. International Tree-Ring Data Bank. IGBP PAGES/World Data Center-A for Paleoclimatology Data Contribution Series # 95-024. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA.

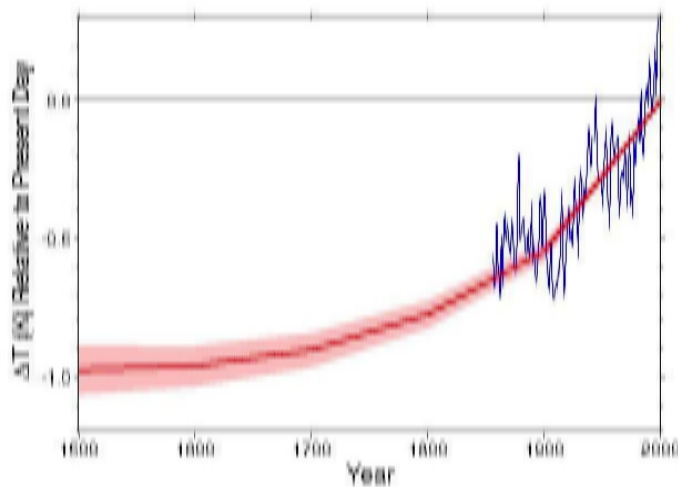
**C. Core Samples of Bog Sediment: (Pollen Grain Analysis):**

Pollen grains from plants are constantly being washed or blown into lakes and other wet areas where they accumulate in sediments. Core samples of these sediments provide a record of past vegetation over time. These cores are obtained by drilling into sediments and extracting the material trapped in the drill bore. Different types of pollen reflect different climate conditions favorable for the vegetation growing at that time (Buchdahl, 1999).

**D. Bore Hole Cores:**

The center of the Earth is extremely hot relative to its surface. The material making up the Earth's crust is influenced from below by intense heat and from above by relative cool. This sets up a temperature gradient as one moves from the surface into the Earth's mantle. Depending on how the actual surface temperature of the planet has varied historically, the temperatures found at various depths in the mantle of the Earth will vary. This relationship has been used by scientists to estimate average surface temperatures for our planet into the distant past (Hieb, 2009). In Fig. 3 below, there are two sets of data represented: bore hole proxy data (thick red line from 1500) and instrumentation data (red line since 1865).

**Fig. 3: Bore Hole Data Since 1500**



Pollack et al. used underground temperature measurements from a database of over 350 bore holes in eastern North America, Central Europe, Southern Africa, and Australia. The thick line represents the mean surface temperature since 1500 relative to the present-day. The shading represents  $\pm$  one standard error of the mean. The thinner jagged line shows the global mean surface air temperature (five year running average) derived from instrumental records by P.D. Jones and colleagues at the University of East Anglia.

**How does the comparison of bore hole data and data from instrumentation affect your impression of the validity of this form of proxy analysis?**

**E. Coral Analysis:**

According to the National Aeronautics and Space Administration (NASA), corals tend to grow in layers, with newer colonies building over the top of older colonies. This leaves a record of past coral skeletons similar to tree rings. Corals are typically made of calcium carbonate ( $\text{CaCO}_3$ ), essentially limestone, or silicon dioxide ( $\text{SiO}_2$ ), a compound common in quartz sand. As coral layers are formed, oxygen representing two different isotope forms is incorporated:  $\text{O}_{16}$  and  $\text{O}_{18}$ . The cooler the surrounding water temperature, the greater the proportion of heavy oxygen (isotope  $\text{O}_{18}$ ) taken in. Through the analysis of the relative proportion of these two oxygen isotopes, core samples of ancient coral provide information on the ways in which temperature has changed over time.

**F. Stalagmite Analysis:**

According to the *NationMaster Encyclopedia* (2003), speleothems are mineral deposits formed from groundwater within underground caverns. Stalagmites, stalactites, and other forms of speleothems are annually banded and contain compounds which can be radiometrically dated. Radiometric dating is a technique used to date materials based on a knowledge of the decay rates of naturally occurring isotopes and the current abundances. It is our principal source of information about the age of the Earth. The thickness of depositional layers or isotopic records can be used as proxies of the Earth's climate history.

**G. Ice Cores:**

The source of proxy temperature data that extends the furthest into our planet's past is found in ice cores. It has been discovered that as ice builds up in glaciers and polar caps, the ice itself contains information regarding the climate of the period of deposition. Drilling into these deep ice histories and recovering core samples has allowed scientists to measure a variety of parameters that can be used to indirectly determine average global temperatures over time (Riebeek, 2005). (See Fig. 4)

Ice sheets contain a record of hundreds of thousands of years of past climate, trapped in the ancient snow. Scientists recover this climate history by drilling cores in the ice, some of them over 11,000 feet deep (Riebeek, 2005).

According to NASA, the ratio of oxygen isotopes plays a key role in the analysis of ice cores. The ratio of light to heavy oxygen found in the ice core samples has been found to be a direct indicator of the temperature that was present at the time the ice was formed. Recently, teams of researchers from a variety of countries have drilled and analyzed ice cores from deposits worldwide. (See Fig 5)

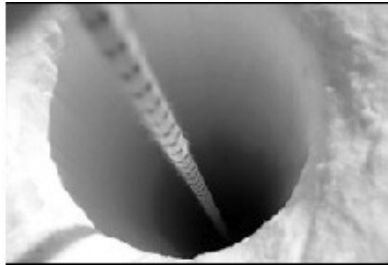
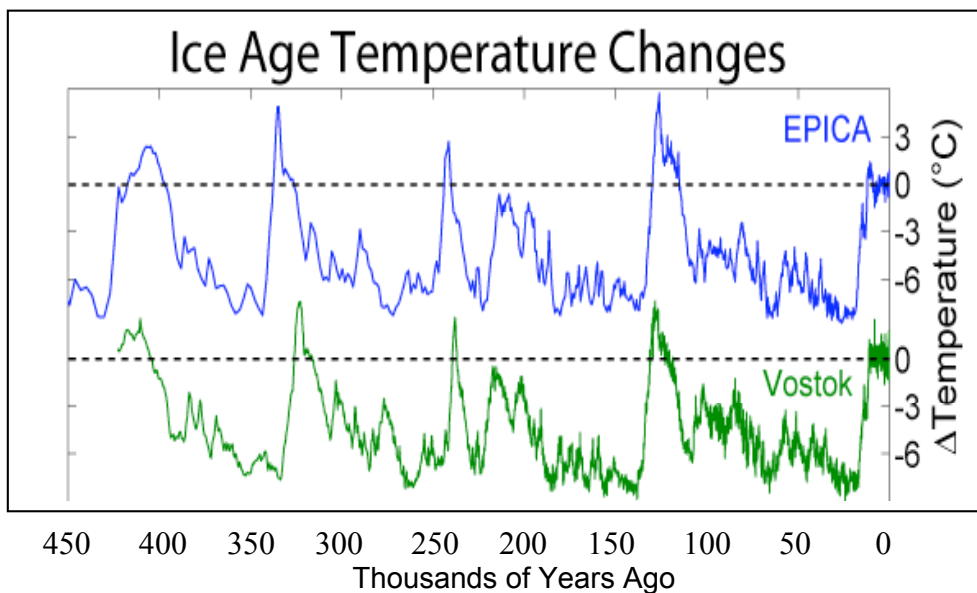


Fig. 4: These photographs show experimental drilling on the Greenland Ice Cap in the summer of 2005. (Photographs copyright Reto Stöckli, NASA)

Fig. 5: Ice Core Data Over 450,000 Years



The graph at left show comparative Antarctic temperature changes during the last several glacial/ interglacial cycles covering 450,000 years. They represent independent ice core data analysis at two different sites in Antarctica.

(Global Warming Art)

Scientists have analyzed ice cores from the Arctic, Antarctic, Greenland, and a wide variety of glaciers worldwide. Their findings agree closely with the two sets of data represented in the ice core graph on the previous page. The close agreement of the data generated by so many different scientific investigations lends credibility to this temperature record (Riebeek, 2005).

The varied temperature reconstruction methods mentioned in this reading all indicate that the temperature of our planet has changed constantly throughout the past 450,00 years. This process of temperature change follows a fairly regular pattern, oscillating within certain high and low points that seem to be relatively constant throughout this period of history.







## Activity 2: Student Worksheet *Climate Catastrophe Cancelled*

NAME \_\_\_\_\_

DATE \_\_\_\_\_

Read over the questions below before watching the short video clips. You may want to take notes as you view the clips. You will then be given time to write your answers.

### **Title of Film Clip: *Climate Catastrophe Cancelled***

1) List three points the clip makes about climate change and global warming. For each point, list the evidence used in the clip to back up the claim.

ANSWERS

EVIDENCE

2) List the ways in which the excerpt contradicts and undermines claims that current warming is unprecedented.

3) What questions do you have about these claims?



## Activity 3: Student Worksheet Trust and Sponsorship

NAME \_\_\_\_\_

DATE \_\_\_\_\_

You have just analyzed two video clips offering very different perspectives on the validity of global warming. Is global warming an over-hyped invention based on faulty science, as claimed by the Friends of Science, or a scientifically established and potentially catastrophic reality, as claimed by Peter Cox of the IPCC? How do we decide which to believe? How do we make well-informed decisions about such an important yet divisive issue?

We can start by thinking critically about conflicting media messages. We need to identify and compare the scientific claims, as we have already begun to do. We typically evaluate conflicting claims based on our own knowledge of the subject, our own beliefs, and our own biases. For complex scientific questions, we typically rely on experts to help distinguish fact from myth. But which experts do we trust? We can seek more complex truths through asking a series of critical questions about any media message:

- 1) **Who produced and who sponsored this message and for what purpose?**
- 2) **How current and accurate is the information? How credible is the source?**
- 3) **What is the bias of the producers and how does that influence the message?**

On the back, you will find information about the two organizations that are behind the conflicting scientific claims in the two video clips. Think about the above questions as you read over this information and answer the questions below.

- 1) **Which organization you think has more credibility, Friends of Science or the IPCC?  
Explain your reasoning.**

- 2) **Do you think that global warming is a fact or a myth? Explain your thinking.**



**Friends of Science**  
Producers of *Climate  
Catastrophe Cancelled*

**From the Friends of Science website:**

"Friends of Science is a non-profit organization made up of active and retired engineers, earth scientists and other professionals, as well as many concerned Canadians, who believe the science behind the Kyoto Protocol is questionable. Friends of Science has assembled a scientific advisory board of esteemed climate scientists from around the world to offer a critical mass of current science on global climate and climate change to policy makers, and any interested parties."

**Goals of FOS:**

"To encourage and assist the Canadian Federal Government to re-evaluate the Kyoto Protocol by engaging in a national public debate on the scientific merit of Kyoto and the Global Warming issue, and to educate the public through dissemination of relevant, balanced and objective technical information on this subject."

**Membership of FOS:** "Scientific Advisory Board:

Dr. Sallie Baliunas, Research scientist at the Harvard-Smithsonian Center for Astrophysics in Cambridge, MA  
Dr. Chris de Freitas, Associate Professor of Geography and Environmental Science, University of Auckland  
Dr. Madhav Khandekar, Meteorologist retired, formerly with Environment Canada  
Dr. Tim Patterson, Professor of Geology and Paleoclimatology, Carleton University

**Financial Sponsorship of FOS:**

While there is no information on the Friends of Science website concerning the funding of this non-profit organization, an August 12, 2006, article in Canada's *Globe and Mail* claimed that FOS receives funding from the oil and gas industry.

**Contact information:**

Friends of Science Society  
P.O. Box 23167, Connaught Post Office  
Calgary, AB T2S 3B1 Canada  
Phone: (403) 236-4203  
Fax: (403) 236-4203  
<http://www.friendsofscience.org>



**IPCC**  
Source of the scientific claims behind *The Truth About Global Warming*

*The Truth About Global Warming* was produced by the Canadian Broadcasting Corporation. The clip you saw featured Professor Peter Cox, one of the lead authors in the Intergovernmental Panel on Climate Change, the IPCC.

**From the IPCC website:**

"The Intergovernmental Panel on Climate Change (IPCC) has been established by the WMO (World Meteorological Organization) and UNEP (the United Nations Environment Programme) to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts, and options for mitigation." It was first established in 1988 and its fourth global assessment report was produced in 2007.

**Goals of IPCC:**

"The Panel's role is to assess on a comprehensive, objective, and open and transparent basis the best available scientific, technical and socio-economic information on climate change from around the world" and to produce "a series of publications, which have become standard works of reference, widely used by policymakers, scientists, other experts and students."

**Membership of IPCC:**

The IPCC is made up of over 2,000 scientists representing more than 100 countries. It is divided into three working groups". As an example of membership, the Technical Summary produced by Working Group #1 of the Third Assessment Report (produced in 2001) included 20 lead authors, 35 contributing authors, and four review editors representing 21 different countries.

**Financial Sponsorship of IPCC:**

The IPCC is supported financially by the joint WMO/UNEP IPCC Trust Fund and is administered by mutual agreement between the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), both agencies of the United Nations.

**Contact information:**

The IPCC Secretariat: [IPCC-Sec@who.int](mailto:IPCC-Sec@who.int)  
URL: [www.ipcc.ch](http://www.ipcc.ch)

# Lesson 3: Discourse or Disinformation?

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LESSON PLAN



Video Clips

## Discourse or Disinformation?

### Lesson Objectives:

- Students will analyze the editing process that was used for constructing print and video documents that altered scientific information about global warming.
- Students will evaluate debates on the presentation of scientific information on global warming.
- Students will identify ways in which one can seek more complex truths concerning scientific debates in the media, including asking questions about scientific discourse and media construction.

### Vocabulary:

**discourse, disinformation, editing, bias, scientific uncertainty, credibility, CO<sub>2</sub> reservoir, human factors in climate change, climate memory**

### Media



**Video:** *The Great Global Warming Swindle* (2007), 2:22 min

### Materials Needed:

- 14-page *Teacher Guide: Discourse or Disinformation?*
- Two-page *Student Reading: Discourse or Disinformation?*
- Two-page *Student Handout: Cooney Edit of CCRI Report*
- Two, two-page *Student Readings on 1996 IPCC Report: A Major Deception on 'Global Warming' Climate Report 'Subject to Scientific Cleansing'*
- Video Clip (access online or via Lesson 3 digital media folder) *The Great Global Warming Swindle, 2:22 min*
- One-page transcript of the video clip *The Great Global Warming Swindle*

### Time

90 min plus background reading

**Lesson Procedures:**

1. Distribute the two-page background reading *Discourse or Disinformation*. Have students read for homework or in class.
2. **Activity 1:** (Approximately 30 min) Distribute *Student Worksheet: Cooney Edit of CCRI Report*. Give students time to complete the task in class or for homework. Decode the document and lead discussion using prompts in the *Teacher Guide*.
3. **Activity 2:** (Approximately 15 min) Show the 2.5 min video clip from *The Great Global Warming Swindle*. Decode the video and lead the discussion using prompts in the *Teacher Guide*.
4. **Activity 3:** (Approximately 35 min) Distribute two *Student Readings* (two articles on 1996 IPCC Report) and the *Student Worksheet*. Give students time to complete the task in class or for homework. Decode the documents and lead discussions using prompts in the *Teacher Guide*.
5. **Activity 4:** (Approximately 10 min) Using the *Summary Activity* section of the *Teacher Guide*, lead a discussion about ways in which one can seek more complex truths concerning scientific debates in the media. Utilize the transcript of the video clip for reference.



TEACHER GUIDE



Printed Documents

# Discourse or Disinformation?

## Activity 1: CCRI Report

1. Organize and make copies of the *Student Handout, Cooney Edit of CCRI Report*, for the class activity.
1. Introduce the lesson:

### Lesson Introduction

As you have read in the *Student Reading, Discourse or Disinformation?*, science is nearly always uncertain and relies on continued debate to come up with better answers. When science enters into the popular arena through the media, it is always edited and sometimes distorted. Some facts are highlighted and others excluded based on the perspective, the interests, and the bias of the source. We will explore three examples of this type of editing to help us to identify the ways in which we can become better informed and more critical readers and viewers of mediated science.

2. Distribute the *Student Worksheet, Cooney Edit of CCRI Report*.
3. Explain the background information regarding the CCRI report:

### CCRI Report Background Information

This document is an excerpt from a 2002 government report written for Congress by government climate scientists. As you will see, it was hand-edited by a senior staff member from the Bush administration. Read over the original text and the hand written edits to identify what, if any, substantial changes the Bush official made to the report. This exercise will help you to understand the role that politics has played in crafting the science about global warming. It also highlights the power of editors to influence content. Make sure to read over the introduction on your handout before reading the document.

4. Allow students to complete the assignment.
5. Lead students through a discussion of the answers to the handout questions. Have students identify patterns in Cooney's editing. Ask for evidence from the document to back up their conclusions. Probe for understanding about why Cooney might have made those edits. Use the *Sample Questions & Answers* in the *Teacher Guide* to facilitate the discussion.

## Sample Questions & Answers



Printed Document

1) Who produced this document?

**Possible Answer:** It was written by a team of government scientists and edited by White House official Philip Cooney.

2) Who was the target audience for the final report?

**Possible Answer:** Congress

3) What pattern do you see in Cooney's edits? What was he changing?

**Possible Answer:** The editing added more scientific uncertainty and doubt related to the research findings.

**Evidence:**

03: ...the Earth **is (may be)** undergoing...

05: ...changes are **(likely)** a result of...

15: ...**diagnose (begin to understand)** its causes

16: ...actions **will (might)** effect...

37: ...and **(substantially increases)** understanding of cause-effect relationships

**Possible Answer:**

Edits suggest that more scientific study is needed before taking action.

**Evidence:**

21: ...and the role for CCRI is to **(reduce the significant remaining uncertainties associated with human induced climate change and)** facilitate full use of **this** scientific information in policy and decision making on **(possible)** responses to strategies for adaptation and mitigation **at the international, national and regional scales.**

36: the USGRCP will **(need to)** continue to actively support fundamental discovery-driven research that tests basic assumptions and **(substantial increases)** the understanding of cause-effect relationships...

**Possible Answer:**

Edits diminish call for action and governmental responsibility.

## Sample Questions & Answers



Printed Documents

### Evidence:

21: ... and mitigation ~~at the international, national and regional scales.~~

31: In this new phase of the climate science programs, information that **(might allow) compares (comparisons of)** the potential consequences of different responses to global changes, including climate change, will be **(pursued.) developed in a form useful to national debate and decisionmaking.** ~~This information will facilitate the search for the most effective and efficient approaches to adapt to and mitigate the effects of both natural and human induced climate change.~~

### Possible Answer:

Edits diminish call for action and governmental responsibility.

### Evidence:

21: ... and mitigation ~~at the international, national and regional scales.~~

Shortly after Philip Cooney's role in rewriting this and other scientific reports was revealed, he left the government to work for Exxon Mobil Corp.

### Additional Information

### FURTHER QUESTIONS

- » What motivations might Philip Cooney have had in his editing?
- » Do you think that Cooney's edits contributed to discourse or disinformation? Explain your reasoning.



TEACHER GUIDE



Video Clip

# Discourse or Disinformation?

## Activity 2: *The Swindle*: Video Clip Decoding

1. Ensure that you have the media equipment set up to play the video clip.
7. Introduce the lesson:

### Lesson Introduction

The CCRI report was intended specifically for Congress, but much information about global warming targets public opinion through newspaper and magazine articles, websites, and documentary films. Like written reports, documentary films are edited. They include only some information, add music and images, and use experts to communicate particular ideas. You are about to view a 2.5 min clip from a documentary about climate change. As you watch and listen, think about whether this clip supports or undermines the idea that global warming is caused by human factors such as CO<sub>2</sub>.

8. Play the film clip.
9. Lead a discussion of the clip using the possible answers in the *Teacher Guide*.



*The Great Global Warming Swindle*  
Documentary, 2.5 min  
(2007)



**Film Introduction**

You are about to view a 2.5 min clip from a documentary about climate change. As you watch and listen, think about whether this clip supports or undermines the idea that global warming is caused by human factors such as CO<sub>2</sub>.

## Media Sample Questions & Answers

1) Does this segment support or undermine the idea that climate change is caused by human factors such as CO<sub>2</sub>? Give the evidence from the clip.

**Possible Answer:** The clip questions/undermines the idea that human factors, specifically CO<sub>2</sub>, are the cause of today's global warming.

**Evidence:** The graph at the end of the clip and the information about ocean memory are used to back up the point that current warming trends are due to factors that pre-date the industrial revolution.

2) Based on what you saw, do you think that Carl Wunsch, the renowned oceanographer featured in this clip, agrees with these ideas? Give the evidence from the clip.

**Possible Answer:** Yes

**Evidence:** Wunsch provides evidence that oceans delay the effects of climate change.

**Possible Answer:** No

**Evidence:** Wunsch speaks about the ocean as a vast reservoir of CO<sub>2</sub> and the fact that oceans have a memory of past climate. He doesn't speak directly against the idea that CO<sub>2</sub> may be the cause of climate change.

## Media Sample Questions & Answers

### Explain:

After the release of the film, Professor Wunsch posted the following disclaimer on his website:

“In the part of the "Swindle" film where I am describing the fact that the ocean tends to expel carbon dioxide where it is warm, and to absorb it where it is cold, my intent was to explain that warming the ocean could be dangerous---because it is such a gigantic reservoir of carbon. By its placement in the film, it appears that I am saying that since carbon dioxide exists in the ocean in such large quantities, human influence must not be very important --- diametrically opposite to the point I was making---which is that global warming is both real and threatening.”

3) According to Wunsch, how is the film misleading?

**Possible Answer:** Wunsch claims that his words were taken out of context to leave a false impression.

### Note:

The teacher may need to help students to understand how the filmmakers edited Wunsch’s words (took only a section of what he said) and used them out of context (placed them in the middle of an argument that he did not agree with to help prove their argument).

4) The clip you just saw is part of a 75 min documentary film, *The Great Global Warming Swindle*, that is available on YouTube. Based on the clip you just saw and the title, what do you suspect is the purpose of the film? Give your evidence.

**Possible Answer:** The purpose of the film seems to be to discredit the idea of global warming.

**Evidence:** The title calls global warming a “great Swindle” and the clip questions the generally accepted fact that human factors, particularly CO<sub>2</sub>, are the cause of climate change.

### FURTHER QUESTIONS

- » What does this exercise teach you about the construction of scientific truth in documentary films?
- » From what you have seen, do you think that the documentary *The Great Global Warming Swindle* promotes scientific discourse or disinformation?





TEACHER GUIDE



Printed Documents

# Discourse or Disinformation?

## Activity 3: Document Comparison

1. Organize and make copies of the two *Student Readings* regarding the IPCC Report, *A Major Deception on 'Global Warming'* and *Climate Report "Subject to Scientific Cleansing."* Also make copies of the Activity 3 *Student Worksheet, Document Comparisons*.
2. Introduce the lesson:

### Lesson Introduction

Although both previous activities show editing by groups critical of the idea that human factors are the cause of climate change, there are other examples where science has been edited to emphasize the human role and catastrophic risks of global warming. You will now read two different media responses to the 1996 IPCC Climate Change Report. Some scientists claimed that the final report was edited to accentuate fears about global warming.

3. Distribute the *Student Readings* (two articles) and the *Student Worksheet*.
4. Provide students time to read the articles and complete the worksheet.
5. Review the worksheet and lead a discussion using the *Questions and Possible Answers* in the *Teacher Guide*.

## Sample Questions & Answers



Printed Documents

1) What is the main focus of the piece in the *Wall Street Journal*?

**Possible Answer:** Frederick Seitz claims that the IPCC report was edited after the peer-review process was completed in order to remove “hints of skepticism” from participating scientists. He calls this “a disturbing corruption of the peer-review process.”

2) What is the main focus of the *Nature* article?

**Possible Answer:** Eshan Masood’s article focuses on criticisms of the IPCC report made by an industry lobby group, the GCC. The article presents the GCC criticisms, but also rebuttals by IPCC supporters as well as criticisms of the GCC.

3) Review the answers to question 3 from the student worksheet.

3) Circle the article or articles that supports each statement below.

the IPCC report is politically biased

*Wall Street Journal*

*Nature*

attacks on the IPCC are motivated by moneyed interests

*Wall Street Journal*

*Nature*

the IPCC report does not reflect scientific consensus

*Wall Street Journal*

*Nature*

criticism of the IPCC is well founded

*Wall Street Journal*

*Nature*

criticism of the IPCC is unfounded

*Wall Street Journal*

*Nature*

the GCC want to hide the truth about Global Warming

*Wall Street Journal*

*Nature*

4) How does the use of the quotation marks in the titles of both articles reflect the bias of the writers/articles?

**Possible Answer:** The *Wall Street Journal* title, “A Major Deception on ‘Global Warming,’” places the words, “global warming,” in quotes, insinuating that the idea of global warming is someone’s opinion or bias while the idea of “a major deception” has no quotes and appears as fact. Conversely, the *Nature* article puts the phrase, “subject to scientific cleansing,” in quotes, suggesting that it is someone’s opinion or bias that the science in the IPCC report was altered.



Printed Documents

## Sample Questions & Answers

5) One of these is a news article and the other is an opinion piece that appeared in the editorial section of the paper. Which one is the opinion piece? What is your evidence?

**Possible Answer:** The *Wall Street Journal* piece by Frederick Seitz is an opinion piece.

**Evidence:** Seitz makes no attempt to present opposing sides. He clearly, forcefully, and directly presents his opinion attacking the IPCC report.

6) Is one of these pieces more objective (less biased) than the other? Explain your reasoning.

**Possible Answer:** Students will likely identify the *Wall Street Journal* opinion piece as more biased as it is an opinion piece. But they should be challenged if they conclude that the *Nature* news article is objective since it presents both sides. The title and the opening and closing lines quickly demonstrate the bias of the writer and editor.

7) If two well-respected periodicals, the *Wall Street Journal* and *Nature*, present such different views on the same news, how are readers supposed to find the truth?

**Possible Answer:** Help students to recognize that no single source presents the entire truth on any topic. All media messages are constructed and have a point of view / a bias. It is important to access varied sources of information, particularly when studying controversial topics such as global warming.



TEACHER GUIDE

## Discourse or Disinformation? Activity 4: Summary Activity

1. Introduce the activity by briefly summarizing the previous activities that have been covered in this lesson.
2. Lead a discussion using the following questions and answers:

For each of the four documents we analyzed for this lesson, indicate its target audience, intent, and potential impact.

### CCRI Report:

- Audience: Congress
- Intent: To inform and influence legislation related to global warming
- Impact: Likely had an impact on national policy (the report and Cooney's edits)

### Swindle Video:

- Audience: People watching the film on the Internet. likely young people since it is on YouTube and people questioning the validity of global warming
- Intent: To persuade people that global warming is a hoax
- Impact: More people, particularly young people, would question global warming and possibly oppose government actions to limit green house gas emissions

### Wall Street Journal Opinion Piece:

- Audience: Readers of the *Wall Street Journal*, likely businesspeople and a more general audience than *Nature*
- Intent: To persuade readers that the IPCC report is flawed.
- Impact: May convince more businesspeople that the science on global warming has been manipulated and that climate change is not as bad as we are led to believe

Continued.....

**Nature Article:**

Audience:	Readers of <i>Nature</i> , likely scientists and science-oriented readers
Intent:	To inform and persuade readers about the criticism of the IPCC report
Impact:	Likely to sway its readers to think that business interests are out to distort the science behind global warming for their own vested interests

**What are the ways that we as students and citizens can seek more informed truths when evaluating scientific claims made in the media?**

**Note:** Teachers may want to have students do individual writing on this question and make a list on the board.

Help students to understand that there is no one simple truth, particularly concerning scientific controversies. Stress the importance of accessing different sources of information, particularly authorities that conflict with student's own biases. One cannot seek truth without becoming well informed, which necessitates making choices about what is important to study. And finally, students should continually ask key questions.

We identify scientific credibility through asking:

- To what degree has the science been peer-reviewed?
- How many scientists or studies have corroborated the information?
- Is the source credible and what is its bias?

We can ask a set of key questions about any media message including:

- Who produced and who sponsored this message?
- What is the purpose of this message and who is the target audience?
- What ideas, information, and perspectives are communicated?
- What has been left out that may be important to know?
- How credible, current, and accurate is the information?
- Who might benefit and who might be harmed by this message?

**Discourse or Disinformation?**

**Background Reading**

**Scientific Discourse**

Physicist David Bohm characterizes science as “the search for truth, whether we like it or not” (Englund, 2010). When researchers tackle a new question, disagreement and discourse are core to the scientific process. Scientific discourse involves sharing methodologies and data, reviewing each other’s findings, working to duplicate results, and offering counter hypotheses. Over time, ideas become generally accepted or discredited through a peer-reviewed process of experimentation. Eventually, some theories become so well supported and promoted that they move into the realm of scientifically accepted truth. However, even accepted theories need to be open to critical questioning. Complete consensus within the scientific community is extremely rare. This lack of agreement can make it difficult to gauge how to respond to conflicting scientific perspectives presented in the media.

**Assessing the Credibility of Science**

Despite lack of consensus, we can begin to assess the credibility of scientific claims through asking questions such as:

- **How many scientists have been involved?** A study by a few scientists has less credibility than one that has been widely peer-reviewed.
- **What are the biases of the scientists and sponsors?** Claims made by an independent organization with a commitment to objectivity have more credibility than findings sponsored by groups with clear economic or political interests.
- **Have multiple studies come to the same conclusions?** If so, credibility is enhanced.
- **Have multiple methodologies been used and do they lead to the same conclusions?** This again strengthens the credibility of the findings. These indicators do not prove scientific truth, but they add credibility to scientific claims.

**Editing and Bias**

Any time we communicate information, we make choices about what to highlight, what to leave out, what facts to use, and how to phrase things. These choices are an inevitable reflection of our biases as communicators. These choices become particularly powerful when communicating about controversial topics like global warming.

Many scientific observations ~~point to the conclusion~~ **indicate** that the Earth **is** ~~may be~~ undergoing a period of rapid change ... Much of the scientific evidence indicates that these changes ~~are~~ **are likely** the result of a complex interplay of several natural and human-related forces.

**How do the edits alter the meaning of the text?**

**The Politics of Global Warming**

Politicians have long recognized that global warming, if it is a reality, will have profound impact on the environment, economics, and politics. As the discourse evolved, some scientists called for more study before taking action. They pointed out that climate fluctuations are the norm and they argued that the current warming trend is not caused by human factors.

Some politicians used this argument in opposing regulations on greenhouse gas emissions. But a growing majority of scientists now see clear evidence that global warming is caused by man-made pollutants, particularly CO<sub>2</sub>, and that it will likely cause catastrophic effects on civilization. This perspective has been promoted by many environmental groups and politicians who are calling for drastic reductions in fossil fuel emissions.

### Political Pressure

Over the course of the debate, leading scientists have found themselves caught between, and sometimes working with, these competing interests and perspectives. Many scientists work for, or receive funding from, the government. Some organizations and studies on climate change have been funded by the energy industry and others by environmental groups, both with vested interests in the issue.

### Media Bias

Most Americans receive their information about global warming not from peer-reviewed scientific journals or directly from the government, but from the mainstream media (Neefus, 2010). Media have their own interests that shape the appearance of scientific discourse. Popular media outlets such as television news, magazines, and newspapers often emphasize conflicting scientific perspectives and dramatic findings since conflict and drama draw in readers and viewers, increasing advertising revenue. In an attempt to maintain interest, media often distill complex scientific information into short sound bites that entertain but often oversimplify and even distort complex scientific theories. Some media sources will craft their stories to suit the interests and bias of their particular target audience (Merchant, 2010).

James Hansen, the leading NASA scientist on climate change, was restricted from talking freely and had his words edited by the Bush administration after he made public statements highlighting the threat of global warming. (Revkin, 2006). Earlier in his career, Hansen had received pressure from the Clinton administration to spin science in the opposite direction of his findings (Goodman, 2008). Scientific discourse on global warming has clearly become intertwined with politics.



**How does each of these films present global warming?**

**Does each promote discourse or disinformation?**

**How does each title reflect the bias of the source?**

*A Major Deception on 'Global Warming'*  
Wall Street Journal, New York, June 12, 1996

*Climate Report 'Subject to Scientific Cleansing'*  
Nature, New York, June 13, 1996

### What to Believe?

This lesson will look at a number of instances where media, political, and economic interests have been involved in shaping and distorting the science behind global warming. This lesson will give students practice in analyzing the credibility and construction of science in the media. It aims to help students answer the question, "How do I seek the truth about a highly political and controversial scientific issue such as global warming when even the experts do not agree?"



**A Major Deception on 'Global Warming'**

By Frederick Sietz

*Wall Street Journal*, New York, June 12, 1996

**Document 1**

Last week the Intergovernmental Panel on Climate Change, a United Nations organization regarded by many as the best source of scientific information about the human impact on the earth's climate, released "The Science of Climate Change 1995," its first new report in five years. The report will surely be hailed as the latest and most authoritative statement on global warming. Policy makers and the press around the world will likely view the report as the basis for critical decisions on energy policy that would have an enormous impact on U.S. oil and gas prices and on the international economy.

This IPCC report, like all others, is held in such high regard largely because it has been peer-reviewed. That is, it has been read, discussed, modified and approved by an international body of experts. These scientists have laid their reputations on the line. But this report is not what it appears to be--it is not the version that was approved by the contributing scientists listed on the title page. In my more than 60 years as a member of the American scientific community, including service as president of both the National Academy of Sciences and the American Physical Society, I have never witnessed a more disturbing corruption of the peer-review process than the events that led to this IPCC report.

A comparison between the report approved by the contributing scientists and the published version reveals that key changes were made after the scientists had met and accepted what they thought was the final peer-reviewed version. The scientists were assuming that the IPCC would obey the IPCC Rules--a body of regulations that is supposed to govern the panel's actions. Nothing in the IPCC Rules permits anyone to change a scientific report after it has been accepted by the panel of scientific contributors and the full IPCC.

The participating scientists accepted "The Science of Climate Change" in Madrid last November; the full IPCC accepted it the following month in Rome. But more than 15 sections in Chapter 8 of the report--the key chapter setting out the scientific evidence for and against a human influence over climate--were changed or deleted after the scientists charged with examining this question had accepted the supposedly final text.

Few of these changes were merely cosmetic; nearly all worked to remove hints of the skepticism with which many scientists regard claims that human activities are having a major impact on climate in general and on global warming in particular.

The following passages are examples of those included in the approved report but deleted from the supposedly peer-reviewed published version:

"None of the studies cited above has shown clear evidence that we can attribute the observed [climate] changes to the specific cause of increases in greenhouse gases."

"No study to date has positively attributed all or part [of the climate change observed to date] to anthropogenic [man-made] causes."

"Any claims of positive detection of significant climate change are likely to remain controversial until uncertainties in the total natural variability of the climate system are reduced."

The reviewing scientists used this original language to keep themselves and the IPCC honest. I am in no position to know who made the major changes in Chapter 8; but the report's lead author, Benjamin D. Santer, must presumably take the major responsibility.

IPCC reports are often called the "consensus" view. If they lead to carbon taxes and restraints on economic growth, they will have a major and almost certainly destructive impact on the economies of the world. Whatever the intent was of those who made these significant changes, their effect is to deceive policy makers and the public into believing that the scientific evidence shows human activities are causing global warming.

If the IPCC is incapable of following its most basic procedures, it would be best to abandon the entire IPCC process, or at least that part that is concerned with the scientific evidence on climate change, and look for more reliable sources of advice to governments on this important question.

*Mr. Seitz is president emeritus of Rockefeller University and chairman of the George C. Marshall Institute.*

**Climate Report 'Subject to Scientific Cleansing'**

By Eshan Masood

*Nature*, New York, June 13, 1996

**Document 2**

A U.S. lobby group partly financed by oil, power and automobile companies is trying to undermine the credibility of the latest report of the U.N. Intergovernmental Panel on Climate Change (IPCC) by accusing it of "scientific cleansing".

The accusation has been made by the Global Climate Coalition (GCC), an umbrella group of 60 industrial concerns, in a document that is currently being widely circulated in the Congress and elsewhere in Washington DC.

Its target is the latest five-yearly report of the IPCC, agreed in principle last November and published in London last week, which concludes in particular that the balance of scientific evidence "suggests a discernible human influence on global climate".

Such a conclusion is likely to boost demands for greater curbs on the use of fossil fuels. The coalition is now trying to throw doubt on its validity on procedural grounds, in particular by criticizing the decision of one of the report's authors to re-edit a chapter before final publication, after it had been peer-reviewed and approved.

But Ben Santer, the author concerned, an atmospheric scientist at the Lawrence Livermore National Laboratory in California, says the changes were endorsed by the IPCC and were necessary "to improve the report's scientific clarity". He describes the GCC's allegations as "dangerous and absurd".

The GCC last week issued a nine-page, line-by-line analysis of the changes made to Chapter 8 of the report, dealing with the question of

potential human influence on climate change. John Shlaes, executive director of the GCC, argues that, under IPCC rules, any extra editing should have been peer-reviewed.

Shlaes concludes that the new version is unbalanced, contains "substantial deletions and significant changes" to the scientific material, and over-emphasizes the role of human activities in climate change.

He has written to Bert Bolin, emeritus professor of meteorology at the University of Stockholm and chairman of the IPCC, asking him to justify the decision to authorize additional editing. Copies of the letter have been sent to senior policy-makers in both houses of Congress.

The GCC analysis claims, for example, that the concluding summary has been deleted from the final report, and that a paragraph towards the end of the chapter plays down the uncertainty of establishing and forecasting human-induced climate change.

"These revisions raise very serious questions about whether the IPCC has compromised, or even lost, its scientific credibility," says Shlaes. "The changes are not just about grammar and punctuation. They go deeper and we want to know why they were made."

But Santer defends the changes, which, he says, "can all be scientifically justified" and which were made in response to "the deluge of comments" he had received both from governments and from other scientists after the final draft had been circulated.

The concluding summary was removed for reasons of consistency, says Santer, as all other chapters in the report contain just one executive summary. References to uncertainties in climate modeling were not removed, he adds. "The executive summary and four and a half pages of Chapter eight are specifically devoted to the discussion of uncertainties in estimates of natural climate variability and the expected 'signal' due to human activities."

Santer describes as a "supreme irony" of the criticism the fact that he "fought very hard during drafting sessions to include sections on signal and noise uncertainties". He points out that many of his co-authors advocated removing these sections, on the grounds that the issues were partially covered in other chapters.

Sir John Houghton, co-chair of the IPCC's science working group, says the GCC's allegations are "scurrilous" and "have absolutely no basis in fact". The IPCC's rules of procedure, he contends, allow authors to make late modifications to the text.

The rules, he adds, state that documents are not "to be approved in detail" by working groups. This is designed to allow the modification of text that does not meet the criteria that an IPCC report must be "comprehensive, objective and balanced". Leaving the chapter unmodified would have breached IPCC procedures, says Houghton.

Santer adds: "I am really troubled by what is going on. This appears to be a skilful campaign to discredit the IPCC, me and my reputation as a scientist."

Houghton points out that many of the revisions were prompted by what he describes as "political interference" from the GCC. "They were openly lobbying Kuwait and Saudi Arabia in Madrid to try and weaken the science [in the report]. This was resisted by the IPCC, and we have now ended up with a document that is scientifically much better."

Santer says he is angry that the GCC "is making a big stink of the whole affair", especially because the report's key phrase -- "taken together, these results point towards a human influence on global climate" -- was approved by all 100 participating governments and is contained in both the draft and the published IPCC report.

**Video Transcript 1:**  
**Clip from *Global Warming Swindle***

**Transcript**

Carl Wunsch is professor of oceanography at MIT. He was also visiting professor in oceanography at Harvard University and University College London, and a senior visiting fellow in mathematics and physics at the University of Cambridge. He is the author of four major textbooks on oceanography.

“The ocean is the major reservoir into which carbon dioxide goes when it comes out of the atmosphere, or to, from which it is re-emitted to the atmosphere. If you heat the surface of the ocean, it tends to emit carbon dioxide. So similarly, if you cool the ocean surface, the ocean can dissolve more carbon dioxide.”

So the warmer the oceans, the more carbon dioxide they produce, and the cooler they are, the more they suck in. But why is there a time lag of hundreds of years between a change in temperature and a change in the amount of carbon dioxide going into, or out of, the sea?

The reason is that oceans are so big, and so deep, they take literally hundreds of years to warm up and cool down. This time lag means the oceans have what scientists call a memory of temperature changes.

“The ocean has a memory of past events, running out as far as ten thousand years. So, for example, if somebody says, ‘Oh, I’m seeing changes in the North Atlantic, this must mean that the climate system is changing,’ it may only mean that something happened in a remote part of the ocean decades or hundreds of years ago whose effects are now beginning to show up in the North Atlantic.”

The current warming began long before people had cars or electric lights. In the past 150 years, the temperature has risen just over half of a degree Celsius. But most of that rise occurred before 1940.

Since that time, the temperature has fallen for four decades, and risen for three. There is no evidence at all in Earth’s long climate history that carbon dioxide has ever determined global temperatures.





## Lesson 3, Activity 1 Cooney Edit of CCRI Report Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

Read the attached excerpt from the CCRI report with Cooney's edits. Note below one or more patterns that you see in Cooney's edits and the impact the edits had on the content of the report. Identify specific evidence from the edited document (use line numbers) to back up your conclusions.

### Cooney Edit of CCRI Report

You are about to analyze an excerpt from an edited document titled *Our Changing Planet: The FY (Fiscal Year) 2003 U.S. Global Change Research Program and Climate Change Research Initiative*. The CCRI report was submitted to Congress in 2003 as an authoritative study of the science behind climate change and possible responses. The typed draft you will see was written by dozens of government scientists. The hand-written edits were made by Philip Cooney, the chief of staff for the White House Council on Environmental Quality. Cooney's job was to devise and promote policies on environmental issues for the Bush administration. Cooney is a lawyer with a bachelor's degree in economics; he has no scientific training. Before working for the White House in 2001, Cooney was a lobbyist for the oil industry.

#### Changes in Cooney's edits

#### Evidence from the text

# OVERVIEW OF U.S. RESEARCH ON CLIMATE AND GLOBAL CHANGE

A Report by the Climate Change Science Program and  
The Subcommittee on Global Climate Change Research

Excerpt from page 2 of the report, hand edited by Philip Cooney

FINAL REVIEW DRAFT      October 15, 2002

01 natural variations in ocean temperatures and currents, all cause variability and changes in climate  
02 conditions.

03 Many scientific observations <sup>indicate</sup> point to the conclusion that the Earth is <sup>maybe</sup> undergoing a period of  
04 relatively rapid change on timescales of decades to centuries, when compared to historical rates of are likely  
05 change on similar timescales. Much scientific evidence indicates that these changes ~~are~~ the result of  
06 a complex interplay of several natural and human-related forces.

07 Although humans are relative newcomers in the vast scale of the Earth's geological history, we  
08 have become agents of environmental change, at least on timescales of decades to centuries.

09 Atmospheric emissions of greenhouse gases and pollutants, and extensive changes in the land  
010 surface, have potential consequences for global and regional climate, weather, and air quality, the  
011 Earth's protective shield of stratospheric ozone, the distribution and abundance of many plant and  
012 animal species, and the health of ecosystems and their ability to provide life-supporting goods and  
013 services.

014 The complexity of the Earth system and the interconnections among its components make it a might  
015 complex scientific challenge to document change, <sup>begin to understand</sup> diagnose its causes, and develop useful  
016 projections of how natural variability and human actions will affect the global environment in the  
017 future. Because of these complexities and the potentially profound consequences of climate change  
018 and variability, climate has become a capstone scientific and societal issue for this generation and  
019 the next, and perhaps even beyond.

020 The challenge for the USGCRP is to provide the best possible scientific basis for documenting, <sup>understanding</sup>  
021 <sup>diagnosing</sup> and projecting changes in the Earth's life-support systems, and the role for CCRI is to  
022 facilitate full use of ~~the~~ scientific information in policy and decisionmaking on response strategies  
023 for adaptation and mitigation at the international, national, and regional scales. <sup>possible</sup>

might allow

## From "Discovery" to "Comparative Analysis" <sup>goals of Pursued</sup>

<sup>reduce the significant remaining uncertainty associated with human-induced climate change and</sup>

028 Because of the scientific accomplishments of USGCRP and other research programs during the  
029 last decade, a period that could be termed a productive "period of discovery and characterization,"  
030 the CCRI, in coordination with the USGCRP, will move into a new "period of comparative  
031 analysis of response strategies." In this new phase of the climate science programs, information  
032 that compares the potential consequences of different responses to global changes, including  
033 climate change, will be developed in a form useful to national debate and decisionmaking. This  
034 information will facilitate the search for the most effective and efficient approaches to adapt to and  
035 ~~mitigate the effects of both natural and human-induced climate change.~~ However, <sup>even</sup> as the programs  
036 move to develop focused, comparative studies, the USGCRP will continue to actively support some need to  
037 fundamental, discovery-driven research that tests basic assumptions and <sup>understanding of cause-</sup>  
038 effect relationships, and that contributes to reducing key scientific uncertainties. <sup>substantially increases the</sup>

039 Future plans for the combined USGCRP and CCRI will focus on three broad tiers of activities:  
040 (1) scientific inquiry, which has been the core activity over the years, with several key issues  
041 continuing to await resolution; (2) observations and monitoring systems; and (3) development of  
042 decision-support resources, including <sup>data</sup> analyses of projected environmental, economic, and  
043 energy system outcomes of various proposed scenarios. The CCRI will supplement the ongoing  
044 USGCRP by focusing elements of each of these three tiers, where significant 2-to-5 year  
045 improvements in decision-relevant information is possible. <sup>Pursuing the third tier in a meaningful way will require significant, sustained progress under the first and second tiers.</sup>

046  
047 Scientific inquiry





## Lesson 3, Activity 3 Document Comparisons Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

You are about to analyze and compare two articles about the same topic, written at roughly the same time. As you read each article, identify the key messages each is constructing about the controversy surrounding the 1996 IPCC Report.

1) Read the *Wall Street Journal* article "A Major Deception on 'Global Warming,'" and summarize the main idea of the article.

2) Read the *Nature* article, "Climate Report 'Subject to Scientific Cleansing,'" and summarize the main idea of the article.

3) Circle the article or articles that supports each statement below.

The IPCC report is politically biased.	Wall Street Journal	Nature
Attacks on the IPCC are motivated by business interests.	Wall Street Journal	Nature
The IPCC report does not reflect scientific consensus.	Wall Street Journal	Nature
Criticism of the IPCC is unfounded.	Wall Street Journal	Nature
Criticism of the IPCC is well-founded.	Wall Street Journal	Nature
The GCC want to hide the truth about global warming.	Wall Street Journal	Nature



## Lesson 3, Activity 3 Document Comparisons Student Worksheet

4) Which article is more credible (believable)? Explain your reasoning.

# Lesson 4: What is Causing Global Warming?

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(access online or via Lesson 4 digital media folder)	
Video Clips:.....	
(access online or via Lesson 4 digital media folder)	
<i>They Call it Pollution</i>	
<i>The Great Global Warming Swindle</i>	
<i>An Inconvenient Truth</i>	



LESSON PLAN



Video Clips

# What is Causing Global Warming?

## Lesson Objectives:

- Students will identify the factors that have influenced global climate in the past.
- Students will review the greenhouse effect and its influence on climate, identify major greenhouse gases and their atmospheric percentages, and understand why carbon dioxide is considered the greenhouse gas most responsible for contemporary global warming.
- Students will identify natural and industrial sources of atmospheric carbon dioxide and understand the ways in which it cycles through systems.
- Students will define and identify different types of fossil fuels, industrial sources of carbon dioxide, and changes in carbon dioxide concentrations since the industrial era.
- Students will understand the correlation between atmospheric carbon dioxide concentrations and average global temperature.
- Students will analyze and evaluate conflicting information about CO<sub>2</sub> and global warming.
- Students will learn strategies for evaluating scientific claims made in the media.

## Vocabulary:

**atmosphere, sun cycles, volcanism, greenhouse effect, greenhouse gases, carbon dioxide (CO<sub>2</sub>), methane, CFCs, nitrous oxides and sulfur oxides, carbon cycle, carbon sink, carbon sequestration, fossil fuels, industrialization, forcing agent**

## Media



CO<sub>2</sub>: *They Call it Pollution, We Call it Life* (2006), TV commercial, 1:05 min



PowerPoint: *The Greenhouse Effect*, 43 slides



*The Great Global Warming Swindle* (2007), documentary film, :38 sec



*An Inconvenient Truth* (2006), documentary film, 5:02 min

**Materials Needed:**

- Nine-page *Teacher Guide: What is Causing Global Warming?*
- Four-page *Student Worksheet: Global Warming Swindle* and *An Inconvenient Truth*
- One-page *Student Worksheet: Lesson Review*
- PowerPoint slide show: *The Temperature History of the Earth*, 43 slides (access online or via Lesson 4 digital media folder)
- Video clips (access online or via Lesson 4 digital media folder)
  - CO<sub>2</sub>: They Call it Pollution, We Call It Life*, 1:05 min
  - The Great Global Warming Swindle*, :38 sec
  - An Inconvenient Truth*, 5:02 min

**Time**

90 min

**Lesson Procedures:**

1. Introduce the activities by using prompts from the *Teacher Guide*.
2. **Activity 1:** Show the 1 min video commercial, *CO<sub>2</sub>: They Call it Pollution, We Call it Life*. Lead the decoding of the video using the prompts in the *Teacher Guide*.
3. **Activity 2:** Present the PowerPoint slide show, *What is Causing Global Warming?* Use the *Teacher Guide* to facilitate discussion.
4. **Activity 3:** Distribute the *Student Worksheets* and show the 30 sec video excerpt from *The Great Global Warming Swindle*.
5. Lead the decoding of the video using the prompts in the *Teacher Guide*.
6. Show the 5 min video excerpt from *An Inconvenient Truth*.
7. Lead the decoding of the video using the prompts in the *Teacher Guide*.
8. Students complete the *Student Worksheet: Lesson Review*. Review the worksheet using the suggested answers in the *Teacher Guide*.

TEACHER GUIDE

# What is Causing Global Warming?

## Activity 1: Video Clip Decoding

### *CO<sub>2</sub>: They Call it Pollution, We Call It Life*

1. Ensure that you have media equipment set up to play the video clips.
2. Introduce the lesson:

#### Lesson Introduction

In this lesson we will be exploring the question, “What causes global warming?” We will be learning the current science that focuses on human causes, in particular CO<sub>2</sub> emissions, but we will also look at the arguments of those who dispute this. At three points in the lesson we will analyze short video clips that weigh in on this controversy.

3. Read aloud the brief introductory excerpt before playing the film clip.
4. Play the film clip.
5. Lead a discussion of the clip using the possible answers in the *Teacher Guide*.



***CO<sub>2</sub>: They Call it Pollution, We Call It Life***  
**The Competitive Enterprise Institute**  
**1:05 min commercial**  
**(2006)**



### Film Introduction

The video clip you are about to watch is an advertisement created in 2006 by the Competitive Enterprise Institute. It aired in 14 U.S. cities from May 18 to May 28, 2006.

## Media Sample Questions & Answers

**1) What are the messages about CO<sub>2</sub> communicated in this commercial?**

**Possible Answer:** CO<sub>2</sub> is an essential and positive aspect of life. Fossil fuels have brought us freedom and prosperity. "Some politicians want to label CO<sub>2</sub> as a pollutant."

**2) What techniques does the commercial use to communicate those messages?**

**Possible Answer:** The images related to CO<sub>2</sub> are all positive and life-affirming, the music is airy and upbeat (flutes, chimes), and the woman's voice is calming and soothing. The narration emphasizes the positive aspects and natural roles of carbon dioxide. The music ends and the narrator's voice becomes sharper when she mentions the "politicians who want to label CO<sub>2</sub> a pollutant."

**3) Does the commercial ever mention global warming? Does it take a position on global warming?**

**Possible Answer:** Although the commercial never mentions global warming, it implies that carbon dioxide should not be labeled a pollutant, taking a position against government regulations of CO<sub>2</sub> as a dangerous greenhouse gas.

**4) Who produced this message and for what purpose?**

**Possible Answer:** An organization called the Competitive Enterprise Institute produced this message. It seems that they wanted to get public support to oppose regulations on CO<sub>2</sub> emissions.

**5) What information about CO<sub>2</sub> is left out of this commercial that is important to know?**

**Possible Answer:** Most leading climate scientists, such as those authoring the IPCC reports, agree that atmospheric CO<sub>2</sub> caused by the burning of fossil fuels is likely to be the primary cause of global warming.

In April 2007, the Supreme Court ordered the Environmental Protection Agency to consider labeling CO<sub>2</sub> as a pollutant.



TEACHER GUIDE



PowerPoint Slide Show

# What is Causing Global Warming?

## Activity 2: Slide show: The Greenhouse Effect

1. Review the Lesson 4 PowerPoint before showing in class. You may want to edit these slides depending upon the level of the class.
2. Prepare to view the PowerPoint in class.
3. Introduce the lesson:

### Slide Show Introduction

The commercial that was previously viewed was produced to sway public debate on the controversial issue of climate change. Before we look at two more video clips that take contradictory positions, we will go over some key science concerning CO<sub>2</sub> and global warming.

4. Lead the students through the PowerPoint slide show, using the text on the slides as a guide.

## Overview of Slide Show

<b>Slides 1-13:</b>	The greenhouse effect, including the electromagnetic spectrum, atmospheric reflection, and absorption.
<b>Slides 14-17:</b>	The role of water vapor in the greenhouse effect.
<b>Slides 18-25:</b>	The main greenhouse gases (CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, CFCs) and their characteristics, sources, and relative effects.
<b>Slides 26-43:</b>	CO <sub>2</sub> , including the carbon cycle, carbon sinks, industrialization, fossil fuels, and energy consumption.
<b>Slides 44-46:</b>	Anthropogenic CO <sub>2</sub> and its effect on the carbon cycle.



TEACHER GUIDE

# What is Causing Global Warming?

## Activity 3: Video Clip Decoding & Lesson Review

1. Organize and make copies of the *Student Worksheets: The Global Warming Swindle, An Inconvenient Truth*, and the *Lesson Review*
2. Introduce the lesson:

### Activity Introduction

Although most scientists think that the recent spike in global temperature is caused by anthropogenic CO<sub>2</sub> concentrations in the atmosphere, there are dissenting opinions. We will now analyze clips from two documentary films that argue different sides of the debate.

3. Distribute *Student Worksheets*. Have students look over the questions on the handouts before showing the video clips. Have students work individually or in pairs to log each film.
4. Read aloud the brief introductory excerpt before playing each film clip.
5. Play the film clip.
6. Have students write their answers on their worksheet after the showing of each clip.
7. Lead a discussion of the clips using the possible answers in the *Teacher Guide*.
8. Have students complete the *Lesson Review* worksheet, either in class or as homework. Lead the lesson review discussion by using suggested questions and answers as a guide.



***The Great Global Warming Swindle***  
**Martin Durkin (2007)**  
**:38 sec excerpt**



**Film Introduction**

First you will view a clip from a British documentary titled *The Great Global Warming Swindle*. Although you will not see it in its entirety, the documentary features many of the major players (scientists, economists, writers, etc.) that represent and work for organizations from the U.K., the U.S., and Canada who have been publically questioning and debating the role of anthropogenic CO<sub>2</sub> in the current global warming trend.

## Media Sample Questions & Answers

**1) What are the core messages being communicated in this clip about global warming and the role of anthropogenic CO<sub>2</sub>? What techniques do the filmmakers use to communicate those messages?**

**2) Compare the information in the film about volcanic CO<sub>2</sub> with information in this diagram from the 2007 *First State of the Carbon Cycle Report (SOCCR)* prepared by the U.S. Climate Change Science Program (King et al.).**

**3) Which source should you believe?**

**4.a) Compare the figures for the sources of carbon entering the atmosphere (anthropogenic and natural) given in the film and the SOCCR diagram.**

**Possible Answer:** The animations and narration indicate that natural sources (volcanoes, oceans, plants, and animals) are by far the greatest contributor to CO<sub>2</sub> in the atmosphere. The animation and light-hearted music supports the message that CO<sub>2</sub> is an everyday and natural reality. The title *The Great Global Warming Swindle* communicates that the public is being duped into believing that global warming is real.

**Possible Answer:** The film claims that volcanoes produce more CO<sub>2</sub> each year than all of the anthropogenic sources combined. According to the SOCCR diagram, volcanoes produce less than 0.1 gigatons (Gt) of carbon each year, while all anthropogenic sources combined account for 6.4 Gt. One of these sources is wrong.

**Possible Answer:** Help students to understand that all sources need to be critically evaluated, but some sources are more credible and some are more biased than others. The *Swindle* film was produced in order to convince viewers that global warming is a hoax. The sponsors and producers have a clear bias that has influenced the information they presented. The SOCCR chart was produced by a government committee of scientists. Although the scientists have their own biases, the intent behind the report was to present objective scientific information. The SOCCR chart estimate of 6.4 Gt of anthropogenic carbon flow is based on 1990s data. The Carbon Dioxide Information and Analysis Center estimates that current annual flow of anthropogenic CO<sub>2</sub> globally is 8.0 Gt.

**4.a) Possible Answer:** The figures in the film and on the diagram are very similar. The film says 6.4 Gt of carbon is released by human activities, and the diagram shows 6.5 Gt. The total natural release of carbon into the atmosphere shown in the SOCCR diagram come to 146 Gt, close to the 150 Gt stated in the video clip.

## Media Sample Questions & Answers

4.b) What important information has been left out of the film, but appears in the diagram, that makes the above statement misleading?

**Possible Answer:** The film made no mention of how nature also removes carbon from the atmosphere. According to the SOCCR diagram, while 146 Gt of carbon are released each year by natural processes, these same processes absorb 149.2 Gt per year. Some absorption and some release within terrestrial systems are anthropogenic.

5.a) Since dying vegetation releases carbon only as it is decomposed, where does this release of carbon appear in the SOCCR diagram?

**Possible Answer:** The release of carbon from dying vegetation is included in the arrows shown flowing from both the land and oceans up into the atmosphere.

5.b) Since bacteria and fungi are responsible for the decomposition of dying vegetation on both land and in oceans, how is the above statement misleading?

**Possible Answer:** This is not an additional source of carbon from the natural environment since it has already been included in the previous statement concerning the carbon released by animals and bacteria. This redundant representation makes it seem like even more carbon is being released through natural processes than is the case.

6) Using the SOCCR diagram, explain how this statement is accurate but misleading.

**Possible Answer:** The diagram agrees with the film that carbon released from the oceans is the largest source of CO<sub>2</sub>. However, the carbon in the oceans comes from the animals, bacteria, and dying vegetation (e.g. algae) accounted for in the previous statements. This redundancy misrepresents the amounts of carbon being released into the atmosphere through natural causes. Also, the film again fails to mention that the oceans absorb about the same amount of CO<sub>2</sub> as they release.

7) Speculate on why the film *The Great Global Warming Swindle* might distort information about the role of anthropogenic CO<sub>2</sub>.

**Possible Answer:** The title of the film indicates that the filmmakers want to prove that global warming is a deliberate hoax. In this segment, they have exaggerated the natural releases of CO<sub>2</sub>, suggesting that the seemingly trivial amount of CO<sub>2</sub> released by humans could not possibly be responsible for global warming. This provides evidence supporting their thesis that global warming is a "great swindle."

8) Given that both the film and the diagram agree that anthropogenic CO<sub>2</sub> accounts for a small percentage of the carbon dioxide flowing into the atmosphere, how is it possible that humans are responsible for the current spike in global temperatures?

**Possible Answer:** Although the numbers are relatively small compared to natural CO<sub>2</sub> releases, it is the anthropogenic variable that is critical in changing climate. Natural CO<sub>2</sub> releases have been generally balanced by the absorption of CO<sub>2</sub> by the oceans, plants, and so forth. The complex balance that has kept CO<sub>2</sub> within a constant range has been thrown out of whack by more than a century of elevated human releases of CO<sub>2</sub>, which have gradually concentrated in the atmosphere to the point where they are now changing climate. Although only 6.4 Gt of carbon are released by human factors each year, it is estimated that our atmosphere now contains an extra 340 Gt of carbon above natural levels from more than a century of fossil fuel emissions.



**An Inconvenient Truth**  
**Al Gore (2006)**  
**5:02 min excerpt**



**Film Introduction**

Al Gore's Academy Award-winning documentary, *An Inconvenient Truth*, has been credited with raising awareness about global warming. Politicians, industrialists, activists, and thousands of citizens have credited the movie with changing their opinion on climate change. But the film and filmmaker have plenty of critics, and some of the information in Gore's film has been challenged. We will now watch one of the more controversial segments from *An Inconvenient Truth* and ask some of the same questions we did for *The Great Global Warming Swindle*.

## Media Sample Questions & Answers

1) What are the core messages being communicated in this clip about global warming and the role of anthropogenic CO<sub>2</sub>?

**Possible Answer:** There is a strong and consistent correlation between atmospheric CO<sub>2</sub> concentrations and global temperature back as far as the ice records extend: 650,000 years ago. Until recently, while temperatures and CO<sub>2</sub> levels have varied through this period of time, the concentration of CO<sub>2</sub> has never exceeded 300 parts per million (ppm). Very recently CO<sub>2</sub> concentrations have gone far above this 300 ppm level. In 50 years (or less) CO<sub>2</sub> levels will be much higher. This is due to anthropogenic releases of CO<sub>2</sub>. The predicted impact of this concentration of CO<sub>2</sub> on global temperature is dire.

2) What techniques does the film use to communicate those messages? Give examples from the film.

**Possible Answer:** The film shows a famous politician (Vice President Al Gore) speaking to everyday people. Gore emphasizes the credibility of scientific sources and belittles his critics.

**Evidence:** "There is not a single fact or date or number... that is in any controversy." "This is the first time anyone outside of a small group of scientists have seen this image." Gore dismisses the "so-called skeptics" with his tone and his seemingly irrefutable facts. Gore repeatedly links CO<sub>2</sub> with temperature through ice core charts. Gore simplifies and personalizes the complex scientific information: "like a forester counts tree rings," "if my classmate," "some of the children here."

**Possible Answer:** Gore dramatizes the impact of climate change.

**Evidence:** "This is the difference between a nice day and having a mile of ice over your head," and uses the mechanical lift to show how high CO<sub>2</sub> levels are projected to go.

3) Given this information, what aspect of Gore's position in the film seems misleading?

**Possible Answer:** Gore implies that rising CO<sub>2</sub> is causing global warming by showing ice core charts that link rising and falling temperature to CO<sub>2</sub> levels over hundreds of thousands of years. In fact, a rise in CO<sub>2</sub> has historically followed a rise in temperature by hundreds of years. The data seems to indicate that temperature leads CO<sub>2</sub>, not the other way around as Gore implies.

## Media Sample Questions & Answers

1) Does this mean that the rise in CO<sub>2</sub> levels caused by humans over the last 100 years is not the cause of today's global warming?

**Explain:** Although it is true that temperature rise has historically preceded a rise in CO<sub>2</sub> levels by approximately 800 years, most scientists believe that current global warming is caused by the unprecedented levels of atmospheric CO<sub>2</sub>. They agree that the relationship between CO<sub>2</sub> and temperature is, as Gore states, "very complicated," and that today's warming is likely the result of the high levels of CO<sub>2</sub> in the atmosphere. Few scientists dispute that these levels are the result of anthropogenic greenhouse gas emissions associated with the burning of fossil fuels.

## Lesson Review Questions & Answers

1) Summarize how the clips we saw from *The Great Global Warming Swindle* and *An Inconvenient Truth* misrepresented accurate scientific facts to promote their main ideas.

**Possible Answer:** *Swindle* misrepresented and omitted key information in order to bolster their idea that global warming could not be caused by humans.

In *An Inconvenient Truth*, Al Gore misrepresented the historic relationship between CO<sub>2</sub> and temperature in order to strengthen his claim that anthropogenic CO<sub>2</sub> is causing global warming.

2) What are the key lessons about media literacy that you learned from analyzing the two film clips?

**Possible Answer:** Media messages can misrepresent accurate scientific facts in order to support erroneous claims.

It is important to identify and analyze the source, credibility, and accuracy of scientific claims made in the media.

Media messages are constructed to communicate particular ideas and come from a particular point of view / bias.

3) Is anthropogenic CO<sub>2</sub> causing global warming?

**Possible Answer:** There are lots of possible answers here. Make sure that students back up their responses with clear reasoning.

Although natural emissions of CO<sub>2</sub> dwarf the amount released by humans, most scientists believe that anthropogenic CO<sub>2</sub> emissions have tipped the balance and are causing global warming.

Although a rise in global temperature has historically preceded a rise in atmospheric carbon dioxide by hundreds of years, today's unprecedented CO<sub>2</sub> levels that have been caused by human emissions are driving global warming.







## Lesson 4, Activity 3 *Global Warming Swindle* Student Worksheet

NAME \_\_\_\_\_

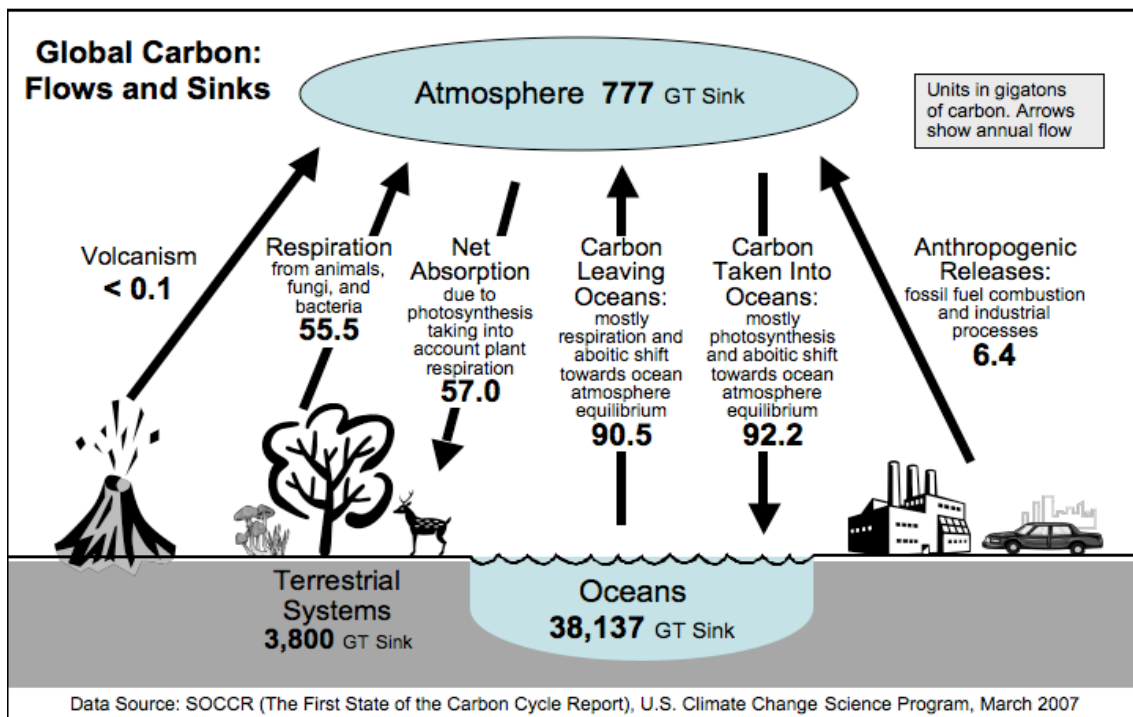
DATE \_\_\_\_\_

Read over the questions below before viewing the short video clip. You may want to take notes as you view the clip. You will then be given time to write your answers.

**Transcript:** Volcanoes produce more CO<sub>2</sub> each year than all the factories and cars and planes and other sources of man-made carbon dioxide put together. More still comes from animals and bacteria, which produce about 150 Gt of CO<sub>2</sub> each year, compared to a mere 6.5 Gt for humans. An even larger source of CO<sub>2</sub> is dying vegetation from fallen leaves. But the biggest source of CO<sub>2</sub> by far is the oceans.

1. What are the key messages in this clip about global warming and the role of anthropogenic CO<sub>2</sub>? What techniques do the filmmakers use to communicate those messages?

2. Compare the information in the film about volcanic CO<sub>2</sub> with information in this diagram from the SOCCR report prepared by the U.S. Climate Change Science Program (2007).



3. Which source should you believe?

4. The film clip states, **“More still comes from animals and bacteria, which produce about 150 Gt of CO<sub>2</sub> each year, compared to a mere 6.5 Gt for humans.”**

a) Compare the figures for the sources of carbon entering the atmosphere (anthropogenic and natural) given in the film and the SOCCR diagram.

b) What important information has been left out of the film, but appears in the diagram, that makes the above statement misleading?

5. The film goes on to state, **“An even larger source of CO<sub>2</sub> is dying vegetation from fallen leaves, for example in the autumn.”** Since dying vegetation releases carbon only as it is decomposed, where does this release of carbon appear in the SOCCR diagram?

6. The film clip ends with this statement: **“But the biggest source of CO<sub>2</sub> by far is the oceans.”** Using the SOCCR diagram, explain how this statement is accurate but misleading.

7. Speculate on why the film *The Great Global Warming Swindle* might distort information about the role of anthropogenic CO<sub>2</sub>.



## Lesson 4, Activity 3 *An Inconvenient Truth* Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

Read over the questions below before viewing the short video clip. You may want to take notes as you view the clips. You will then be given time to write your answers after viewing the clips.

### **Title of Film Clip: *An Inconvenient Truth***

1. What are the key messages being communicated in this clip about global warming and the role of anthropogenic CO<sub>2</sub>?

2. What techniques does the film use to communicate those messages?

3. Gore has been criticized for the way in which he represented the relationship between CO<sub>2</sub> and temperature in the film. Al Gore states the following in the clip you just saw:

**“The relationship is actually very complicated, but there is one relationship that is far more powerful than all the others and it is this: When there is more carbon dioxide, the temperature gets warmer because it traps more heat from the sun inside.”**

Climate scientists are generally in agreement that temperature rise has historically preceded a rise in CO<sub>2</sub> by approximately 800 years. In its Fourth Assessment Report released in 2007, the IPCC stated:

**“The ice core record indicates that greenhouse gasses co-varied with Antarctic temperatures over glacial-interglacial cycles, suggesting a close link between natural atmospheric greenhouse gas variations and temperatures. Variations in CO<sub>2</sub> over the last 420 kyr (thousand years) broadly followed Antarctic temperatures, typically by several centuries.”**

Given this information, what aspect of Gore’s position in the film seems misleading?



## Lesson 4: Lesson Review Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

### Lesson Review

1) Summarize how the clips we saw from *The Great Global Warming Swindle* and *An Inconvenient Truth* misrepresented accurate scientific facts to promote their main ideas.

2) What are the key lessons about media literacy that you learned from analyzing the two film clips?

3) Is anthropogenic CO<sub>2</sub> causing global warming?



# Lesson 5:

# The Consequences of Global Warming

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**LESSON PLAN**



Printed Documents



PowerPoint  
 Slide Show

# The Consequences of Global Warming

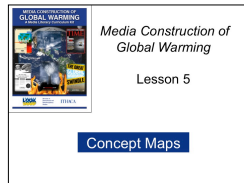
**Lesson Objectives:**

- Students will be able to describe the most commonly projected consequences of global warming in seven areas: hurricanes, diseases, agriculture, sea level, severe weather, freshwater, and biodiversity.
- Students will become familiar with the range of opinions and predictions regarding the severity and likelihood of each of the projected consequences.
- Students will become familiar with the global distribution of predicted consequences to climate change.
- Students will analyze a news or commentary article about one of the consequence and discuss critical questions about the source, construction, and bias of the article.
- Students will work individually and in groups to analyze, discuss, present, and synthesize information.
- Students will develop a map of interrelationships regarding the effects of various possible consequences on each other and explore the concept of positive feedback loops within these interrelationships

**Vocabulary:**

<b>Hurricanes</b>	<b>cyclones, ocean surface temperatures, frequency, intensity</b>
<b>Diseases</b>	<b>vector borne, diseases, malaria, dengue fever, lyme disease, cholera</b>
<b>Agriculture</b>	<b>higher temperatures, available water, climate variability. pests and disease</b>
<b>Sea Level Rise</b>	<b>sea levels, glaciation, ice sheets, coastal deltas</b>
<b>Severe Weather</b>	<b>surface temperature, drought, severe precipitation</b>
<b>Freshwater</b>	<b>hydrologic cycle, groundwater table, evaporation transportation, glacial retreat, potable water</b>
<b>Biodiversity</b>	<b>speciation, extinction, reproductive isolation, paleontologist, phenology</b>
<b>News Articles</b>	<b>news analysis, commentary, editorial, bias</b>
<b>Interrelationships</b>	<b>synergies, positive feedback loops</b>

## Media



Slide Show: *Concept Maps*  
10 slides

### Materials Needed:

- 24-page *Teacher Guide: Consequences of Global Warming*
- Seven four-page *Student Readings* (which include one-page articles):
  1. *The Projected Impact of Climate Change on Hurricanes*  
"A Hundred Katrinas," *Mother Jones*
  2. *The Projected Impact of Climate Change on Diseases*  
"Tropical Disease Back as Europe Warms Up," *Sunday Times* - London
  3. *The Projected Impact of Climate Change on Agriculture*  
"How Will Agriculture Adapt to a Shifting Climate?" *Daily Observer* - Gambia
  4. *The Projected Impact of Climate Change on Sea Level Rise*  
"The Submerging World," *Orion*
  5. *The Projected Impact of Climate Change on Severe Weather*  
"Katrina's Real Name," *Boston Globe*
  6. *The Projected Impact of Climate Change on Freshwater*  
"Millions Face Glacial Catastrophe," *Observer* - London
  7. *The Projected Impact of Climate Change on Biodiversity*  
"The Sixth Extinction," *Newsweek*
- Seven two-page *Student Worksheets* for each of the consequences
- Blank concept map titled *Interrelated Impacts*, one per student
- (OPTIONAL) Completed concept map, *Interrelated Impacts*, one per student. You may decide to project the completed concept map for the whole class to view.
- Large world map

### Time

Four 45 min class periods, or less if students complete readings outside of class.

### Lesson Procedures:

1. **Activity 1:** Introduce the lesson using the prompt in the *Teacher Guide*.
2. Arrange for students to work in seven groups (each group designated for one of the seven consequences).
3. Distribute the four-page *Student Readings* and the two-page *Student Worksheets* to the seven groups of students. (Each group should be studying a different consequence.)
4. Allow appropriate time for the students to complete the reading and worksheet, in class or for homework (20 min).
5. **Activity 2:** Have groups meet to discuss their answers and prepare to present the information on page one of the worksheet (20 min).

**Lesson Procedures Continued:**

6. Distribute the blank concept map, *Interrelated Impacts*. Introduce the concept map activity.
7. Have each group present their worksheet answers on their consequence to the class, preferably with a projected world map. Use the *Teacher Guide* to help facilitate the presentations. All non-presenting students should identify interrelationships and add these to their concept maps (45 min).
8. **Activity 3:** Lead culminating activity, *Examining Bias in News Articles about Global Warming*, using prompts in *Teacher Guide* (15 min).
9. **Activity 4:** Lead culminating activity, *Mapping the Consequences*, using prompts in *Teacher Guide* (15 min). \*
10. **Activity 5:** Lead culminating activity, *Systems Thinking: Feedback Loops*, using prompts in the *Teacher Guide* and projected concept maps (40 min).
11. Collect all worksheets and concept maps from each student.
12. Use the *Possible Answers* for worksheet questions in the *Teacher Guide* to evaluate student work.

\* It is important for students to address the moral implications of the fact that many poor and less-developed nations will suffer the worst consequences from global warming, while the greenhouse gases produced by the industrialized nations have been a primary cause. Lesson 7, *Assessing Carbon Footprints*, explores this issue. If you are not planning to use Lesson 7, consider inserting the culminating activity, *Personal, Policy, and Moral Choices* found at the end of that lesson.



TEACHER GUIDE



Printed Documents

# Consequences of Global Warming

## Activity 1: Readings and Analysis

1. Organize and make copies of the *Student Readings and Student Worksheets* for the activity (these include all readings and worksheets for each of the seven consequences).
2. Introduce the lesson:

### Lesson Introduction

We are beginning a lesson on the consequences of global warming. Some of these consequences are already being felt, while others are projections based on current scientific research. No one can predict the future but the data is mounting concerning these consequences.

You will work in seven groups, each studying the potential impact of global warming on a different topic area: hurricanes, diseases, agriculture, sea level rise, severe weather, freshwater, and biodiversity. Each of the seven groups will read a short article from a newspaper or magazine that you will critically analyze, responding to questions on the credibility and bias of the article.

Each group will receive a four-page reading that you will use to complete a two-page worksheet. The reading and worksheet will help you to prepare to give a 5 min presentation to the class where you will briefly summarize the major impacts that climate change is having, and may have, on your topic area. You will also be asked to identify the areas on a world map where these impacts will likely be greatest. You will end your presentation by leading a discussion with the entire class about the ways in which your consequences may impact other topic areas, for instance, the ways in which sea level rise may impact agriculture, diseases, and so forth.

We will end the lesson reflecting on the disproportionate impact of climate change globally, the ways in which news articles portray global warming, and the possibility of positive or negative feedback loops that may dramatically influence the impacts of global warming.

3. Create seven groups of students and distribute the *Student Readings and Student Worksheets*.
4. Have the students complete the *Student Readings and Student Worksheets* for homework or in small groups. Allow appropriate time for students to complete the reading and worksheets.
5. Review the *Questions & Answers* in the *Teacher Guide* in preparation for facilitating the presentations and reviewing the worksheet answers.



TEACHER GUIDE



Printed Documents

# Consequences of Global Warming

## Activity 2: Presentations

1. After students have completed their worksheets from Activity 1, students should meet with their group for approximately 20 min to discuss answers and prepare to present for 5 min on the information on page one of the *Student Worksheet*.
2. Make copies of the blank concept map for each student, and have a large world map available for each group to refer to when presenting. (Alternatively, use overhead transparencies or a projected world map so that each group can color in a different map to be layered together for the culminating activity. See *Mapping the Consequences* later in this *Teacher Guide*.)
3. Facilitate the presentations using the possible answers provided in this *Teacher Guide*. *Possible Answers* are given to help the teacher identify the key information and understandings we intend students to address through the worksheet questions. The teacher may want to add information from the *Teacher Guide* during the presentations if needed.

**NOTE:** While students will summarize their answers to the questions on page one of their worksheets concerning the consequences of global warming, they will not present the answers from page two of their worksheet where they analyze a particular news article. These questions will help prepare them for the culminating activity: *Examining Bias in News Articles about Global Warming*. Possible answers to the worksheet questions about the news articles are included in this *Teacher Guide* so that the teacher can assess student worksheet responses.

4. Distribute the blank concept map titled *Interrelated Impacts* and explain the following:

### Explain Concept Map

As you listen to the presentations from the other groups, you will need to build your individual concept map labeling the interrelationships or connections between different concepts related to global warming. As groups present, you should listen for interrelationships between the concepts. For each interrelationship you recognize, draw an arrow between the concepts and label the arrow with a brief description of the relationship. Note the descriptions written between CO<sub>2</sub>, atmospheric warming, severe weather, and biodiversity as examples. In particular, you should do this for your topic area, but also add any other connections that you see. At the end of each group report, you will have the opportunity to name these interrelationships during which time you should be filling out your concept map. At the end of all of the activities for this lesson, you will each turn in your concept map along with your completed two-page worksheet.

5. Begin the group presentations using the prompts in the *Teacher Guide* for each group.
6. Have students add to their concept maps as they listen to the presentations.
7. Discuss concept maps. Collect student worksheets, but have students keep concept map for later activity.





## Hurricanes: Questions & Answers Guide

1) Briefly summarize the major impact that climate change is having, and may have in the future, on hurricanes.

2) Identify the regions on a world map where these impacts will likely be greatest.

3) Summarize the scientific debates about the impact of climate change on hurricanes presented in the background reading. Include any reflection on the bias of the reading.

4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on hurricanes and other impact areas.

**Note:** The group presenting should have the rest of the class name interrelationships before adding additional answers. Students should add these to their individual concept maps.

**Possible Answer:** Climate change has warmed tropical seas where hurricanes form. Some scientists believe that this has resulted in an increase in the frequency of the most intense level 4 and 5 hurricanes. A rise in sea levels will contribute to the increase in the impact of hurricanes on low-lying coastal areas.

**Possible Answer:** Students will likely use the “Hurricane Basins” map in their handout to craft this answer. They will likely identify the regions where current hurricanes have the highest landfall frequency (the West Pacific, particularly Taiwan and the Philippines) and the region where hurricanes are the most deadly (South Asia, from India to Myanmar). They should also explain that impoverished, densely populated, and low-lying countries in hurricane-prone areas, such as Bangladesh, are likely to have the greatest death toll from rising seas. The reading from the magazine *Mother Jones* may lead them to include the low-lying coastal regions of the United States, particularly New Orleans.

**Possible Answer:** The reading includes numerous quotes and charts implying that global warming is causing a rise in ocean surface temperatures, which have resulted in an increase in the frequency and intensity of hurricanes. The reading includes just a few comments challenging this conclusion, including “other studies report that changes in observational techniques and instrumentation are responsible for these increases.” The final quote notes that the increase in the economic impact of hurricanes is due to coastal development, not an increase in the intensity and frequency of storms.

**Answer: Interrelated Impacts (from Student Reading):**

- Combined effect of more intense hurricanes and storm surges with sea level rise on damage to ecosystems, people, and property.
- Effect of flooding produced by major hurricanes and typhoons on incidence of disease due to destruction of sanitation infrastructure and contamination of food and water.
- The high winds, and flooding caused by torrential rains and storm surge strongly impact local agriculture, both through direct damage to crops and through intensified soil erosion.
- Hurricanes impact the biodiversity of ocean edge ecosystems both through direct damage as well as through the chemical pollution caused to these sensitive areas by the collapse of infrastructure to developed coastal areas.

**Note:** Have the rest of the class address this question about interrelationships. The group presenting should add additional answers after the rest of the class has shared.

- Because of infrastructure collapse, access to clean fresh water is reduced.
- Hurricanes can cause environmental refugees.
- Dramatic economic effects, including on the insurance, real estate, and energy industries.

### **“A Hundred Katrinas: Climate Change and the Threat to the U.S. Coast”**

By John McQuaid, *Mother Jones*, August 26, 2007

5) Give your reactions to McQuaid’s article, including reflections on any bias that you see in its construction.

**Note:** This question encourages open-ended responses and initial reflections on the potential for bias in the article (and all media).

6) What conclusion does the article most emphasize? Explain your reasoning.

**Possible Answer:** b) Fear of looming catastrophe for coastal cities

- a) The scientific uncertainty behind global warming and hurricanes
- b) Fear of looming catastrophe for coastal cities
- c) Equally a and b

**Evidence:** The title, “A Hundred Katrinas: Climate Change and the Threat to the U.S. Coast.” The article suggests that there is a “scientific consensus” on the issue. It emphasizes fear: “threat to U.S. coast,” “dozens of minor disasters,” “intensity of flooding,” “more major storms,” “massive storm surges, and higher winds,” “more stuff to be destroyed,” “double the average annual cost.”

7) Who is the likely audience for *Mother Jones* magazine, and how might the article target that readership?

**Possible Answer:** The statement from *Mother Jones* suggests that it is a liberal or left-leaning magazine. Its audience is likely to be liberal Americans who already believe that global warming is a reality. The article uses fear and disaster as compelling hooks for these readers. The article focuses on the impact of hurricanes on U.S. cities (*Mother Jones* is a U.S. magazine) and on the insurance industry (presumably of interest to middle class readers who would subscribe to a news magazine).

8) Discuss the credibility (believability, trustworthiness) of this article.

**Note:** This small-group discussion will help prepare students for the whole-class discussion at the end of the lesson.

## Diseases: Questions & Answers Guide

1) Briefly summarize the major impact that climate change is having, and may have in the future, on the spread of diseases globally.

**Possible Answer:** The spread of vector-borne diseases such as malaria, dengue fever, and Lyme disease all depend on the movement of organisms such as mosquitoes and ticks. They appear to be expanding their range and the length of transmission due to global warming. Increased flooding, droughts, and severe weather will likely increase disease transmission as well.

2) Identify the regions on a world map where these impacts will likely be greatest.

**Possible Answer:** Students will likely use the “Climate Change and Malaria” map to aid them in creating this answer, identifying tropical regions as the current target of many diseases, especially in Africa, South America, and Asia. The occurrence of diseases in these regions will most likely be exacerbated by climate change, while areas of slightly higher latitudes and altitudes will also be affected by increased spread of disease.

3) Use Italy and Britain as examples of the potential impact of global warming on the spread of diseases. Include examples from the article.

**Possible Answer:** The article reports that malaria has returned to Italy’s southern regions, which were declared free of the disease in 1970. Because of its location, at “the southern edge of the globe’s temperate area,” it is especially vulnerable to climatic changes. The article also talks about how climate change is having an effect on wildlife migration patterns, including butterfly and moth species; scientists are concerned about other—possibly disease-carrying—species of insects that might join them.

4) Summarize the conflicting points of view about the impact of global warming on disease.

**Possible Answer:** The statement to the Science and Transportation Subcommittee on Global Climate Change and Impacts says that malaria is not an “exclusively tropical disease.” Malaria has had a significant presence in temperate regions of the world in the past, even in Siberia, implying that the existence of malaria in temperate regions clearly predates global warming.

5) Prepare to lead the class in a discussion about the potential interrelationships between the impact of climate change on diseases and other impacts.

**Answer: Interrelated Impacts (from Student Reading):**

- Severe weather causing flooding or droughts influences the rate of transmission.
  - Any increase in the number of category 4 or 5 hurricanes and cyclones will result in increased water source contamination, possibly increasing cholera.
  - Changing climate and ecosystems may result in agricultural and timber-related epidemics such as mountain pine beetle, red band needle blight, and sudden oak death.
- Sea level rise, reductions in agricultural productivity, and loss of freshwater will each add economic and social stresses, particularly in poor nations, that will make it harder to control the spread of disease.

**Note:** The group presenting should have the rest of the class name interrelationships before adding additional answers. Students should add these to their concept maps.

**Note:** Have the rest of the class address this question about interrelationships. The group presenting should add additional answers after the rest of the class has shared.

- Increased disease incidence requires increased expenditures in the way of response. These funds compete with other needs such as the provision of food and mitigation responses to climate change.

### “Tropical Diseases Back as Europe Warms Up”

By Maurice Chittenden, *Sunday Times* (London), January 7, 2007

**6) Who is the target audience for this newspaper and how has the article been constructed to address that specific audience?**

**Possible Answer:** *The Sunday Times* come from London, which suggests a British audience. The article focuses on Italy, but targets a British readership by mentioning “holiday makers” (e.g. British tourists), Mussolini (known to the British because of WWII), Britain’s North Sea, increased butterfly and moth species in Britain, and the possibility of dangerous insects coming to Britain.

**7) What words and expressions are used in the article that emphasizes the dangers of global warming?**

**Possible Answer:** Many words and expressions emphasize the danger of global warming, including “at risk,” “shattering of climate equilibriums,” “hazards,” “inflammation of the brain,” “potentially fatal,” “fatal illness,” “bluetongue disease,” “dangerous,” “destroy,” and “consequences.”

**8) How are statistics and numbers used to emphasize these dangers?**

**Possible Answer:** The article uses numbers to stress the threats caused by global warming. It uses statistics to show how climate change is increasing diseases including encephalitis (18 cases before 1993, 100+ cases since) and Visceral leishmaniasis (50 cases before 1990, 150+ cases annually since 2000). It states that “20% of Mediterranean fish are now tropical species that have emigrated from the Red Sea,” and that “increased temperatures could cause the deaths of 120,000 per year in Europe by the end of the century.”

**9) What organizations or experts are used and quoted? How might this reflect a bias?**

**Possible Answer:** Most of the article takes its facts from one report from “an Italian environmental association.” The longest quote in the article comes from the director of that organization. The article ends with a quote and information from “the UK’s Center for Ecology and Hydrology.”

**10) How does the writer begin and end the article to frame the key messages?**

**Possible Answer:** Chittenden opens the article emphasizing the risk of climate change bringing malaria back to Europe. He ends with a quote, “The possible consequences require immediate attention.”

**11) What does the article leave out that might be important to know about this issue? How might this reflect the bias of the article?**

**Possible Answer:** The article does not mention the uncertainty of the research, such as the IPCC’s statement in the reading, “there is still much uncertainty about the impact of climate change on malaria.” Omitting that statement suggests scientific agreement.

## Agriculture: Questions & Answers Guide

1) Briefly summarize the major impact that climate change is having, and may have in the future, on agriculture.

**Possible Answer:** Higher temperatures will generally increase crop productivity in higher latitudes, but in regions closer to the equator, yields will decrease if temperatures exceed the optimum for growing. Climate change will have an effect on the availability of water, including changes in precipitation, evaporation, demand for irrigation, and so forth. Increased extreme weather events will have a destructive effect on crop productivity, while increased temperatures will make conditions favorable for pests and diseases to thrive.

2) Identify the regions on a world map where these impacts will likely be greatest.

**Possible Answer:** The student reading suggests that although the impact of climate change on agriculture will vary based on many factors, agricultural productivity is more likely to decrease closer to the equator and increase in the higher latitudes. The *Daily Observer* concludes that Africa will be “the hardest hit.”

3) Use Africa and Canada as examples of the potential impact of global warming on agriculture.

**Possible Answer:** Canada may benefit from a longer growing season, earlier planting and maturation of crops, and greater diversity of plants and crops. However, Canada’s less fertile soil may not result in increased yields. Africa may suffer more than other regions because of greater temperature increases, greater dependency on agriculture and rain fed irrigation, and Africa’s overall land degradation and poverty.

4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on agriculture and other impact areas.

**Answer: Interrelated Impacts (from Student Reading):**

- Severe weather, such as spells of high temperature, heavy storms, or droughts, disrupts crop production.
- Any increase in the Category 4 or 5 hurricanes and cyclones will result in increased water source contamination and related diseases.
- Sea level rise will inundate some coastal agricultural areas and damage water tables necessary for irrigation.
- Loss of biodiversity will impact plant species and the supportive organisms that provide services (e.g. bees) and control pests (e.g. bats).
- Agriculture may be impacted as changes in CO<sub>2</sub> concentrations alter the photosynthetic processes of plants.
- In some areas, irrigation will become increasingly necessary, creating increased freshwater scarcity.
- Warming can lead to increases in pest population and disease by lengthening the annual reproductive period, thus allowing some pest species to complete a greater number of reproductive cycles each year.
- Rapid shifts in agricultural productivity will lead to economic instability that will likely threaten the poorest populations.

**Note:** The group presenting should have the rest of the class name interrelationships before adding additional answers. Students should add these to their individual concept maps.

### “How Will Agriculture Adapt to a Shifting Climate?”

By Alhagie Jobe, *Daily Observer* (Gambia), September 11, 2007

5) Give your reactions to Jobe’s article.

6) Who is the target audience for this article and how has it been written to target this group?

7) List at least five different ways in which African agriculture is particularly vulnerable to the effects of climate change according to this article.

8) Contrast this article with the few comments by Dr. Timothy Ball in the reading about the effects of climate change on agriculture in Canada.

**Note:** This question encourages open-ended responses and initial reflections on the potential for bias in the article (and all media).

**Possible Answer:** The *Daily Observer* is likely targeted to the entire English language newspaper-reading population of The Gambia, and perhaps other countries in West Africa as well as people who are interested in the region. The article targets this readership by focusing on Africa’s vulnerability to the effects of climate change. Although it reads like a news article, it takes a position that the industrial nations are obligated to address climate change, a point of view that is likely to reflect the interests of its readers.

**Possible Answers:**

- “Temperature increases in parts of Africa could be double the global average increase.”
- “Agriculture employs 70% of people in Africa.”
- Much of the agriculture in Africa is rain fed, and therefore directly affected by rainfall variability.
- “Poverty is widespread in Africa, and governments typically face tight budget constraints; thus making it much harder for individuals and governments to invest in adaptations to climate change.”
- “Africa accounts for 30% of global land degradation, so farmers are already struggling to grow crops on land that contains inadequate nutrients and has little capacity to retain water.”
- Areas “currently classified as moderately water constrained will become severely water limited.”

**Possible Answer:** Dr. Timothy Ball cited several beneficial impacts of climate change on Canadian agriculture, including a longer growing season, greater variety of crops, less frost damage and crop loss, and more rapidly growing forests and increased rate of reforestation. On the other hand, the *Daily Globe* article largely focused on the negative effects of climate change on agriculture, especially in Africa. Climate change was referred to as “one of the most serious threats that humanity may ever face.”

## Sea Level Rise: Questions & Answers Guide

1) Briefly summarize the major impact of climate change related to sea level rise.

**Possible Answer:** If climate change were to cause Greenland's ice cap and the western Antarctic shelf to melt completely, it is estimated that sea levels would rise by approximately 40 feet. Low-lying lands, including many major cities and entire nations, would be flooded. This would cause unprecedented economic damage and cultural losses. Many of the world's most vulnerable countries are the least capable of adapting and mitigating a much smaller sea level rise.

2) Identify the regions on a world map where these impacts will likely be greatest.

**Possible Answer:** Students will likely use the map in the reading to identify areas likely to be most affected by rising sea levels. McKibben's article emphasizes the vulnerability of low-lying islands (i.e. Tuvalu) and impoverished densely populated coastal areas (i.e. Bangladesh).

3) Explain how Tuvalu and Bangladesh will likely be affected by climate change.

**Possible Answer:** According to McKibben's article, rising sea levels could render Tuvalu unlivable. Bangladesh's low elevation and dense population makes it particularly vulnerable to flooding of the Ganges River. Neither Tuvalu nor Bangladesh has the resources to cope with these changes.

4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on hurricanes and other areas impacted by global warming, including hurricanes, diseases, agriculture, severe weather events, freshwater, and biodiversity.

**Answer: Interrelated Impacts (from Student Reading):**

- Hurricanes will do greater damage as sea levels rise.
- An increase in intensity and rainfall of severe storms will increase flood and wind damages.
- Coastal agriculture may be flooded and impacted by saltwater intrusion.
- Rising sea levels will increase the salinity of freshwater supplies, including rivers, bays, groundwater, and aquifers, contaminating them.
- Coastal estuaries (some of the most biologically diverse and productive areas on the planet) will be lost. This could negatively affect food availability and drastically reduce biodiversity.
- As sea levels rise, millions of environmental refugees will be displaced.
- Flooding of coastal cities worldwide will cause unprecedented economic challenges.
- The cost of coping with significant sea level rise will cause resources to be diverted from other social and environmental needs.

**Note:** The group presenting should have the rest of the class name interrelationships before adding additional answers. Students should add these to their individual concept maps.

### "The Submerging World"

By Bill McKibben, *Orion* magazine, September/October 2004

5) Give your reactions to McKibben's article.

6) This article is best described as...

- a) news
- b) editorial
- c) commentary

Explain your answer.

7) Explain how this article targets *Orion's* core mission and readership.

8) Summarize McKibben's main message to U.S. citizens about climate change expressed in this article.

9) Give examples of McKibben's use of dramatic language and imagery, analogies, and irony to stress his main points.

**Note:** This question encourages open-ended responses and initial reflections on the potential for bias in the article (and all media).

**Possible Answer:** c) commentary

**Evidence:** This article does not report on any specific news events, but rather conveys the author's strong opinion that sea level rise, which will affect poor nations the most, is a consequence of the lifestyle of industrialized peoples. Because the article expresses the opinion of a single person (Bill McKibben) and not the newspaper itself, this article is best described as commentary.

**From Student Worksheet:** The following is from the *Orion* magazine website: "It is *Orion's* fundamental conviction that humans are morally responsible for the world in which we live, and that the individual comes to sense this responsibility as he or she develops a personal bond with nature."

**Possible Answer:** The subject of this article and its author's very strong and pointedly liberal opinion targets *Orion's* liberal readership, as many of them are likely to share the same views and concern for the same subjects. The magazine's core mission of moral responsibility is addressed by McKibben's argument that what is happening in Tuvalu and projected to happen in other areas of the world is "happening by choice, our choice."

**Possible Answer:** McKibben declares that U.S. citizens (and members of other developed countries) have the choice to determine what happens to especially vulnerable, low-lying areas of the world as a result of climate change. If we continue to burn fossil fuels at the current rate, the effects of sea level rise and climate change will be catastrophic.

**Possible Answer:**

- **Dramatic language:** "utterly inexorable," "die off and disintegrate," "with sacrifice and with fortitude"
- **Imagery:** "the submerging world," "instead of choking it's drowning," "enormous waves," "crumbling foundations," "swelling lagoons," "parched deserts," "dying forests," "discombobulated agriculture"
- **Analogies:** "reckless drive-by drowning," "came first for the Jews"
- **Irony:** "miniscule rounding error," "Why worry," "we will be hard-pressed to say we don't deserve it"



## Severe Weather: Questions & Answers Guide

**1) Briefly summarize the major impact that climate change is having, and may have in the future, on severe weather.**

**Possible Answer:** Scientists generally believe that increasing average temperatures of the Earth will change the availability and flow of heat energy that creates weather, therefore changing precipitation patterns as well. However, it is likely that this precipitation will occur in varied amounts around the world; some areas might experience more droughts and heat waves, others unprecedented rain and flooding. Scientists expect land temperatures to rise more quickly than oceans, and therefore increase the frequency and intensity of severe weather events. Climate change may also possibly increase the frequency of El Niño conditions.

**2) Identify the regions on a world map where these impacts will likely be greatest.**

**Possible Answer:** Climate change is likely to affect different regions of the world in a variety of ways. An area's weather patterns and events are affected by many different factors, such as geographic location and proximity to large bodies of water. Some regions will experience more moisture, while others will experience drying. Students may refer to the map on page three of the reading for details.

**3) Summarize the scientific debates about the impact of climate change on severe weather presented in the background reading. Include any reflection on the bias of the reading.**

**Possible Answer:** While many scientists point out examples of recent extreme weather events, noted climate scientist Roger Pielke claims that climate models cannot be used as a "projection" or "forecast" of future effects of climate change on severe weather events. Indeed, much of the debate about the impact of climate change on severe weather involves the uncertainty and inability to accurately predict long-term weather patterns.

**4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on severe weather events and other impact areas.**

**Answer: Interrelated Impacts (from Student Reading):**

- Droughts and floods reduce agricultural productivity.
- Severe weather will likely increase erosion. The resulting loss of soil will affect agriculture and reduce natural carbon sinks.
- Flooding can spread disease as sanitation and water purification systems are inundated.
- Both droughts (less water) and flooding (greater percentage of runoff) can reduce access to freshwater.
- Severe weather damage puts economic strain on affected areas.
- Severe drying can lead to forest and brush fires, releasing CO<sub>2</sub>. The loss of living biomass reduces carbon sequestration.
- A shift from a predominant La Niña to a more dominant El Niño phase could affect the distribution of ocean nutrients and impact biodiversity in the most productive fisheries.

**Note:** The group presenting should have the rest of the class name interrelationships before adding additional answers. Students should add these to their individual concept maps.

**“Katrina’s Real Name”**

By Ross Gelbspan, *The Boston Globe*, August 30, 2005

5) Give your reactions to the *Boston Globe* article, including reflections on any bias that you see in its construction.

6) List the types of severe weather events that Gelbspan attributes to global warming.

7) This article is best described as...

- a) news
- b) news analysis
- c) editorial
- d) commentary

Explain your reasoning.

8) Which words best describe the article...

- a) factual, detached, scientific, objective
- b) emotional, passionate, sensational, alarmist

Give evidence from the article.

9) Is it appropriate, or even essential, for newspapers to print articles that take strong and passionate opinions on controversial topics such as global warming? Or, is it important for newspapers to remain dispassionately balanced and stick to the proven facts?

**Note:** This question encourages open-ended responses and initial reflections on the potential for bias in the article (and all media).

**Possible Answer:** Hurricane Katrina, a two-foot snowfall in Los Angeles, severe winds in Scandinavia, severe drought in the Midwest, wildfires in Spain and Portugal, low water levels in France, a lethal heat wave in Arizona, torrential rains in India, and a deadly ice storm in New England.

**Note:** It is important for students to recognize causality cannot be proven scientifically.

**Possible Answer:** d) commentary

**Evidence:** The article is not reporting on a news event but rather is a strongly opinionated position on a controversial issue: global warming. An editorial is the position of the newspaper itself. This is an article from one reporter, not the newspaper, and therefore is a commentary and not an editorial. One could argue that it is news analysis, but Gelbspan’s strong, opinionated advocacy speaks more to commentary than analysis.

**Possible Answer:** b) emotional, passionate, sensational, alarmist

**Evidence:** The article opens with a string of catastrophic events that Gelbspan says were caused by global warming—although this is impossible to prove. He emphasizes death and destruction and uses dramatic words including “villain,” “culprit,” “heartbreaking,” “terrifying,” “ignorance,” and “indictment.” The article uses fear to sound an alarm about the threat of global warming.

**Note:** This small-group discussion will help prepare students for the whole-class discussion at the end of the lesson.

## Freshwater: Questions & Answers Guide

**1) Briefly summarize the major impact that climate change is having, and may have in the future, on freshwater.**

**Possible Answer:** Scientists expect climate change to impact the hydrologic cycle and thus the availability of freshwater. Changes in precipitation patterns, both in amount and frequency, impact the soil's and plants' ability to absorb the water, and can increase the chance of floods and water scarcity. Sources of water, including rivers, lakes, snow pack, glaciers, and groundwater, may be affected. The rapid melting of Himalayan glaciers is leading to unprecedented flooding and may eventually result in the loss of access to freshwater for millions of people as the glaciers recede. This pattern may affect a billion people who depend upon glaciers or seasonal snow pack for their water supply.

**2) Identify the regions on a world map where these impacts will likely be greatest.**

**Possible Answer:** Students may use the "World Water Scarcity" map to identify regions of the world currently experiencing physical water scarcity, economic water scarcity, and those approaching physical water scarcity. The reading suggests that precipitation is increasing in higher latitudes and decreasing in southern Asia, southern Africa, the Mediterranean, and parts of Australia. The Hindu Kush area of Asia is suffering from shrinking glaciers.

**3) Describe how communities dependent upon water from the Himalayan glaciers are being impacted by global warming.**

**Possible Answer:** Unprecedented melt water from Himalayan glaciers has caused several lakes to swell and burst, while many more are at risk. This has already destroyed several villages and threatens hydroelectric plants. Scientists predict future catastrophes in the Himalayas may include "floods, droughts, land erosion, biodiversity loss and changes in rainfall and the monsoon." Glaciers, the main source of freshwater in the region, will undermine the availability of water for drinking and irrigation as they shrink.

**4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on freshwater and other impact areas.**

**Answer: Interrelated Impacts (from Student Reading):**

- Rising sea levels will cause contamination of freshwater sources for populations living in coastal regions.
- Increasingly dense populations in many areas require more intense agriculture, which in turn can require more irrigation.
- A sharp reduction in available water will reduce agricultural productivity.
- Severe cyclones, hurricanes, and typhoons can cause contamination of water supplies.
- Severe weather can result in more runoff and therefore a loss of freshwater, even if the total amount of precipitation stays the same, while increased drought will cause some areas to receive too little water, possibly requiring massive relocation.

**Note:** The group presenting should have the rest of the class name interrelationships before adding additional answers. Students should add these to their individual concept maps.

**Note:** Have the rest of the class address this question about interrelationships. The group presenting should add additional answers after the rest of the class has shared.

- Severe precipitation events causing flooding will increase freshwater contamination, increasing the risk of water-borne diseases.
- Changes in access to freshwater may cause economic hardship, particularly for poorer communities.

### “Millions face glacier catastrophe”

By Robin McKie, *The Observer*, November 20, 2005

5) Give your reactions to McKie’s article.

**Note:** This question encourages open-ended responses and initial reflections on the potential for bias in the article (and all media).

6) What conclusion does the article most emphasize? Explain your reasoning.

**Possible Answer:** d) commentary or b) news analysis

- a) news
- b) news analysis
- c) editorial
- d) commentary

**Evidence:** Although the article references floods in the Himalayas, it is not primarily about these events (news) but is rather a commentary or analysis about the global implication of these events and climate change. The opinions expressed are from an individual as opposed to a newspaper (editorial).

7) Which words best describe this article?

**Possible Answer:** b) emotional, passionate, sensational, alarmist

- a) factual, detached, scientific, objective
- b) emotional, passionate, sensational, alarmist

**Evidence:** The article is full of powerful imagery and phrases describing several past, present, and future disasters in the Himalayan region. Some of these phrases and words include: “destroyed,” “crashed,” “tenfold jump in such catastrophes,” “poised to burst their banks,” and “imminent danger.” The article also does not include any contrasting perspectives to balance out its emphasis on catastrophe, looming danger, and destruction—all caused by climate change.

Explain your answer with evidence from the article.

8) Is it appropriate, or even essential, for newspapers to print articles that take strong and passionate opinions on controversial topics such as global warming? Or, is it important for newspapers to remain dispassionately balanced and stick to the proven facts?

**Note:** This small-group discussion will help prepare students for the whole-class discussion at the end of the lesson.

## Biodiversity: Questions & Answers Guide

**1) Briefly summarize the major impact of climate change on biodiversity.**

**Possible Answer:** Many scientists, most notably the famous biologist E. O. Wilson, propose that humans are causing an unprecedented mass die-off of species. This sixth great mass extinction is thought to be the result of a variety of human causes, including climate change. Climate influences temperature and access to solar energy, which in turn affects access to water, the availability of food, and the timing for breeding and migration. Although it is impossible to predict the exact impact of global warming, it is clear that some species will not be able to adapt. Already, coral reef communities worldwide are struggling to survive in the face of rising ocean temperatures.

**2) Identify the regions on a world map where these impacts will likely be greatest.**

**Possible Answer:** Biodiversity is likely to be affected across the globe by climate change, and it is hard to predict where species will be hit the hardest. The map in the reading, "Biodiversity hotspots for conservation priorities," identifies regions of particular concern.

**3) Summarize the scientific debates about the impact of climate change on biodiversity presented in the background reading. Include any reflection on the bias of the reading.**

**Possible Answer:** The reading includes just a few comments challenging the conclusion that global warming is contributing to a catastrophic mass extinction. One is from a Danish associate professor questioning the data, and one from a professor of business administration who says the "doomsters' claims of rapid disappearance" is not based on the evidence. He also suggests that modern science (genetics and seed banks) may mitigate the economic effects of extinction. The *Newsweek* article targets human factors other than climate change as the main culprits of mass extinction, including development, habitat loss, and hunting.

**4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on biodiversity and other impact areas.**

**Answer: Interrelated Impacts (from Student Reading):**

**Note:** The group presenting should have the rest of the class name interrelationships before adding additional answers. Students should add these to their individual concept maps.

- Diverse vegetation ensures soil cover over longer periods of annual cycles, reducing soil erosion, enhancing agricultural productivity, and establishing freshwater catchment and recharging of ground water.
- The biodiversity found in ocean estuaries and salt marshes provides rearing grounds for food sources such as ocean fisheries. A loss of species diversity represents a loss of genetic diversity and all of the organic molecules coded for by these organisms. In strictly human terms, these molecules represent possible pharmacological resources, which may help address newly emerging diseases as well as the raw materials for the developing field of "biomimicry".

**Note:** Have the rest of the class address this question about interrelationships. The group presenting should add additional answers after the rest of the class has shared.

- Climate change may adversely impact plants, animals, and insects vital to agriculture (e.g. bees).
- An increase in the range of insect pests and impact on the organisms that control these pests may result in a rise in disease and negative impact on agriculture.
- Decreases in biodiversity due to climate change will lessen the capacity of plants and animals to recover from severe weather events such as hurricanes and droughts.

**“The Sixth Extinction: Why We Need Owls And Ants”**  
By Sharon Begley, *Newsweek*, October 19, 1992

**5) Give your reactions to the *Newsweek* article, including reflections on any bias that you see in its construction.**

**Note:** This question encourages open-ended responses and initial reflections on the potential for bias in the article (and all media).

**6) Give examples from the opening paragraph of the use of dramatic imagery and language that would target a large, mainstream audience.**

**Possible Answer:** The opening line compares the scientist E. O. Wilson to a “borscht-belt comic.” It goes on to give images of wild and crazy creatures (“a 10-foot tall carnivorous bird”) with exotic names (“Titanis, *Nanaloricus mysticus*”) and dramatic descriptions (“resembles ambulatory pineapple,” “like a malevolent ostrich”). The dramatic and humorous descriptions and imagery are likely to attract a broad audience that might not have as much interest in a more scientific article.

**7) Describe the scientific sources that author Sharon Begley references in this article. Explain what impact this might have on the credibility (believability, trustworthiness) of the article.**

**Possible Answer:** The article references only one scientific source, E. O. Wilson. The absence of any other authoritative source or opinion limits the credibility of the article. The emphasis on sensational imagery and language over more factual scientific information lessens the credibility of the article.

**8) Discuss the scientific credibility (believability, trustworthiness) of this article.**

**Note:** This small-group discussion will help prepare students for the whole-class discussion at the end of the lesson.

TEACHER GUIDE



Printed Documents

# Consequences of Global Warming

## Activity 3: Examining Bias in News Articles

1. Introduce the activity:

### Introduce the Activity

Each of you has analyzed a short article about your consequence from a particular newspaper or news magazine. Some of these are news articles and others are commentaries. News, like all mediated information, has a particular point of view / a bias. This bias is often related to the perspective of the author, the purpose, and the target audience for a particular periodical and the commercial interests of the newspaper or magazine.

2. Lead a discussion on examining the bias in the news articles that the students have already read. Use this *Teacher Guide for Questions and Possible Answers* to facilitate the discussion.

## Bias Questions & Answers

**1) What bias, if any, did you identify in your article? Why do you suspect your article had that bias? Give evidence from your article where you can.**

**Possible Answers:** The article emphasized the dramatic and catastrophic because fear sells (e.g. “imminent danger,” “reckless drive-by drowning,” “utterly inexorable”).

The article assumed the liberal position that global warming is a real and human-caused catastrophe, reflecting the liberal bias of the magazine’s readership (e.g. *Mother Jones*, *Orion*).

The article tended to emphasize information relevant to the demographic audience of the periodical, (e.g. West African –*Daily Observer*, British – *Sunday Times*).

The article used quotes from selected scientists that reinforced the bias of the article (e.g. exclusively using E. O. Wilson for biodiversity).

## Bias Questions & Answers

**2) What information about the science of global warming tended to be left out of your article?**

**Possible Answers:** Although there is some disagreement between scientists about the data, the article failed to include any reference to scientific debate.

The article incorrectly implied that there was a scientifically proven causal relationship between global warming and specific events (e.g., Hurricane Katrina, melting glaciers). Although the data suggests that global warming is playing a role, it is inaccurate to say that the science proves that global warming is the cause.

The article fails to mention that some regions (i.e., Canada) may benefit from global warming (e.g., for agriculture).

**3) What does this teach you about news coverage of global warming or any (controversial) scientific issue?**

**Possible Answers:** Newspapers and magazines often use drama and fear to hook readers. The articles are likely to reflect the biases of the periodical's target audience.

Complex and confusing scientific debate is typically absent from non-scientific periodicals.

It is important to:

- recognize the biases inherent in all information
- think critically about the media
- make informed judgments based on the science
- recognize how our own biases influence our judgments\*

### FURTHER QUESTIONS & ADDITIONAL INFO

- » **Is it appropriate, or even essential, for newspapers and magazines to print articles that take a passionate or alarmist stand on global warming? Or, should they remain dispassionately balanced and stick to the proven facts?**
- » **How does one assess the credibility (believability, trustworthiness) of an article on a (controversial) scientific issue such as global warming?**

\* Yale Law School's *Cultural Cognition Project* ([www.culturalcognition.net](http://www.culturalcognition.net)) has conducted studies showing that attitudes about global warming are greatly impacted by one's perspective or bias. Their studies show that we are likely to discount information and sources that contradict our existing beliefs about global warming (i.e., it is a real danger or it is a hoax), and that we are likely to believe and see as credible information and sources that confirm what we already believe about global warming. According to researcher Don Bramen, "People tend to conform their factual beliefs to ones that are consistent with their cultural outlook, their world view" (Joyce, 2010).



TEACHER GUIDE

# Consequences of Global Warming

## Activity 4: Mapping the Consequences

1. Introduce the activity:

### Introduce the Activity

Now that we have explored the different possible consequences of global warming around the planet, we will briefly reflect on how different regions of the world will be impacted by the changing climate.

2. (OPTIONAL) Layer the world maps from each group presentation, using either the transparencies or the whiteboard map, to visually display the overlapping centers of impact.
3. Lead a discussion using *Question and Possible Answers* below.

## Question & Possible Answers

**1) Given the information in the presentations, what regions of the world are projected to suffer the most from the impacts of climate change?**

**Possible Answers:** There is ample room for different responses to this question. However, the discussion should include the following ideas:

- Developing nations are likely to suffer the most because they have fewer resources to mitigate the impacts. Many people in the poorest nations are already suffering at the edge of survival. Global warming is likely to push these populations over the edge.
- Low-lying coastal areas will be devastated by the significant sea level rise caused by the melting of the Greenland and Antarctic ice caps, including dozens of cities and millions of people living in coastal deltas.
- The polar regions, particularly in the Arctic North, are seeing greater temperature rises and related environmental changes than other regions. This is likely to bring great changes to those ecosystems and may result in the extinction of plant and animal species. Although the warming may make some northern regions more hospitable for human habitation and certain kinds of agriculture or timber, rapid climate changes can undermine the capacity of ecosystems to adapt.

**NOTE:** If the majority of the world's scientists are correct, it is the fossil-fuel dependent lifestyle of the industrialized nations that are the primary cause of global warming, while the poorer developing nations still suffer the greatest consequences. It is important that students address the moral implications of this information. If students will not experience Lesson 7: *Assessing Carbon Footprints*, you should consider inserting here the activity *Personal, Policy, and Moral Choices* found at the end of that lesson.



TEACHER GUIDE



PowerPoint Slide Show

# Consequences of Global Warming

## Activity 5: Systems Thinking: Feedback Loops

1. Make copies of the **completed** *Concept Map Student Worksheet* for the class activity.
2. Ensure that the *Concept Maps* PowerPoint is ready to be projected.
3. Introduce the activity:

### Activity Introduction

The next step in our study of the consequences of global warming is to look at the ways in which the impacts of climate change may interrelate and create feedback loops that either limit or further intensify the effects. When it comes to the consequences of climate change, the whole may in fact be greater than the sum of its parts.

4. Ask: **Take out the concept maps you have been working on.**
5. Project and/or hand out the completed concept map, *Interrelated Impacts*.
6. Have students study the completed concept map and then suggest additional connections.

OPTIONAL: Add student connections to the completed concept map on a transparency or whiteboard.

7. Introduce feedback loops:

### Introduce Feedback Loops

In systems where different things interact, such as the map of consequences we have just created, feedback loops develop. There are two very different kinds of feedback loops. A negative feedback loop tends to keep things as they are by constantly working to bring any changes to the system back to a norm.

The thermostat in a room creates a negative feedback loop. As the temperature gets too low, the thermostat turns on a heater, which raises the temperature. As the temperature begins to climb too high, the thermostat turns the heating mechanism off. Through this interaction, a fairly constant temperature is maintained through time.

Positive feedback loops do just the opposite. As a change starts to occur, a positive feedback loop reinforces that change, causing it to shift further and further from the norm. These loop's synergistic effects create combinations of things that have a greater influence than the sum of their individual parts (Saladin, 2010).

8. Explain the definition of a negative feedback loop.

### **Negative Feedback Loop**

Oceans have created a negative feedback loop by absorbing vast quantities of carbon since the advent of the industrial revolution, thus mitigating the potential impact of anthropogenic carbon. However, oceans are currently unable to mitigate the effects of the increased levels of CO<sub>2</sub> emissions in the 21st century. The negative feedback loop created by the oceans can no longer be counted on to moderate global warming (Saladin, 2010).

9. Project Slide 4, “Ocean Absorption – A Negative Feedback Loop,” from the PowerPoint slide show to explain and demonstrate an example of a negative feedback loop.
10. Project Slide 5, “Methane from Ocean Sediments,” to explain and demonstrate a positive feedback loop. Follow up with the question below.

### **Positive Feedback Loop**

Huge deposits of methane in the form of methane hydrates are presently stored in sediments in the Arctic Ocean. These deposits will begin to be released if ocean temperatures rise sufficiently. This would likely create a positive feedback loop (Saladin, 2010).

QUESTION

**According to this concept map, how could the huge amounts of methane stored in ocean sediments act as a positive feedback loop and accelerate the impact global warming?**

POSSIBLE  
ANSWER

If temperatures in the Arctic Ocean get high enough, methane will be released from sediments under the ocean. A massive release of methane, a greenhouse gas much more powerful than CO<sub>2</sub>, will increase global temperatures. An increase in ocean temperatures will lead to a decrease in the ice cover in the Arctic. Less ice means greater heat absorption since ice reflects most incoming solar radiation, while water absorbs most of this energy. This will cause the oceans to warm more quickly and melt more ice. The release of methane will create a positive feedback loop that will cause global temperatures to rise even faster.

11. Have students meet in small groups to identify possible positive or negative feedback loops that have resulted from the interrelationships already identified on their concept maps. Have students write or highlight the loops on their concept maps.

12. Ask the following question:

QUESTION

**How do feedback loops and the possible interrelated impacts we identified on our concept maps influence our ability to predict the consequences of global climate change?**

POSSIBLE  
ANSWER

The different consequences clearly influence each other.

It is hard to see how any one consequence will proceed without considering all of the other things involved.

Because so many things are interacting, it seems necessary to consider everything at once.

Because of all of the interactions, it is very hard to predict what will happen in the future.

#### FURTHER QUESTIONS

- » **Given what we have learned about the possible or probable consequences of global warming, what can or should be our response?**
- » **Where do our individual behaviors fit into the concept map we have developed?**
- » **What are the implications of this information for the lifestyle choices of most people living in the United States?**

**NOTE:** The moral implications of a carbon rich lifestyle will be more fully explored in Lesson 7: *Assessing Carbon Footprints*. You should consider inserting here the activity *Personal, Policy, and Moral Choices* found at the end of that lesson.



**The Projected Impact of Climate Change on  
HURRICANES**

**Document 1**

**Background Information**

“Hurricane” is the name given to especially severe tropical storms located in the northern hemisphere. Other names, including typhoon and cyclone, are used for similar storms in other parts of the world. These intense storm systems are formed over warm ocean basins when sea surface temperatures reach at least 80°F. In the absence of sustained lateral surface winds (shear winds), the air over these waters is warmed and takes on a great deal of moisture. Warm air rises, and as this warm, moisture-laden air moves upward, it starts to cool and its moisture condenses into rain. This process of condensation releases a huge amount of heat energy (referred to as the latent heat of evaporation). This release of heat energy causes the air to become overheated. As this hot air rushes upward it causes a vacuum and therefore draws new surface air into the center of the system. This new air creates a positive feedback loop by collecting additional energy from the surface waters, further charging and intensifying the storm. As this process continues, the rotation of the Earth causes the entire system to start to spin.

When such a storm develops winds over 39 miles per hour, it is called a “tropical storm” and is given a name. It becomes a hurricane when it establishes sustained winds of at least 74 mph. Hurricanes are assigned categories based on their wind speeds, ranging from a Category 1 storm with average wind speeds of 74-95 mph to Category 5 storms with wind speeds exceeding 155 mph. Hurricanes build and sustain themselves by drawing on the heat of the ocean’s surface waters. If they travel over cooler water or land, their intensity is reduced.

When a hurricane hits land, there are three avenues of impact: wind, rain, and storm surge. While each of these aspects of hurricanes can do enormous damage, the storm surge is by far the most dangerous and damaging. Sustained hurricane level winds, blowing across the surface of the ocean, gradually stack water higher as it moves landward. This “surge” can add over 20 feet to the high tide at the point of landfall. As much as 90% of the deaths attributed to hurricanes result from such surges (National Geographic, 2010).

**Hurricane Basins**



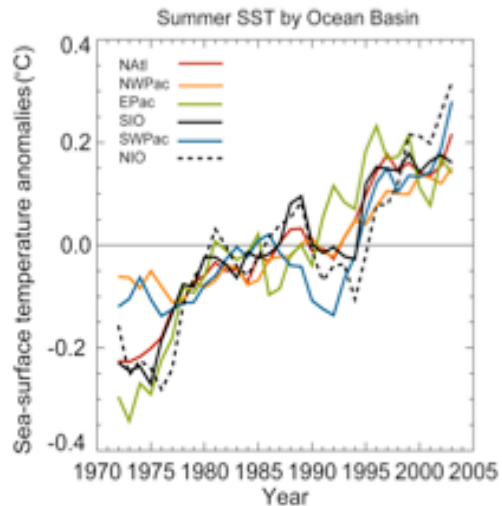
**Impact of Climate Change**

Because it is the warmth of tropical oceans that provide the energy for these storms, a link between global warming and the number and intensity of hurricanes is actively being investigated. The possible influence of global warming on hurricanes can be thought of as two interrelated questions:

- As global temperatures increase, are global tropical surface sea temperatures also increasing?
- Is this causing an increase in the frequency and intensity of hurricanes?

Regarding the first question, there is little controversy over the fact that global temperatures have risen since the beginning of the 20th century. Among many others, Judith Curry, chair of the School of Earth and Atmospheric Sciences at the Georgia Institute of Technology, has studied the question of ocean temperature change. On April 26, 2007, Dr. Curry testified to a Select Committee on Energy Independence and Global Warming of the United States House of Representatives. Her testimony included the graphical information above right, showing the variation of tropical sea surface temperature (SST) in each of the ocean regions where tropical cyclone storms form. It is seen that in each of these regions that the sea surface temperature has increased by approximately 0.5°C (or 1°F) since 1970.

The link between sea surface temperature (SST) and the development of tropical storms was established over 50 years ago when it was observed that ocean surface temperatures of over 26.5°C are needed in order to support development of hurricanes. According to the National Oceanic and Atmospheric Administrations' Earth System Research Laboratory: "Hurricanes Katrina and Rita were both associated with anomalously warm sea surface temperatures in the Gulf of Mexico during the month of August 2006, in particular. Hurricane Wilma became a record-breaking third Category-5 hurricane of the season in October, in the wake of exceptionally high sea surface temperature recorded in the Western Caribbean."



**Figure 6. Evolution of the sea surface temperature anomalies relative to the 1970-2004 period for the North Atlantic, Western Pacific, East Pacific, South Indian Ocean, Southwest Pacific and North Indian Ocean Basins (Curry et al., 2006).**

Despite these findings, there is still controversy over whether global warming is causing an increase in the number and intensity of hurricanes. There is a lack of direct correlation between increasing sea surface temperatures and the incidence and intensity of hurricanes over the same time periods. Hurricanes are complex and a number of variables have been shown to influence their development and intensity, including the degree of sheer winds acting in the vicinity of the storm, the variable El Niño influence, and internal hurricane dynamics such as the "eye wall replacement" process.

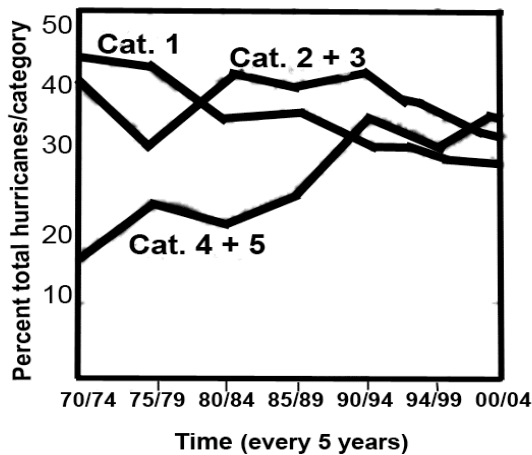
**Research Findings**

Talking about his 2005 report done with colleagues G. J. Holland, J. A. Curry, and H. R. Chang, Dr. Peter Webster of the Georgia Institute of Technology summarized the research by saying to NOVA scienceNOW:

"The bottom line of our study is that we found a consistency between the increase of surface temperature in all of the oceans and a change in intensity to more intense storms. Now, if it were natural variability, what one would expect to find is that the variation would be different in each of the basins. I think the first conclusion, perhaps the most important one, is that the characteristic change to more intense hurricanes is a global phenomenon and not a local phenomenon" (2006).



**Climate Change Impact on Hurricanes**



Hurricane intensity is based on wind speed. As the graphs above show, the number of Category 4 and 5 storms has nearly doubled in the past 35 years. This upward trend occurs in all of the ocean basins Webster’s team examined. There has not been a change in the maximum wind speed of the most intense, yet overall, hurricanes have indeed grown more intense—and potentially destructive—in recent decades (Webster, et al., 2005).

**Conflicting Perspectives**

The World Meteorological Organization put out the following summary statement at its annual international workshop in November 2006: “The surfaces of most tropical oceans have warmed by 0.25 – 0.5 degree Celsius during the past several decades.”

“Some recent scientific articles have reported a large increase in tropical cyclone energy, numbers, and wind-speeds in some regions during the last few decades in association with warmer sea surface temperatures. Other studies report that changes in observational techniques and instrumentation are responsible for these increases.”

According to Dr. Tad Murty, adjunct professor at the University of Ottawa, Canada and editor of the international scientific journal *Natural Hazards*, “No one doubts that the economic impact is increasing all the time, not because the hurricane frequency or intensity is increasing, but because the population is increasing and the coastal infrastructure is increasing” (2005).

**Interrelated Impacts:**

- Combined effect of more intense hurricanes and storm surges with sea level rise on damage to ecosystems, people, and property.
- Effect of flooding produced by major hurricanes and typhoons on incidence of disease due to destruction of sanitation infrastructure and contamination of food and water.
- The high winds and flooding caused by torrential rains and storm surge strongly impact local agriculture, both through direct damage to crops as well as through intensified soil erosion.
- Hurricanes impact the biodiversity of ocean edge ecosystems both through direct damage as well as through the chemical pollution caused to these sensitive areas by the collapse of infrastructure to developed coastal areas.
- Because of infrastructure collapse, access to clean fresh water is reduced.
- Hurricanes can cause environmental refugees.
- Dramatic economic effects including on the insurance, real estate, and energy industries.

## **“A Hundred Katrinas: Climate Change and the Threat to the U.S. Coast”**

By John McQuaid, *Mother Jones*, August 26, 2007

As the atmosphere heats up and polar ice caps melt, sea levels are projected to rise significantly, sending water lapping against coastal flood defenses around the world. And if that added heat fuels bigger hurricanes, as many scientists now believe, Katrina-like storms won't strike once a century, but possibly once a generation. And if that still seems infrequent enough, consider this: For every catastrophic storm, we experience dozens of minor disasters, and many of those will strike harder, or in unexpected places. If so far you've been among the majority of Americans who haven't had to worry about floods or hurricanes, that may soon change.

The Intergovernmental Panel on Climate Change, the global organization distilling the scientific consensus on the issue, estimated this year that seas could rise between 7 and 23 inches by the 2090s. Rising water alone will present serious problems for the United States coastline. A 2001 study by scientists at the Environmental Protection Agency estimated that about 22,000 square miles of the U.S. Atlantic and Gulf coasts lie less than five feet above mean sea level—and thus would likely be flooded by a spring high tide at some point early in the 22nd century. (About 43 percent of that area is in Louisiana, but the remaining area is equal in size to Maryland.)

It's relatively easy to prepare for a high tide. The far less predictable threat from rising seas will be storms. Not every hurricane is a Katrina, but rising sea levels increase the likelihood and the intensity of flooding even from smaller tropical storms and nor'easters. If there's an extra foot or two of water near your home, floods will be deeper, and high water that once came along just once every century may instead happen once a decade. If that weren't enough, many atmospheric scientists are now saying that a hotter planet will also add to hurricane strength, meaning more major storms, massive storm surges, and higher winds.

New Orleans is the American city most vulnerable to this threat, but it's far from the only one. Galveston, Houston, Tampa, Charleston, and even New York are also exposed, and residents all along the Atlantic and Gulf coasts, from Maine to Texas, will face increasing risks. Most of those risks have yet to be studied and quantified, in part because of the uncertainties

involved, and in part because few scientists and government agencies have taken up the challenge.

In some sense, we had it coming. Ever-expanding shoreline development has steadily increased the size and costs of disasters—there is simply more stuff to be destroyed along the coast than there used to be. Worldwide, the number of major catastrophes each year has increased from two in the 1950s to about seven now, according to a study by Munich Re, the global reinsurance company. A 2006 paper by Yale economist William Nordhaus estimated that global warming would double the average annual cost of U.S. hurricane disasters—about \$8 billion a year in 2005 dollars. Nordhaus also concluded that Katrina-sized disasters would occur more often due to global warming—once every 28 years on average, instead of once every 86 years. Another recent study generated an even more pessimistic number, estimating that by 2050, climate change could more than double annual hurricane losses worldwide. The threat of climate change has understandably set off alarm bells in the insurance industry. A United Nations task force composed of representatives of leading reinsurers and financial service companies concluded back in 2002 that “the increasing frequency of severe climatic events, coupled with social trends, has the potential to stress insurers, reinsurers and banks to the point of impaired viability or even insolvency.”

What's the best approach to this problem? A 2005 report by the Association of British Insurers suggested that reducing carbon emissions could reduce insured losses from extreme weather events by 80 percent, or \$35 to \$50 billion per year, the equivalent of two Hurricane Andrews. But Roger Pielke Jr., a professor of environmental studies at the University of Colorado, says that even if the world enacts the principal fix for global climate change—reducing carbon dioxide emissions—it will probably be too slow and indirect to have much effect on disasters. Instead, he suggests nations do it the old-fashioned way—either protect people or move them out of harm's way.

## The Projected Impact of Climate Change on DISEASES

### Document 2

#### **Background Information**

Some experts speculate that malaria has killed half of all the humans that have ever lived. Malaria, dengue fever, and Lyme disease are vector-borne diseases, spread by blood-feeding arthropods such as mosquitoes, ticks, and fleas. These diseases infect hundreds of millions of people worldwide each year.

Malaria is a vector-borne disease caused by various plasmodial protozoans. These disease-causing organisms are themselves transmitted by female *Anopheles* mosquitoes. The disease is widespread in tropical and subtropical regions, including parts of the Americas, Asia, and Africa. Each year, malaria causes disease in approximately 650 million people and kills between one and three million, most of them young children in Sub-Saharan Africa (Finkel).

As we entered the 21st century, dengue had become the most important mosquito-borne disease affecting humans after malaria. According to the World Health Organization, 50 to 100 million infections of dengue occur yearly, including 500,000 cases of dengue hemorrhagic fever (2010).

Lyme disease is the most common tick-borne disease in North America and Europe. It is one of the fastest-growing infectious diseases in the United States (Cunha, 2009).

#### **Impact of Climate Change**

Because these diseases are spread by organisms such as insects or ticks that are sensitive to climatic conditions, it is believed that climate change will have an impact on the transmission and incidence of these diseases. For instance, some temperate regions may now be hospitable to disease-carrying insects and ticks that previously could not survive in the coldest winter temperatures. According to the Centers for Disease Control and Prevention (2010), "Where malaria is found depends mainly on climatic factors such as temperature, humidity, and rainfall. Malaria is transmitted in tropical and subtropical areas, where

- \* *Anopheles* mosquitoes can survive and multiply
- \* Malaria parasites can complete their growth cycle in the mosquitoes ("extrinsic incubation period")."

### Climate Change and Malaria



(Rogers & Randolph, 2005)

“Temperature is particularly critical. For example, at temperatures below 20°C (68°F), *Plasmodium falciparum* (which causes severe malaria) cannot complete its growth cycle in the *Anopheles* mosquito, and thus cannot be transmitted” (CDC, 2010).

Dengue fever, also known as dengue hemorrhagic fever or breakbone fever, is a viral disease spread by two different mosquito species. As a result of climate change, increased rainfall in conjunction with warmer temperatures will provide optimal growing conditions for these insects. Dengue also has the potential of increasing dramatically in areas where climate change is decreasing rainfall (CDC, 2009).

The *Aedes* mosquitoes, which carry the disease-causing virus, breed well in small containers used for household water storage. In areas where water availability is reduced and the use of such water storage containers is increasing, additional breeding opportunities may be provided. Through both of these changes dengue is expected to expand into new areas (CDC, 2009).

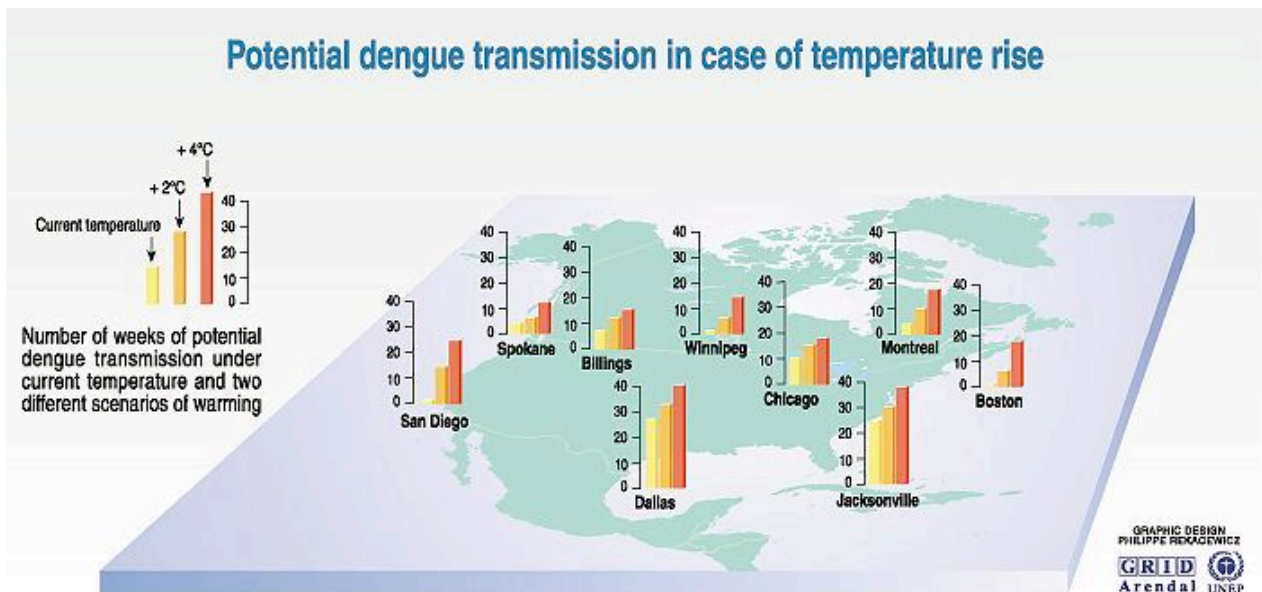
According to the IPCC’s fourth assessment report (2007), climate change will put 3.5 billion people at risk of contracting dengue fever by the year 2085. Dengue may hold particular risks for those residing in the Americas. The number of cases reported in this part of the world increased from 66,000 in 1980 to 890,000 in 2007 (CDC, 2009).

Unlike malaria, dengue is both an urban and rural disease. The disease causes severe headaches and muscle and joint pain, along with fever and a bright red rash. Approximately 2 to 3% of those infected die (CDC, 2009).

Other non-vector transmitted diseases are also thought to be impacted by climate change. Cholera is a severe diarrheal disease caused by the bacterium *Vibrio cholerae*. Transmission to humans occurs by ingesting contaminated water or food. Because climate change involves severe shifts in weather, water sources can be impacted strongly by such things as flooding. This in turn can influence the rate of infection in affected areas (WTO, 2010).

**Research Findings**

According to an article in the journal *Nature*, there is a link between climate change and the patterns of cholera infection. Using 40 years of records detailing the incidence of cholera in part of Bangladesh, the researchers created a computer model that took into account such things as disease transmission in the region, local patterns of immunity, and climate factors. They found that both drought and floods increased the spread of cholera (Koelle, Rodó, Pascual, Yunus, & Mostafa, 2005).



The IPCC's Fourth Assessment Report: *Climate Change Impacts, Adaptation, and Vulnerability*, addresses the possible impact of climate change on malaria in Africa:

- By 2100 (there is projected to be) a 16% to 28% increase in person-months of exposure.
- Countries with large areas that are close to the climate threshold for transmission show large increases across all scenarios.
- Despite the known causal links between climate and malaria transmission dynamics, there is still much uncertainty about the potential impact of climate change on malaria at local and global levels.

### **Conflicting Perspectives**

In an April 26, 2006 statement to the Committee on Senate Commerce, Science, and Transportation Paul Reiter, PhD, professor and chief of the insects and infectious disease unit of the Institut Pasteur in Paris, France, said:

"Malaria is not an exclusively tropical disease."

"In the early 1990s, malaria topped the list of dangerous impacts of global warming; the disease would move to temperate regions as temperatures increased. This prediction ignored the fact that malaria was once an important cause of morbidity and mortality throughout most of the US and Europe, even in a period that climatologists call the 'Little Ice Age.'"

"The most catastrophic [malaria] epidemic on record anywhere in the world occurred in the Soviet Union in the 1920s, with a peak incidence of 13 million cases per year, and 600,000 deaths. Transmission was high in many parts of Siberia, and there were 30,000 cases and 10,000 deaths in Archangel, close to the Arctic Circle."

### **Interrelated Impacts:**

- Severe weather causing flooding or droughts influences the rate of transmission.
- Any increase in the number of Category 4 or 5 hurricanes and cyclones will result in increased water source contamination, possibly increasing cholera.
- Changing climate and ecosystems may result in agricultural and timber-related epidemics such as mountain pine beetle, red band needle blight, and sudden oak death.
- Sea level rise, reductions in agricultural productivity, and loss of freshwater will each add economic and social stresses, particularly in poor nations, that will make it harder to control the spread of disease.
- Increased disease incidence requires increased expenditures in the way of response. These funds compete with other needs such as the provision of food and mitigation responses to climate change.

## **“Tropical Diseases Back as Europe Warms Up”**

By Maurice Chittenden, *Sunday Times* (London), January 7, 2007

Scientists have uncovered the first evidence that diseases such as malaria, long thought beaten in Europe, are making a comeback because of climate change. Holiday makers could be at risk this summer because the disease has already re-emerged in Italy, where Mussolini once drained marshes to try to eradicate it.

Italy was declared malaria free in 1970 but cases of malaria are now being registered every year in the country's southern regions. "We are at the southern edge of the globe's temperate area and that's why Italy is being hit most by the shattering of climatic equilibriums. As a result we are importing illness from Africa," said Francesco Ferrante, director-general of Legambiente, an Italian environmental association which has produced a new report on the hazards of climate change.

Other illnesses taking advantage of the warmer weather include tick-borne encephalitis. Up to 1993 only 18 cases of the illness—an acute virus-induced inflammation of the brain—had been reported in Italy since modern records began, but there have been almost 100 since, mostly around Venice. Visceral leishmaniasis, a potentially fatal tropical disease caused by parasites and transmitted by sandfly bites, is also making a comeback. Since 2000 more than 150 cases

have been recorded in Italy each year, compared with about 50 up to 1990. The southern region of Campania, around Naples, is the worst hit.

Farm animals are not exempt from the effects of climate change, with fatal illnesses such as bluetongue disease traveling from Africa to southern Italy. Climate change is also having its effect on wildlife. According to the Italian report, 20% of Mediterranean fish are now tropical species that have emigrated from the Red Sea. A study on climate change by the European commission, to be released this week, says that Britain's North Sea coast could replace the French Riviera and warns that increased temperatures could cause the deaths of 120,000 people a year in Europe by the end of this century.

So far, most of the new arrivals in Britain have been more colourful than dangerous. The number of butterfly and moth species migrating to Britain for the summer has increased fourfold in the past 25 years, according to research by the UK's Centre for Ecology and Hydrology.

However, Tim Sparks, who led the study, said that future arrivals could include malaria-carrying mosquitoes and the Colorado beetle, which can destroy potato crops. "The possible consequences require immediate attention," he said.

**The Projected Impact of Climate Change on  
AGRICULTURE**

**Document 3**

**Background Information**

It seems obvious that any significant change in climate on a global scale would impact local agriculture, and therefore affect the world's food supply. Considerable study has gone into questions of how farming might be affected in different regions, by how much, whether the net result may be harmful or beneficial, and to whom. Several uncertainties limit the accuracy of current projections. One relates to the degree of temperature increase and its geographic distribution. Another pertains to the concomitant changes likely to occur in the precipitation patterns that determine the water supply to crops, and to the evaporative demand imposed on crops by the warmer climate.

**Impact of Climate Change**

Higher temperatures will have variable impacts on agriculture. In middle and higher latitudes, global warming will extend the length of the

potential growing season, allowing earlier planting of crops in the spring, earlier maturation and harvesting, and the possibility of completing two or more cropping cycles during the same season.

Crop-producing areas may expand poleward in countries such as Canada and Russia, although yields in higher latitudes will likely be limited due to the less fertile soils that lie there. When temperatures exceed the optimal for biological processes, crops often respond negatively with a steep drop in net growth and yield. Another important effect of high temperature is accelerated physiological development, often resulting in hastened maturation and reduced yield.

Climate change will modify rainfall, evaporation, runoff, and soil moisture storage. Changes in total seasonal precipitation or in its pattern of variability are both important. Increased evaporation from the soil and accelerated transpiration in the plants themselves will cause moisture stress; as a result there will be a

**Impacts of Climate Change on Crop and Livestock Yield and Forest Production by 2050**



Data source: Working Group II contributions to the IPCC Fourth Assessment Report: "Climate Change Impacts, Adaptation and Vulnerability," Chapter 5 "Food, Fiber, and Forestry Products," page 302. 2007

need to develop crop varieties with greater drought tolerance. The demand for water for irrigation is projected to rise in a warmer climate, bringing increased competition between agriculture—already the largest consumer of water resources in semiarid regions—and urban and industrial users.

Falling water tables and the resulting increase in the energy needed to pump water will likely make the practice of irrigation more expensive, particularly in drier conditions when more water will be required per acre.

Extreme meteorological events, such as heat waves, heavy storms, or droughts, disrupt crop production. An expected increase in convective rainfall—caused by stronger gradients of temperature and pressure and more atmospheric moisture—may result in heavier rainfall, which can cause increased soil erosion.

Conditions are more favorable for the proliferation of insect pests in warmer climates. Longer growing seasons will enable insects such as grasshoppers to complete a greater number of reproductive cycles during the spring, summer, and autumn. Warmer winter temperatures may also allow larvae to winter-over in areas where they are now limited by cold, thus causing greater infestation during the following crop season (Rosenzweig & Hillel, 1995).

### **Research Findings**

According to the contribution of working group II to the *Fourth Assessment Report* of the IPCC :

- Importantly, crop production in developing countries would suffer more, and earlier, than in developed countries due to a combination of adverse agro-climate, socio-economic and technical conditions.
- In mid-to-high latitude regions, moderate warming benefits cereal crop and pasture yield, but even a slight warming decreases yields in seasonally dry and tropical regions.
- Projected changes in the frequency and severity of extreme climate events have significant consequences on food and forestry production and food insecurity.

According to the United States Department of Agriculture Natural Resources Conservation Service (1995):

- The timing and length of growing seasons might shift geographically, which would alter planting and harvesting dates and likely result in a need to change crop varieties currently used in a particular area.
- Seasonal precipitation patterns and amounts could change. With warmer temperatures, evapotranspiration rates would rise, which would call for much greater efficiency of water use.
- Perhaps most important of all, there is general agreement that in addition to changing climate, there would likely be increased variability in weather, which might mean more frequent extreme events such as heat waves, droughts, and floods.

According to the United States Environmental Protection Agency (2010):

- Agriculture is highly sensitive to climate variability and weather extremes, such as droughts, floods and severe storms. The forces that shape our climate are also critical to farm productivity. Human activity has already changed atmospheric characteristics such as temperature, rainfall, levels of carbon dioxide (CO<sub>2</sub>), and ground level ozone.
- The scientific community expects such trends to continue. While food production may benefit from a warmer climate, the increased potential for droughts, floods and heat waves will pose challenges for farmers.
- The enduring changes in climate, water supply and soil moisture could make it less feasible to continue crop production in certain regions.

### **Conflicting Perspectives**

According to Dr. Tim Ball, a former geology professor at the University of Winnipeg, “A warmer Canada would improve our lives in these and other ways too numerous to list. Global warming? Let’s hope so.” Ball suggests that global warming could lead to:

- A longer growing season, allowing a greater variety of crops.
- Less frost damage and crop loss.
- A greater variety of plants for gardens and other uses.
- More rapidly growing forests and an increased rate of reforestation (2006).



**Interrelated Impacts:**

- Severe weather, such as spells of high temperature, heavy storms, or droughts disrupt crop production.
- Any increase in the number of Category 4 or 5 hurricanes and cyclones will result in increased water source contamination and related diseases such as cholera.
- Sea level rise will inundate some coastal agricultural areas and damage water tables necessary for irrigation.
- Loss of biodiversity due to climate change will impact the availability of plant species and the supportive organisms that provide services (e.g. bees) and control pests (e.g. bats).
- Agriculture may be impacted as changes in CO<sub>2</sub> concentrations alter the photosynthetic processes of plants.
- In some areas, irrigation will become increasingly necessary, creating increased freshwater scarcity.
- Changes in temperature affect both the growing season of plants and the growth conditions of their pest species. Warming could lead to increases in pest population and disease by lengthening the annual reproductive period, thus allowing some pest species to complete a greater number of reproductive cycles each year.
- Rapid shifts in agricultural productivity, both positive and negative, will lead to economic instability that will likely threaten the poorest populations.

### **“How Will Agriculture Adapt to a Shifting Climate?”**

By Alhagie Jobe, *Daily Observer* (Gambia), December 28, 2006

Awareness of climate change and its risks has now made it firmly onto the international agenda. Former U.S. Vice-President Al Gore recently released a documentary, *An Inconvenient Truth*, on the risks of global warming, and in October 2006 Sir Nicholas Stern, a U.K. Treasury official and former World Bank economist, published the “Stern Review on the Economics of Climate Change,” a 700-page report arguing that the risks are large and the costs of acting now are relatively small.

“Climate change is rapidly emerging as one of the most serious threats that humanity may ever face,” said Kenyan Environment Minister Kibwana at the opening of the United Nations Climate Change Conference on November 6. The conference, of which Kibwana was president, brought together representatives of the 166 parties to the Kyoto Protocol for their second meeting.

Because it is linked so closely to natural resources and climate conditions, agriculture will keenly feel the effects of climate change through changes in both temperature and precipitation, and thus the availability of water for growing food.

Scientists predict that the interiors of major continents will warm more quickly than the oceans. In addition, current weather extremes are likely to be exacerbated. It is likely that wet areas of the world will get even wetter, and dry areas will get drier. Thus, for example, monsoons in South Asia will intensify, while arid regions of Africa will become drier. Mark Rosegrant, director of the International Food Policy Research Institute’s (IFPRI) Environment and Production

Technology Division, points out, “Agriculture is the largest consumer of water globally, and as climate change alters the quantity and reliability of water supplies, it could threaten the welfare of millions of poor farmers.”

Clearly, controlling and ultimately reducing greenhouse gas emissions are essential to minimizing the severity of global climate change and its harmful effects. Yet global warming has already begun, and given the levels of past greenhouse gas emissions, it will continue for decades.

According to Bob Watson, World Bank’s Chief Scientist and Advisor for Environmentally and Socially Sustainable Development, “The Earth’s climate is already changing, and further change is inevitable. Therefore we need to both mitigate climate change and to adapt to climate change.

Clearly, the industrialized countries must take the lead in mitigating climate change by reducing greenhouse gas emissions, but large developing countries such as India and China will also have to start to reduce their emissions over the next 20 to 30 years, albeit with differentiated responsibilities. But for many countries, especially in Africa and small countries in Asia and Latin America, the challenge of the day is adaptation to current climate variability and climate change.”

#### **Africa to Be Hardest Hit**

Of all the world’s regions, Africa is likely to be hardest hit by the impacts of global warming. Climate models differ, but according to the U.K.’s Hadley Centre for Climate Change, a leading producer of global climate change estimates, temperature

increases in parts of Africa could be double the global average increase. Given Africa's heavy dependence on agriculture—agriculture employs 70 percent of people in Africa—the effects of climate change could put millions of people there at greater risk of poverty and hunger.

Africa is particularly vulnerable to climate change because of its high proportion of low-input, rainfed agriculture, compared with Asia or Latin America. The Food and Agriculture Organization of the United Nations (FAO) reports that rainfed agriculture is used on 95 percent of cropland in Sub-Saharan Africa. "This type of exposure to rainfall variability also extends to livestock, which mostly depend on range and grasslands that are affected by environmental shocks, such as climate change," says Siwa Msangi, an IFPRI researcher.

In addition, temperatures in Africa are already generally high and rainfall patterns often erratic, and climate change that exacerbates these

and governments to invest in adaptations to climate conditions will thus create even more hardship. Most important, poverty is widespread in Africa, and governments typically face tight budget constraints, making it much harder for individuals change.

Moreover, Africa accounts for 30 percent of global land degradation, so farmers are already struggling to grow crops on land that contains inadequate nutrients and has little capacity to retain water. According to a November 2006 report from the United Nations Framework Convention on Climate Change (UNFCCC), climate models show that 80,000 square kilometers of agricultural land in Sub-Saharan Africa that is currently classified as water constrained will experience more rainfall with climate change. On the other hand, a much larger 600,000 square kilometers classified as moderately water constrained will become severely water limited. This will create even more challenges for African farmers, even for subsistence crops like millet, groundnuts, and sorghum.

## **The Projected Impact of Climate Change on SEA LEVEL RISE**

### **Document 4**

#### **Background Information**

Just as temperature has varied greatly over the history of our planet, so too have our ocean levels. These two aspects of our ever-changing planet are linked. At any point in time, a certain amount of the planet's surface water is frozen in the form of polar ice caps and glaciers. Depending on the average climate of the time, the amount of water trapped in this frozen form varies. During periods of glaciation, when greater amounts of water are locked into polar caps and glaciers, the sea levels of the Earth have been much lower. It is believed that during our last ice age, humans first reached North America by walking across what is now the Bering Strait from Asia to North America. During warmer periods, much less water is in frozen form and thus contributes to the ocean's volume, raising sea levels.

Since the most recent ice age, which ended about 11,000 years ago, major ice deposits have been located at each of the Earth's poles, in the glaciers and ice fields of Greenland, and in other isolated glaciers located around the world. While world maps and globes seem to indicate similar volumes of ice at each pole, the arctic ice sheet averages only about 10 feet in thickness, while the ice of Antarctica has an average depth of 7,000 feet and in many places exceeds over 13,000 feet in depth. Also, while millions of cubic meters of ice are located in mountain glaciers throughout the world, this volume is dwarfed by the amount of ice held in Greenland's interior. Thus the two deposits of ice with the highest potential to affect sea level are those in Antarctica and Greenland.

It is also important to consider the differential impact of ice deposits on sea levels depending on their specific location. Floating sea ice, such as that making up the Arctic polar cap, will not affect sea levels if melted. This is due to the fact that their volume is already impacting sea level through their buoyancy. On the other hand, ice deposits that are located on land (such as those in Greenland) or "perched" on shallow sea beds (such as those in the Western Antarctic Ice Shelf) will increase sea levels if they melt or slide into the ocean (EPA, 2010).

#### **Impact of Climate Change**

According to the U.S. Geological Survey (2010), "The vast majority, almost 90 percent, of Earth's ice mass is in Antarctica, while the Greenland ice cap contains 10 percent of the total global ice mass." Of the ice located in Antarctica, the Western Antarctic Ice Shelf is recognized as being the most vulnerable to the melting influences of climate change. Already, huge deposits of sea ice, which help hold the western shelf in place, have shown sometimes abrupt decay (Romm, 2009).

According to the National Snow and Ice Data Center, satellite imagery revealed that the northern section of the Larsen B ice shelf, a large floating ice mass on the eastern side of the Antarctic Peninsula, has shattered and separated from the continent. The shattered ice formed a plume of thousands of icebergs adrift in the Weddell Sea. A total of about 3,250 km<sup>2</sup> of shelf area disintegrated in a 35-day period beginning on 31 January 2002. This section represented an area roughly the size of Rhode Island.

Estimates of the volumes of ice located in the glaciers and ice fields of Greenland and those of the Western Antarctic Ice Shelf indicate that these two ice deposits would raise sea levels by approximately 20 feet each, if fully melted.

#### **Impact of Sea Level Rise**

In "Global Estimates of the Impact of a Collapse of The West Antarctic Ice Sheet" (2005), Robert J. Nicholls, Richard S.J. Tol, and Athanasios T. Vafeidis used 1995 population data to estimate that over 400 million people (approximately 8% of the global population at the time) would be displaced in the event of a 5 meter sea level rise. As sea levels rise millions of environmental refugees will be displaced (from Bangladesh alone). Productive cropland will be flooded and new land will be taken up by those displaced.

Sea level rise will have many far-reaching impacts on civilization. Low-lying lands, including entire nations, are at risk of being inundated. Many of the world's largest cities are located near the coast. In fact, according to the IPCC's 2007 Fourth Assessment

Report, it is estimated that 23% of the world's population lives both within 100 km distance of the coast and less than 100 m above sea level. Sixty percent of the world's 39 metropolises with a population over 5 million are located within 100 km of the coast, including 12 of the world's 16 cities with populations greater than 10 million.

Significant sea level rise would displace millions of people and cause severe economic damage. These impacts are likely to be exacerbated by more frequent and intense tropical storms that may result from climate change, adding to the risk of flooding and erosion of protective beaches and dunes.

Significant sea level rise would have a tremendous effect on coastal regions around the world and would likely lead to an unprecedented refugee crisis. Those nations and regions least able to adapt to rising seas will be most affected.

Many countries called small island developing states (SIDS) by the UN Framework Convention on Climate Change (UNFCCC) possess several characteristics that make them especially susceptible to the effects of sea level rise, according to a UN paper titled "Vulnerability and Adaptation to Climate Change in Small Island Developing States." Their typically small physical area limits their natural resources, economies, and ability to adapt to and mitigate climate change.

These nations are also relatively isolated, further limiting resources and major markets available to them. Tourism serves as a major economic booster

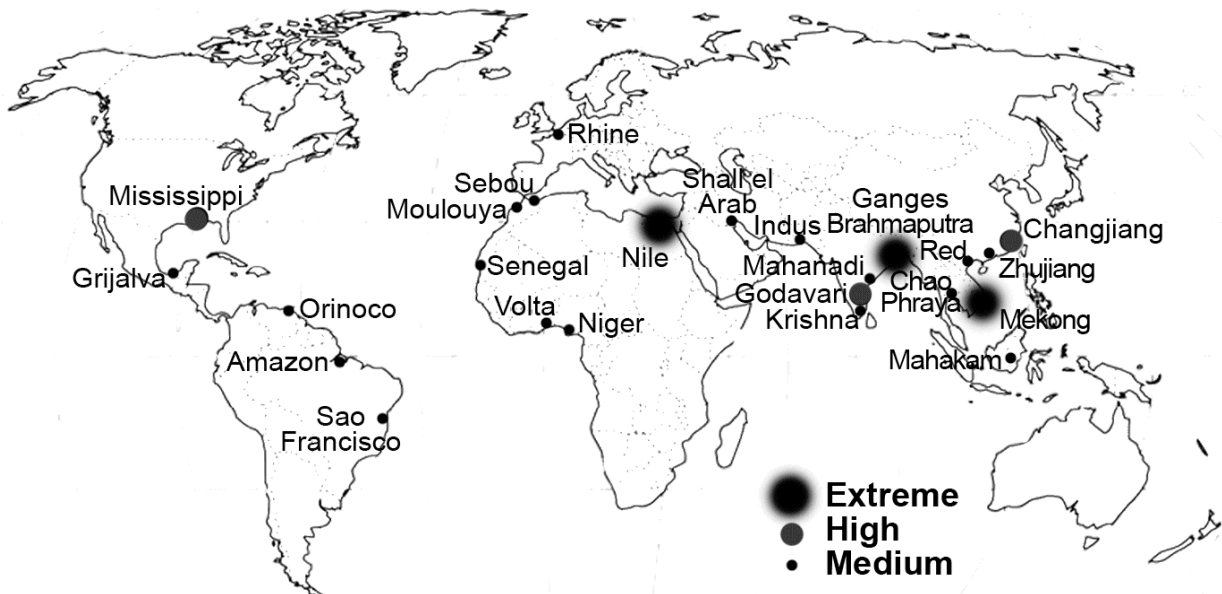
to many of these countries, and the adverse effects of climate change could reduce their appeal to travelers. Also, the populations of these nations are usually highly concentrated, and their infrastructure is often inadequate. Many valuable assets to these SIDS, such as coastal villages, traditions, and community structure, may be lost to rising sea levels.

Sea level rise will result in the loss of natural coastal habitat, including wetlands and estuaries. Coastal wetlands regulate water levels and mitigate the impact of storm surges. These wetlands filter pollution and support estuaries, some of the most biologically diverse and productive areas on the planet. Loss of these low-lying wetland areas will effect both flooding and food production. Freshwater supplies may also be at risk if sea levels rise, causing an increase in the salinity of rivers, bays, groundwater, and aquifers.

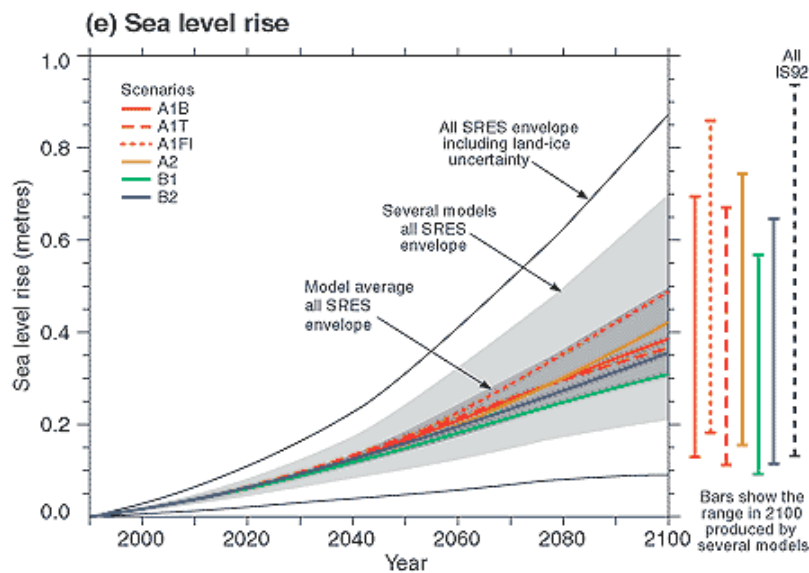
According to Jim Hansen, the director of the NASA Goddard Institute for Space Studies and former President George W. Bush's top climate modeller (2006):

"We know that...14,000 years ago, sea levels rose 20 m in 400 years, that is 5 meters in a century...The last time the world was three degrees warmer than today—which is what we expect later this century—sea levels were 25 m higher. So that is what we can look forward to if we don't act soon."

### Relative Vulnerability of Coastal Deltas



Data source: Working Group II contribution to the IPCC Fourth Assessment Report. Page 327



This IPCC chart from 2001 shows projects of sea level rise based on 7 different projections related to the melting of the Greenland and Antarctic ice sheets.

Data source: Working Group I contributions to the IPCC Third Assessment Report: "Climate Change 2001: The Scientific Basis"

### **Positive Feedback Loops**

The melting of significant amounts of sea ice will likely lead to an increase in the rate of global warming. Ice is highly reflective, sending incoming solar radiation back into the atmosphere in a form that is not captured by greenhouse gases. Ice reflects approximately 80% of the incoming solar energy, while seawater absorbs approximately 80% of the remaining energy. As ice caps melt, our planet absorbs more heat.

According to a 2010 article in *ScienceDaily*, Significant melting of sea ice may further speed up climate change through the release of greater quantities of methane. As the Arctic sea ice melts, the oceans will tend to warm more quickly. If the Arctic Ocean were to warm enough, huge deposits of methane hydrates could be released from the ocean sediments. Methane is a very powerful greenhouse gas, with heat trapping capacity 23 times that of CO<sub>2</sub>.

### **Conflicting Perspectives**

But the science for predicting the speed and extent of seal level rise is based on a variety of computer models and is therefore subject to dispute. In "Global Warming FAQ: What Every Citizen Needs to Know About Global Warming" (2006) Iain Murray of the Competitive Enterprise Institute said:

- The researchers report a net contribution of the [Greenland and Antarctic] ice sheets to sea level of +0.05 +/-0.03 millimeters per year" (Referring to research done by Zwally in 2005).
- CO2Science.org puts this in perspective: "At the current sea-level-equivalent ice-loss rate of 0.05 millimeters per year, it would take a full *millennium* to raise global sea level by *just* 5 cm, and it would take fully *20,000* years to raise it a *single meter*."

### **Interrelated Impacts:**

- Hurricanes will do greater damage as sea levels rise.
- An increase in intensity and rainfall of severe storms will increase flood and wind damages.
- Coastal agriculture may be flooded and impacted by saltwater intrusion.
- Rising sea levels will increase the salinity of freshwater supplies, including rivers, bays, groundwater, and aquifers, contaminating them.
- Coastal estuaries (some of the most biologically diverse and productive areas on the planet) will be lost. This could negatively affect food availability and drastically reduce biodiversity.
- As sea levels rise, millions of environmental refugees will be displaced.
- Flooding of coastal cities worldwide will cause unprecedented economic challenges.
- The cost of coping with significant sea level rise will cause resources to be diverted from other social and environmental needs.

## “The Submerging World”

By Bill McKibben, *Orion* magazine, September 2004

Warm water takes up more space than cold water does. That simple fact of physics, utterly inexorable, is one of the two or three most important pieces of information humans will have to grapple with in this century. And the people who get to grapple with it first are in places like Tuvalu, where suddenly the spring high tides are washing across the island of Funafuti, eroding foundations and salt-poisoning crops in the fields. Tuvalu is the canary in the miner’s cage, and instead of choking it’s drowning. Tuvaluans have begun to work out plans for evacuating the population over the course of the next decades as the sea rises.

The warmer water, of course, is a product of steadily increasing global temperature, just like melting permafrost, shrinking glaciers, and increased evaporation over deserts. And the global temperature rises because we burn oil and coal and gas, which inexorably produce as a byproduct of their combustion carbon dioxide—carbon with two oxygen atoms, a molecular structure that traps heat that would otherwise radiate back out to space.

When I say “we,” of course, I don’t mean all of us. People in Tuvalu don’t burn much coal and gas and oil—it’s warm there year-round...

In truth, no one in the submerging world has earned the fate that’s about to befall Tuvalu. A hundred and forty million people live in Bangladesh, half the population of our fifty states, but when the United Nations tries to figure out how much CO<sub>2</sub> they produce, the number is a minuscule rounding error.

Almost as minuscule as their chances of living out the century in their homeland, for Bangladesh is low to the ocean. When the Bay of Bengal rises, the Ganges and the Brahmaputra, great sacred rivers of Asia, will back up and flood the country.

When I say “we,” I mean we proud, we few, we Yanks. Four percent of the Earth’s population, 25 percent of its CO<sub>2</sub>. Earlier this year, Hollywood offered its global warming epic, *The Day After Tomorrow*, which depicted climate change destroying... New York City. Enormous waves overtopped the Statue of Liberty and then, oddly, the city froze solid in a matter of minutes, in a blizzard that also enveloped our nation’s capital. One hopes that *The Day After Tomorrow* doesn’t play in Tuvalu, or in Dhaka, or in the Maldives, or on the coastal plain of China, or any of the thousand other spots that will feel first and foremost the effects of global warming. It seems too much to ask that they feel fright or pity for fictional Manhattanites and

Washingtonians when real Manhattanites and Washingtonians have felt nothing whatever for them.

Recent polling indicated that the single most salient issue for American voters in this year’s election is not Iraq, not the deficit, but the price of gas. Too high, the price of gas. Faced with the high price of gas, why worry that Tuvalu has a culture that may date back four thousand years? Why worry that as we raise the temperature of the oceans we not only make them larger but we also—inexorably—kill off the coral reefs that surround these islands? Marine scientists have warned that this most benign and teeming of all ecosystems may not make it to mid-century. Already, widespread bleaching from higher temperatures has sterilized many reefs. Oh, and when the reefs die off and disintegrate, islands like Tuvalu’s, with nothing to break the surf, are opened to increased wave action, which merely compounds the problem of rising seas...

You could come up with reasons to worry, but I fear that none of them, in the end, would be persuasive. Think back for a moment. When we wanted Muslim allies for the war on terror and to keep peace in Iraq, Bangladesh was one of the countries we turned to. We needed the Bangladeshis’ help with our big problem. But it wouldn’t occur to us even to ask if we might be of help with their big problem. Because helping would require us to change...

I keep using the word “inexorable,” but only as a tease. There is nothing inexorable about what is happening to Tuvalu, and to every other place on the planet. It is all happening by choice, our choice; we are engaging in a reckless drive-by drowning of much of the rest of the planet and much of the rest of creation. Admittedly, no one intends this destruction—on the other hand, nobody is doing much of anything to stop it, either. Eventually, of course, our inaction will do enormous damage even to our midlatitude fortress continent. Those pictures of crumbling foundations, swelling lagoons—that’s our future too, along with parched deserts, dying forests, discombobulated agriculture. But by the time that future kicks in, later in the century, we will be hard-pressed to say we don’t deserve it. Right now, global warming is coming first for the Tuvaluans—a little like last century’s scourge came first for the Jews. It took us too long, but eventually we roused ourselves to help meet that challenge with sacrifice and with fortitude. I wonder what we’ll do about this one.

## The Projected Impact of Climate Change on SEVERE WEATHER

### Document 5

#### Background Information

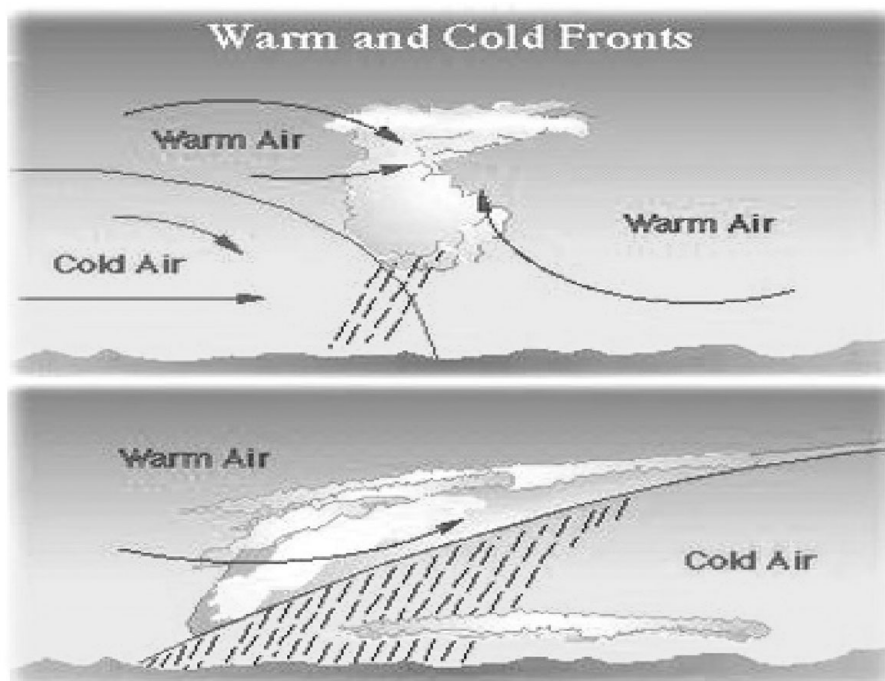
The term “weather” refers to the day-to-day temperature, cloud cover, precipitation, and wind conditions brought to a specific location through the interaction of air masses in our lower atmosphere. Air masses absorb different amounts of energy depending on their locations. This not only gives them different temperatures, but unique pressure and moisture characteristics as well. Masses of warm air tend to be less dense than cold air and therefore tend to rise. The warmer the air, the more water vapor it is able to hold. Cooler air masses tend to be more dense and dry.

Air masses take on different temperatures for a variety of reasons. For instance, the daily cycle of solar days and nights affect land and large bodies of water differently. Water is slower to shift its temperature when the sun rises and so air masses over land and sea are often different temperatures. Air masses located over areas of higher latitude tend to take on colder temperatures relative to air masses located closer to the equator. Even cities and large geological formations cause differential warming and cooling due to differences in reflectivity and absorption of solar

energy, thereby impacting the weather.

Air masses move, creating changing weather conditions for a variety of reasons. Sometimes the rising of one air mass will cause another to move horizontally into the space provided. The rotation of the Earth causes a global swirling of air known as the Coriolis effect. Major ocean currents that carry water of different temperatures influence the air masses above them. Even the seasonal changes in temperature of vast areas of the ocean influence air mass movement through phenomena such as El Niño and La Niña.

When air masses of differing temperatures meet, they tend to seek different elevations in our atmosphere and impact one another, sometimes violently. For instance if a mass of warm moist air runs into a mass of cold dry air, a front develops. As the colder heavier air mass slides under the mass of warmer, moister air, wind is created. As the cooler air lowers the temperature of the warm air that it meets, the warm air releases some of its moisture as precipitation (Short).



Weather includes phenomena such as wind, various forms of precipitation (rain, snow, sleet, and hail) as well as fog and severe events such as thunderstorms and even tornados. Extended severe weather patterns are responsible for flooding and drought.

In this lesson, hurricanes, cyclones and typhoons will be considered separately and are addressed in a separate reading (Short).

### **Impact of Climate Change**

Because weather is so closely involved with the absorption, flow, and exchange of heat energy, it is closely linked to global warming. As the Earth's average temperature increases, energy availability and flow will be changed. Due to the gradual warming of our oceans and soils, evaporation rates are expected to increase. The resulting increase in atmospheric moisture will in turn increase precipitation globally.

However, due to the widely varying influences affecting the absorption of energy and moisture by air masses, distribution of this additional precipitation is expected to be highly variable, both geographically and temporally. For instance, as global warming proceeds, the increases in temperature are predicted to produce more intense convection over land areas, which will lead to more severe weather events. A 2007 study by NASA's Goddard Institute for Space Studies used computer models to show that as our climate warms, land areas will warm more quickly than oceans, which will likely increase severe weather events:

"The prediction of stronger continental storms and more lightning in a warmer climate is a natural consequence of the tendency of land surfaces to warm more than oceans and for the freezing level to rise with warming to an altitude where lightning-producing updrafts are stronger. These features of global warming are common to all models..."

According to the National Oceanic and Atmospheric Administration, climatologists also believe that a relationship exists between the gradual warming of our planet and the El Niño / La Niña cycle. During the La Niña phase of this cycle, dominant westerly winds tend to gradually push the warm surface waters of the southern Pacific westward toward Australia. This allows the cooler Humboldt ocean current to surface off the Pacific coast of South America.

The El Niño part of the cycle occurs when the westerly winds weaken. This allows the warm surface waters of the southern Pacific to shift back to the east, preventing the Humboldt from surfacing. This shift in the oceans surface waters causes humidity to be released into the atmosphere.

The warmer waters off of the Pacific coast of South America bring floods to this normally arid region of South America. Simultaneously, the cooler waters now surfacing in the western Pacific do not yield as much moisture to the air masses there and result in

droughts to Australia and Southeast Asia. Consistently strong El Niño conditions have been known to afflict two-thirds of the globe with droughts, floods, and extreme weather. Currently, a shift is underway toward more frequent El Niño conditions.

### **Research Findings**

A 2005 study by the National Center for Atmospheric Research points to global warming as a key factor in the growth of drought conditions:

- The percentage of Earth's land area stricken by serious drought more than doubled from the 1970s to the early 2000s... Widespread drying occurred over much of Europe and Asia, Canada, western and southern Africa, and eastern Australia. Rising global temperatures appear to be a major factor, says NCAR's Aiguo Dai, lead author of the study.
- "Global climate models predict increased drying over most land areas during their warm season, as carbon dioxide and other greenhouse gases increase," says Dai. "Our analyses suggest that this drying may have already begun."

According to a 2007 press release from the World Meteorological Organization:

- Weather and climate are marked by record extremes in many regions across the world since January 2007.
- During the first half (June-July) of the Indian summer monsoon season, four monsoon depressions (double the normal frequency) caused heavy rainfall and floods in India, Pakistan and Bangladesh.
- Cyclone Gonu, the first documented cyclone in the Arabian Sea, made landfall in Oman on 6 June with maximum sustained winds near 148 km/h.
- Heavy rains during 6-10 June ravaged areas across southern China. Flooding affected over 13.5 million people with more than 120 fatalities due to floods and landslides.
- An unusual cold winter season brought winds, blizzards and rare snowfall to various provinces in South America with temperatures reaching as low as -22°C in Argentina and -18°C in Chile in the beginning of July.
- Many European countries had their warmest January on record.
- In India, a heat wave during mid-May produced temperatures as high as 45-50°C.



According to the IPCC's 2007 *Fourth Assessment Report*:

- More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and subtropics. Increased drying linked with higher temperatures and decreased precipitation have contributed to changes in drought. Changes in sea surface temperatures (SST), wind patterns, and decreased snowpack and snow cover have also been linked to droughts.
- The frequency of heavy precipitation events has increased over most land areas, consistent with warming and observed increases of atmospheric water vapour.

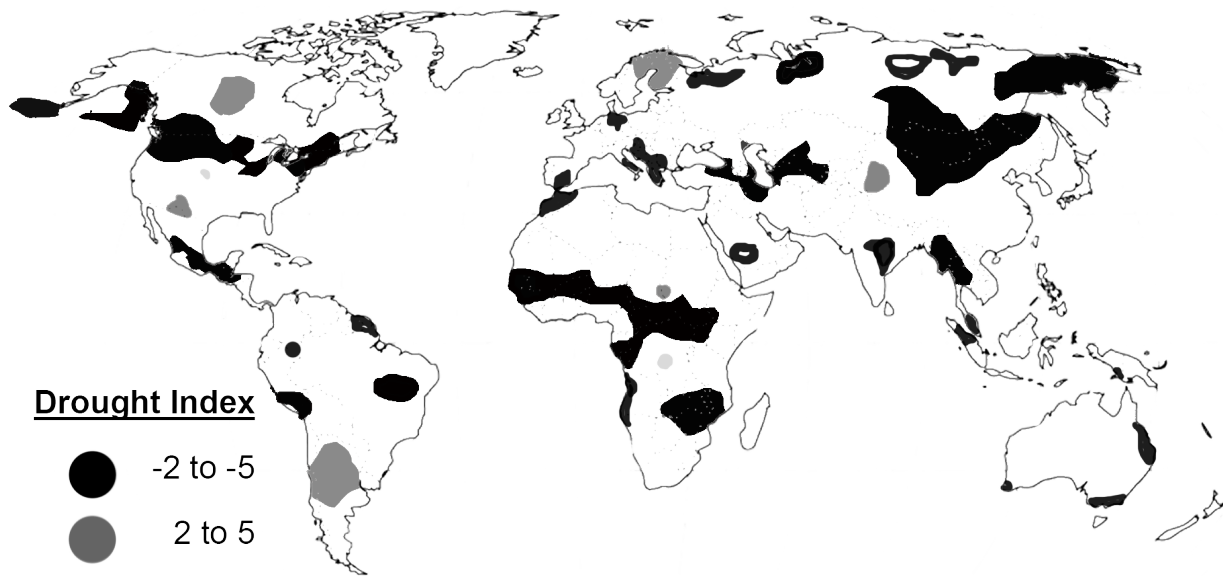
**Conflicting Perspectives**

According to climate scientist and co-author of the book *Human Impacts on Weather and Climate*, Roger Pielke, Sr. said in a 2008 interview:

- The IPCC reports... inaccurately present their assessment as a “projection”—one that’s widely interpreted by policymakers and others as being able to skillfully forecast the future state of the climate system.
- ...current climate models clearly cannot accurately model observed real-world changes in climate. Global model results projected out decades into the future should never be interpreted as skillful forecasts. Instead, they should be interpreted as sensitivity studies on limited variables.

**Drought Index by Region**

(-5 shows more severe drought, 5 shows a general moistening)



(American Meteorological Society)

**Interrelated Impacts:**

- Droughts and floods reduce agricultural productivity.
- Severe weather will likely increase erosion. The resulting loss of soil will affect agriculture and reduce natural carbon sinks.
- Flooding can spread disease as sanitation and water purification systems are inundated.
- Both droughts (less water) and flooding (greater percentage of runoff) can reduce access to freshwater.
- Severe weather damage puts economic strain on affected areas.
- Severe drying can lead to forest and brush fires, releasing CO<sub>2</sub>. The loss of living biomass reduces carbon sequestration.
- A shift from a predominant La Niña to a more dominant El Niño phase could affect the distribution of ocean nutrients and impact biodiversity in the most productive fisheries.

### **“Katrina’s Real Name”**

By Ross Gelbspan, *The Boston Globe*, August 30, 2005

The hurricane that struck Louisiana yesterday was nicknamed Katrina by the National Weather Service.

Its real name is global warming.

When the year began with a two-foot snowfall in Los Angeles, the cause was global warming. When 124-mile-an-hour winds shut down nuclear plants in Scandinavia and cut power to hundreds of thousands of people in Ireland and the United Kingdom, the driver was global warming.

When a severe drought in the Midwest dropped water levels in the Missouri River to their lowest on record earlier this summer, the reason was global warming.

In July, when the worst drought on record triggered wildfires in Spain and Portugal and left water levels in France at their lowest in 30 years, the explanation was global warming.

When a lethal heat wave in Arizona kept temperatures above 110 degrees and killed more than 20 people in one week, the culprit was global warming.

And when the Indian city of Bombay (Mumbai) received 37 inches of rain in one day—killing 1,000 people and disrupting the lives of 20 million others—the villain was global warming.

As the atmosphere warms, it generates longer droughts, more-intense downpours, more-frequent heat waves, and more-severe storms.

Although Katrina began as a relatively small hurricane that glanced off south Florida, it was supercharged with extraordinary intensity by the relatively blistering sea surface temperatures in the Gulf of Mexico.

The consequences are as heartbreaking as they are terrifying.

Unfortunately, very few people in America know the real name of Hurricane Katrina because the coal and oil industries have spent millions of dollars to keep the public in doubt about the issue. The reason is simple: To allow the climate to stabilize requires humanity to cut its use of coal and oil by 70 percent. That, of course, threatens the survival of one of the largest commercial enterprises in history.

In 1995, public utility hearings in Minnesota found that the coal industry had paid more than \$1 million to four scientists who were public dissenters on global warming. And ExxonMobil has spent more than \$13 million since 1998 on an anti-global warming public relations and lobbying campaign.

In 2000, big oil and big coal scored their biggest electoral victory yet when President George W. Bush was elected president—and subsequently took suggestions from the industry for his climate and energy policies.

As the pace of climate change accelerates, many researchers fear we have already entered a period of irreversible runaway climate change.

Against this background, the ignorance of the American public about global warming stands out as an indictment of the US media.

When the US press has bothered to cover the subject of global warming, it has focused almost exclusively on its political and diplomatic aspects and not on what the warming is doing to our agriculture, water supplies, plant and animal life, public health, and weather.

For years, the fossil fuel industry has lobbied the media to accord the same weight to a handful of global warming skeptics that it accords the findings of the Intergovernmental Panel on Climate Change—more than 2,000 scientists from 100 countries reporting to the United Nations.

Today, with the science having become even more robust—and the impacts as visible as the megastorm that covered much of the Gulf of Mexico—the press bears a share of the guilt for our self-induced destruction with the oil and coal industries.

As a Bostonian, I am afraid that the coming winter will—like last winter—be unusually short and devastatingly severe. At the beginning of 2005, a deadly ice storm knocked out power to thousands of people in New England and dropped a record-setting 42.2 inches of snow on Boston.

The conventional name of the month was January. Its real name is global warming.

## The Projected Impact of Climate Change on FRESHWATER

### Document 6

#### Background Information

According to U.S. Geological Survey (2010), there is more water on Earth than there is land. Seventy percent of the Earth's surface is covered by water, but only a very small percentage of water that is freshwater and usable for consumption.

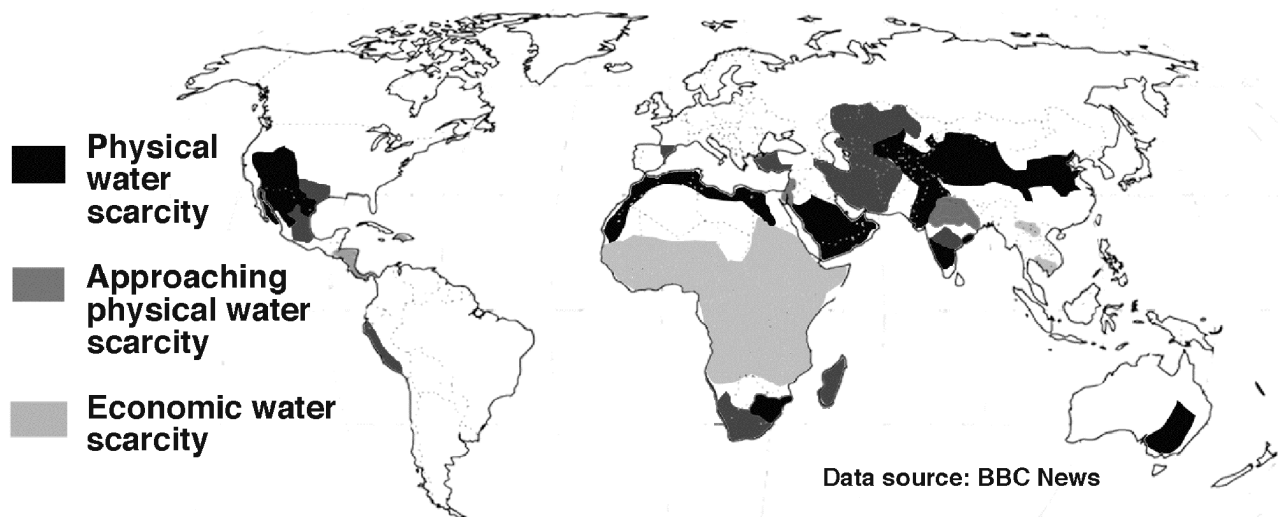
Of all the water on earth, 97% is saline (saltwater), making it unusable for drinking or agriculture. Of the 3% of earth's water that is fresh, nearly 70% is captured in glaciers and icecaps and 30% is in groundwater. Less than 1% of Earth's freshwater is found in rivers, lakes, and swamps, and is therefore available for direct consumption and agricultural needs. We also rely on freshwater for such things as cooking, cleaning, generating electricity, travel, food, certain industrial processes, and recreation. Beyond mere human consumption, freshwater is a key component of non-marine aquatic ecosystems and all of the diversity they support.

Water is constantly moving between vast reservoirs

(such as the ocean and atmosphere) in the hydrological cycle. Water moves into our atmosphere from our oceans, streams, lakes, and soils through evaporation, as well as through transpiration by plants. It returns as freshwater through seasonal rains and snows and is stored in lakes, snow pack, glaciers, and in the water table below ground.

There is great variability concerning the degree to which freshwater is available in different areas of the Earth. Areas along the Equator, such as from the Niger Delta to the Congo River basin, receive large amounts of rainfall annually. Other regions, such as the Sahara Desert, receive virtually no rain at all. Many regions often have unpredictable or highly variable rainfall. Because freshwater is not continually available through precipitation, a variety of sources function as key sources. Rivers and streams bring water to a large portion of our population. These can carry water deposited as rain or can carry melt-water from snow

### World Water Scarcity



**Physical water scarcity:** More than 75% of river flows are allocated to agriculture, industries, or domestic purposes (accounting for recycling of return flows). Dry areas are not necessarily water-scarce (e.g. Mauritania).

**Approaching physical water scarcity:** More than 60% of river flows are allocated. These basins will experience physical water scarcity in the near future.

**Economic water scarcity:** Water resources are abundant relative to water use, with less than 25% of water from rivers withdrawn for human purposes, but malnutrition exists.

pack or glaciers. Similarly, lakes are important source of fresh water. Ground water brought to the surface through wells is another significant source of freshwater for humanity.

Water scarcity occurs when the amount of water withdrawn from lakes, rivers, or groundwater is greater than the replenishment rate, diminishing access to freshwater over time. Many things can influence this balance:

- Population shifts (in number and location)
- Changes in land use (affecting soil evaporation, amount of runoff and rate of groundwater recharging)
- Changes in culture and water use patterns (agricultural shifts such as irrigation, changes in land cover, as well as technological shifts requiring water for industrial processes)
- Temperature changes (affecting melting and evaporation rates)
- Changes in precipitation patterns (both in amount and frequency or severity)
- Changes in water storage processes (such as the balance between the buildup and melting of glaciers and snow pack)
- Water scarcity can also be caused through contamination either by pollution or the influx of salt water

### **Impact of Climate Change**

According to *Webster's Dictionary*, climate is "the average course or condition of the weather at a place usually over a period of years as exhibited by temperature, wind velocity, and precipitation." Climate change, therefore, represents fundamental shifts in these patterns, all of which impact the hydrologic cycle, and through this, the relative availability of fresh water.

According to the IPCC's 2007 *Fourth Assessment Report*, "the impacts of future climate change will be mixed across regions of the world, with more than a billion people at risk of increased water stress."

The analysis of existing data by climatologist worldwide has identified fundamental changes in precipitation patterns over the past decade. In the most general terms, increased precipitation has been occurring in higher latitudes while reductions in precipitation have been the pattern in southern Asia, South Africa, and the Mediterranean.

The variability and intensity of precipitation events has also increased over the past decade. When rainfall occurs in fewer yet more intense events, a

larger percentage of this water tends to be lost as runoff. This has direct implications for agriculture as well as for water catchments and flooding. When rain falls intensely during a short period of time, plants have less opportunity to absorb the water. At the same time, less of this valuable resource is able to percolate through the ground and enter the water table, decreasing the availability of water for drinking and irrigation through wells. Finally, the increased percentage of runoff can manifest itself in severe flooding.

The patterns of snowfall too have great influence on the availability of freshwater. Mountain snowfields and glaciers act as huge reservoirs of fresh water, gradually building up and releasing this resource according to seasonal patterns. As many as 1.3 billion people who live in areas affected by the current pattern of glacial retreat are at risk of losing access to fresh water or being displaced by associated flooding.

Climate change will have increasing impact on established relationships between population centers and agricultural areas and their access to freshwater. Centers of human population tend to develop where necessary resources such as food and water are able to support them. If current trends continue, many large metropolitan areas worldwide will experience decreasing freshwater availability. While transporting water is possible, it requires great expenditure in energy to do so, energy expenditure that could further influence global warming.

### **Research Findings**

According to Barnett, Adam, and Lettenmaier (2005):

- Around one-sixth of the world's population is dependant on glaciers and seasonal snow packs for their water supply. But climate change is disrupting the annual flow of water downstream from snowy mountainous regions, says this paper. The hydrological changes taking place will impact on future water availability, and these impacts are likely to be severe.
- The negative impacts of melting glaciers will probably be felt the hardest in the Himalaya–Hindu Kush region (China, India, and parts of Asia), home to more than half the world's population. Here, glacial water provides nearly three-quarters of the summer flow in the Ganges

and 50–60% of the flow in other major rivers. In China, 23% of the population lives in the western regions, where glacial melt provides the principal dry season water source. Another hard-hit region will be the South-American Andes, where glacial shrinking will reduce the river flow used for potable water and hydropower, requiring huge adjustments on the part of local peoples and economies.”

According to the IPCC’s 2007 *Fourth Assessment Report*:

“Drought-affected areas are likely to increase in extent. Heavy precipitation events, which are very likely to increase in frequency, will augment flood risk. In the course of the century, water supplies in glaciers and snow cover are projected to decline, reducing water availability in regions supplied by meltwater from major mountain ranges.”

In his 2006 book, *An Inconvenient Truth*, Al Gore writes:

“The Himalayan Glaciers on the Tibetan Plateau have been among the most affected by global warming, The Himalayas.... Provide more than half of the drinking water for 40% of the world’s population through seven Asian river systems that all originate on the same plateau.”

In his 2006 book, *The Weather Makers*, Tim Flannery writes:

“Western Australia’s capital is Perth, a thirsty city of 1.5 million people and the world’s most isolated metropolis. For Perth, the most crucial impact from the decline in winter rainfall was less water in the city’s catchments. Over most of the twentieth century an average of 338 gigatons of water per year had flowed into the dams... between 1975 and 1996 the average was only 177 gigatons... Between 1997 and 2004 it had fallen to just 120 gigatons.”

### **Conflicting Perspectives**

In an op-ed piece, Competitive Enterprise Institute’s Iain Murray writes:

“However, a review of the recent scientific evidence on glaciers suggests that, as is so often the case with global warming, much of the concern is overwrought, poorly based or simply alarmist. First and foremost, people assert we know a lot about glaciers, but we don’t. We know next to nothing about glacial activity, but what we do know suggests there are as many expanding glaciers as there are shrinking ones (this even happens with two glaciers within a few miles of each other) and that there is no universal trend either way. There are more than 160,000 glaciers on the planet. Scientists have good, long-term (20-year or more) mass balance measurements on a comparative handful of them.”

### **Interrelated Impacts:**

- Rising sea levels will cause contamination of freshwater sources for populations living in coastal regions.
- Increasingly dense populations in many areas require more intense agriculture, which in turn can require more irrigation.
- A sharp reduction in available water will reduce agricultural productivity.
- Severe cyclones, hurricanes, and typhoons can cause contamination of water supplies.
- Severe weather can result in more runoff and therefore a loss of freshwater, even if the total amount of precipitation stays the same, while increased drought will cause some areas to receive too little water, possibly requiring massive relocation.
- Severe precipitation events causing flooding will increase freshwater contamination, increasing the risk of water-borne diseases.
- Changes in access to freshwater may cause economic hardship, particularly for poorer communities.

## **“Millions Face Glacier Catastrophe: Global Warming Hits Himalayas”**

By Robin McKie, *The Observer*, November 20, 2005

Nawa Jigtar was working in the village of Ghat, in Nepal, when the sound of crashing sent him rushing out of his home. He emerged to see his herd of cattle being swept away by a wall of water. Jigtar and his fellow villagers were able to scramble to safety. They were lucky: “If it had come at night, none of us would have survived.”

Ghat was destroyed when a lake, high in the Himalayas, burst its banks. Swollen with glacier meltwaters, its walls of rock and ice had suddenly disintegrated. Several million cubic metres of water crashed down the mountain.

When Ghat was destroyed, in 1985, such incidents were rare—but not any more. Last week, scientists revealed that there has been a tenfold jump in such catastrophes in the past two decades, the result of global warming. Himalayan glacier lakes are filling up with more and more melted ice and 24 of them are now poised to burst their banks in Bhutan, with a similar number at risk in Nepal.

But that is just the beginning, a report in *Nature* said last week. Future disasters around the Himalayas will include “floods, droughts, land erosion, biodiversity loss and changes in rainfall and the monsoon.”

The roof of the world is changing, as can be seen by Nepal’s Khumbu glacier, where Hillary and Tenzing began their 1953 Everest expedition. It has retreated three miles since their ascent. Almost 95 percent of Himalayan glaciers are also shrinking—and that kind of ice loss has profound implications, not just for Nepal and Bhutan, but for surrounding nations, including China, India and Pakistan.

Eventually, the Himalayan glaciers will shrink so much their meltwaters will dry up, say scientists. Catastrophes like Ghat will die out. At the same time, rivers fed by these melted glaciers—such as the Indus, Yellow River and Mekong—will turn to trickles. Drinking and irrigation water will disappear. Hundreds of millions of people will be affected. “There is a short-term danger of too much water coming out the Himalayas and a greater long-term danger of there not being enough,” said Dr. Phil Porter, of the University of Hertfordshire. “Either way, it is easy to pinpoint the case: global warming.”

According to *Nature*, temperatures in the region have increased by more than 1°C recently and are set to rise by a further 1.2°C by 2050, and by 3°C by the end of the century. This heating has already caused 24 of Bhutan’s glacial lakes to reach “potentially dangerous” status, according to government officials. Nepal is similarly affected.

“A glacier lake catastrophe happened once in a decade 50 years ago,” said UK geologist John Reynolds, whose company advises Nepal. “Five years ago, they were happening every three years. By 2010, a glacial lake catastrophe will happen every year.”

An example of the impact is provided by Luggye Tsho, in Bhutan, which burst its banks in 1994, sweeping 10 million cubic metres of water down the mountain. It struck Panukha, 50 miles away, killing 21 people.

Now a nearby lake, below the Thorthormi glacier, is in imminent danger of bursting. That could release 50 million cubic metres of water, a flood reaching to northern India 150 miles downstream.

“Mountains were once considered indomitable, unchanging and impregnable,” said Klaus Tipfer, of the United Nations Environment Programme. “We are learning they are as vulnerable to environmental threats as oceans, grasslands and forest.”

Not only villages are under threat: Nepal has built an array of hydro-electric plants and is now selling electricity to India and other countries. But these could be destroyed in coming years, warned Reynolds. “A similar lake burst near Machu Picchu in Peru recently destroyed an entire hydro-electric plant. The same thing is waiting to happen in Nepal.”

Even worse, when Nepal’s glaciers melt, there could be no water to drive the plants. “The region faces losing its most dependable source of fresh water,” said Mike Hambrey, of the University of Wales.

A Greenpeace report last month suggested that the region is already experiencing serious loss of vegetation. In the long term, starvation is a real threat.

“The man in the street in Britain still isn’t sure about the dangers posed by global warming,” said Porter. “But people living in the Himalayas know about it now. They are having to deal with its consequences every day.”

**The Projected Impact of Climate Change on  
BIODIVERSITY**

**Document 7**

**Background Information**

According to the *Encyclopedia of the Earth* (2009), the term “biodiversity” refers to the overall diversity of the types of organisms living in a particular area. This area could refer to a particular ecosystem or the entire planet. While the term biodiversity congers up larger, more exotic species, it includes organisms in all of the kingdoms of life: plants, animals, fungi, and protists as well as the far simpler but more numerous bacterial species. Biodiversity is often considered an indicator of the relative health of the biological system of which it is part.

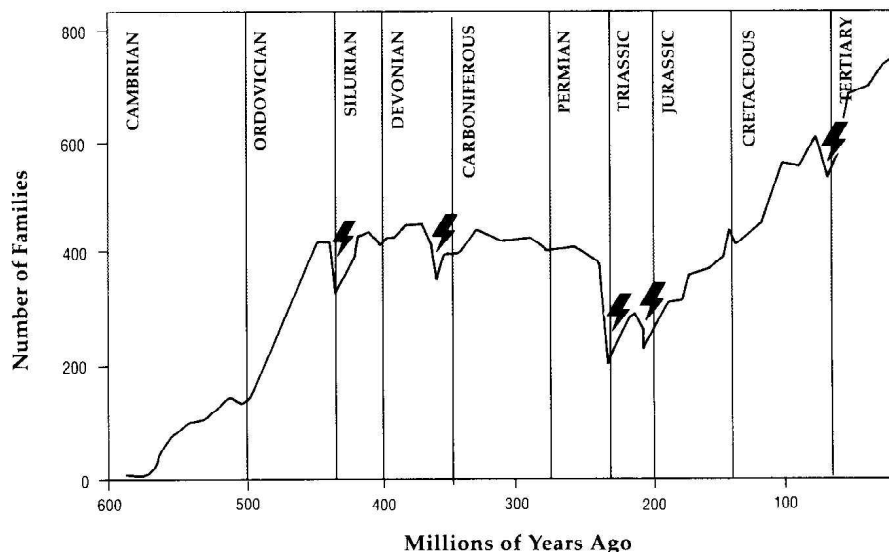
New species are continually being created through the evolutionary process of speciation, and existing species are constantly being lost through the process of extinction. The *Encarta World Dictionary* defines speciation as, “the evolutionary formation of new biological species, usually by one species that divides into two or more species that are genetically unique. Extinction is defined as: the death or ceasing to exist of all members of a species or family of organisms.”

Through the interplay of speciation and extinction, the number of species on Earth has varied tremendously since life established itself on our planet. Estimates concerning the total number of species currently inhabiting the planet range widely, from 5 to 80 million, with about 1.6 million actually identified, according to the *Encyclopedia of the Earth* (2009).

Paleontologist who have studied the fossil records have determined that while species have continually been created and gone extinct, there have also been specific periods in our planet’s past when mass extinctions have taken place.

The image below, from E. O. Wilson’s *The Diversity of Life*, offers a quantitative look at the changes in the degree of biodiversity found on our planet over the past 600 million years. As Wilson points out, a wide variety of factors has influenced the diversity of life on this planet, among them plate tectonics, changes in atmospheric composition, and random events such as huge collisions between the Earth and other celestial bodies like comets. The cumulative effect of these influences over geologic time can be summarized as follows:

- The number of different species on Earth has gradually increased since life first appeared.
- The trends in this increase are linked to the changing physical conditions of the planet through time.
- While species have continually come and gone, there have been a number of major events which have suddenly reduced the biodiversity on the planet. These are commonly referred to as the five mass extinctions. Each represents a relatively sudden shift in life conditions for many species at once.



**Five Mass Global Extinctions**

From  
*The Diversity of Life*,  
by E. O. Wilson (1999)

Data is for families  
(groups of related  
species) of marine  
organisms

**Impact of Climate Change**

Every living thing on Earth interacts both with other living things and the physical components of its environment. Ecologists refer to these highly dynamic systems as ecosystems: the system of interactions between the various members of the community of living things occupying a certain area and between this community and the non-living components of the physical environment of which it is part.

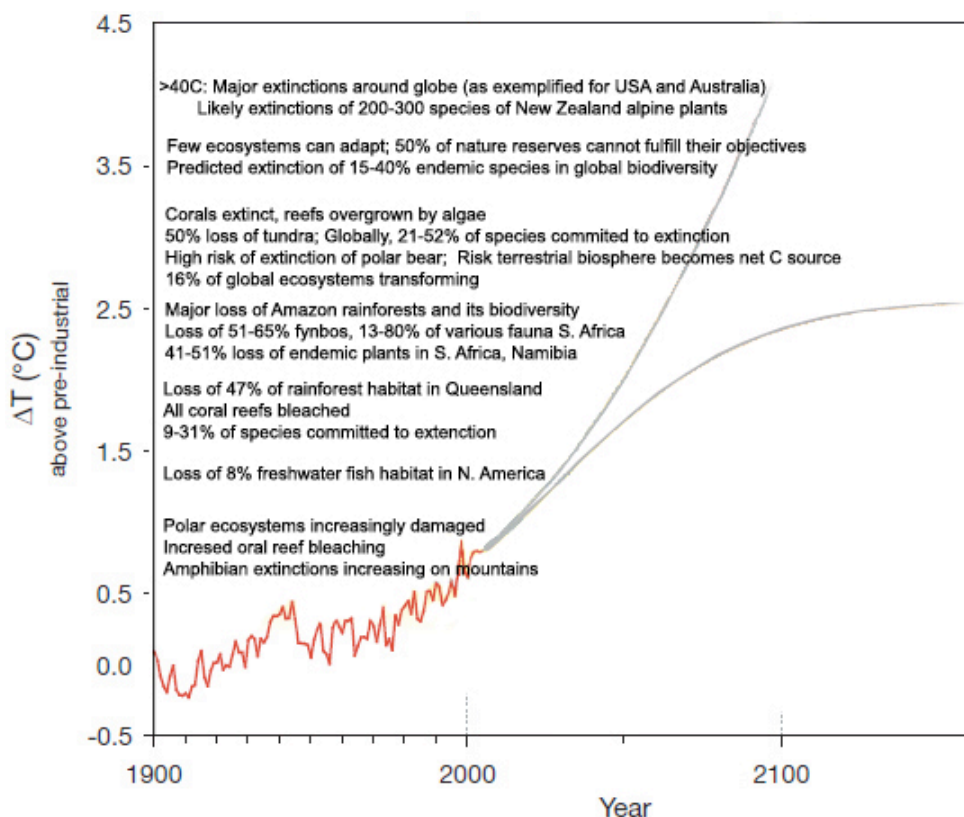
According to the *Encyclopedia of the Earth* (2008), within its ecosystem, any species occupies both a habitat as well as a unique niche. The species' habitat is essentially the set of physical parameters chosen as the preferred "address" within the ecosystem, while the niche is more analogous to the organism's life style: how it accomplishes life through its myriad interactions with its surroundings.

The climate regime of an area asserts a fundamental influence on all ecosystems by impacting a wide range of parameters that are pivotal to life. Through dictating the average temperature of a certain area and the availability of solar energy, climate strongly influences access to water and the availability of food. Climate conditions control not only the amounts of vital

resources accessible to life but also the timing of their availability. As a result, climate has fundamental influence over such things as phenology (the breeding dates of organisms) and migration.

When climate conditions shift, the dynamic array of ecosystem interactions shifts accordingly. As habitats and niches are impacted and altered, each species is forced to respond by attempting to find suitable habitat and maintain its niche. As the United Nations Environment Programme's World Conservation Monitoring Centre puts it: "When climate conditions change, unexpected results may follow. Each species will respond in an individual fashion, according to its climate tolerances and its ability to disperse into a new location... It is difficult to predict the overall result of changes in the abundance of herbivores and food plants, predators and prey."

Climate change is a global phenomenon and is impacting ecosystems and their species worldwide to varying degrees. One pattern already seen in response to climate change involves a discernable shift of many species' habitats toward higher latitudes and altitudes as temperatures gradually



**Species Extinction  
Based on Two  
Projections for  
Warming**

*Working Group II  
Contributions to the IPCC  
Fourth Assessment Report:  
"Climate Change Impacts,  
Adaptation and  
Vulnerability," Chapter 4  
"Ecosystems, their  
Properties, Goods and  
Services," page 240. (2007)*



warm. These shifts in turn represent new impacts on the new terrain being colonized. As these changes unfold, not all species will find it equally feasible to maintain a hold on life. For instance, coral reef communities are currently demonstrating a limited ability to respond to increasing ocean temperatures.

The ultimate impact of climate change on the species diversity of our planet is impossible to predict. The response of human societies to the threat of climate change will likely be a key factor in the survival of countless species. Those species with enough tolerance and flexibility will adapt. Those unable to adapt will go the way of extinction.

In his 2001 article, "The Sixth Extinction," paleontologist Niles Eldredge writes: "There is little doubt left in the minds of professional biologists that Earth is currently faced with a mounting loss of species that threatens to rival the five great mass extinctions of the geological past.

As long ago as 1993, Harvard biologist E. O. Wilson estimated that Earth is currently losing something on the order of 30,000 species per year—which breaks down to the even more daunting statistic of some three species per hour. Some biologists have begun to feel that this biodiversity crisis—this 'Sixth Extinction'—is even more severe, and more imminent, than Wilson had supposed."

Bjorn Lomborg, associate professor of statistics in the Department of Political Science at the University of Aarhus, Denmark, has this to say in his controversial 2001 book, *The Skeptical Environmentalist: Measuring the Real State of the World*:

"We had long been hearing figures for the extinction of the world's species which were far too high—that we would lose about half of all species within a generation. The correct figure is closer to 0.7 percent in 50 years."

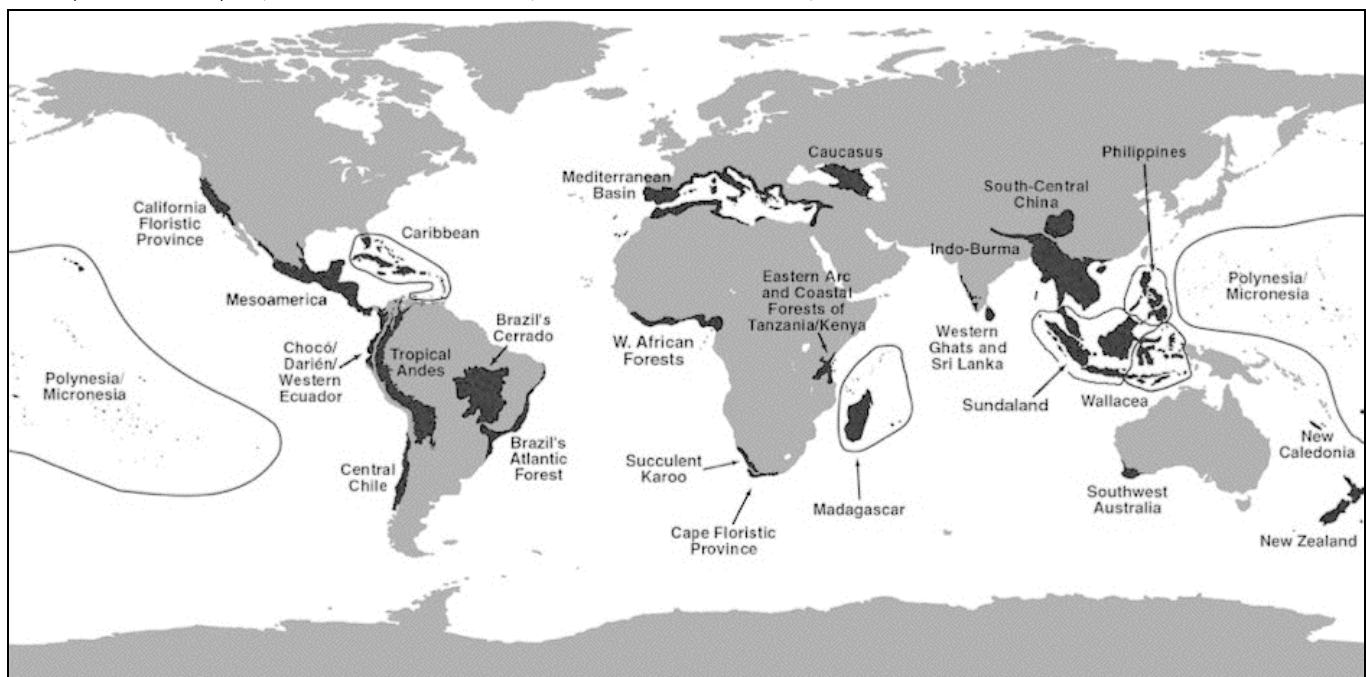
Lomborg argues that that biologists (perhaps for the purpose of securing funding) have misinterpreted the data and that environmental pessimists use highly emotional claims not based in the science to exaggerate concerns over mass extinctions.

Julian Simon, professor of business administration at University of Maryland, had this to say in his 1996 book *The Ultimate Resource 2*:

"The existing data on the observed rates of species extinction are almost ludicrously out of whack with the doomsters' claims of rapid disappearance.... Furthermore, recent scientific and technical advances—especially seed banks and genetic engineering—have diminished the economic importance of maintaining species in their natural habitat."

**"Biodiversity hotspots for conservation priorities" *Nature* (2000)**

By Norman Myers, Russell A. Mittermeier, Cristina G. Mittermeier, Gustavo A. B. da Fonseca and Jennifer Kent



**Interrelated Impacts:**

- Diverse vegetation ensures soil cover over longer periods of annual cycles, reducing soil erosion, enhancing agricultural productivity, and establishing freshwater catchment and recharging of ground water.
- The biodiversity found in ocean estuaries and salt marshes provide rearing grounds for food sources such as ocean fisheries.
- A loss of species diversity represents a loss of genetic diversity and all of the organic molecules coded for by these organisms. In strictly human terms, these molecules represent possible pharmacological resources which may help address newly emerging diseases as well as the raw materials for the developing field of “biomimicry”.
- Climate change may adversely impact plants, animals, and insects vital to agriculture (e.g. bees).
- An increase in the range of insect pests and impact on the organisms that control these pests may result in a rise in disease and negative impact on agriculture.
- Decreases in biodiversity due to climate change will lessen the capacity of plants and animals to recover from severe weather events such as hurricanes and droughts.

**“The Sixth Extinction: Why We Need Owls and Ants”**

By Sharon Begley, *Newsweek Magazine*, October 19, 1992

If biological diversity needed a borscht-belt comic (“How diverse is life on earth? It’s so diverse that...”) Harvard University entomologist and evolutionary biologist Edward O. Wilson would be it. He’s full of stories starring microorganisms that thrive in boiling sea water, or featuring the extinct Titanis, a 10-foot-tall carnivorous bird that “lop[ed] along on stilt legs like a malevolent ostrich,” or *Nanaloricus mysticus*, a .01-inch-long creature that “vaguely resembles an ambulatory pineapple.”

It only seems as if Wilson has personally met and studied every one of the 100 million species thought to live on earth. Of course, no one has—and that’s the subject of *The Diversity of Life*, (424 pages, Harvard, \$29.95). Since we don’t even know the names of the vast majority of these creatures, when they vanish from earth “they enter oblivion like the dead of Gray’s *Elegy*, leaving at most a name, a fading echo in a far corner of the world, their genius unused,” Wilson writes. And vanish they do, thanks to the destruction of (especially tropical) habitats, to climate change, to that paradoxical thing called development. Wilson predicts that if we do nothing, we’ll lose one quarter of the planet’s species within a few decades. If we wise up, we’ll lose maybe 10 percent.

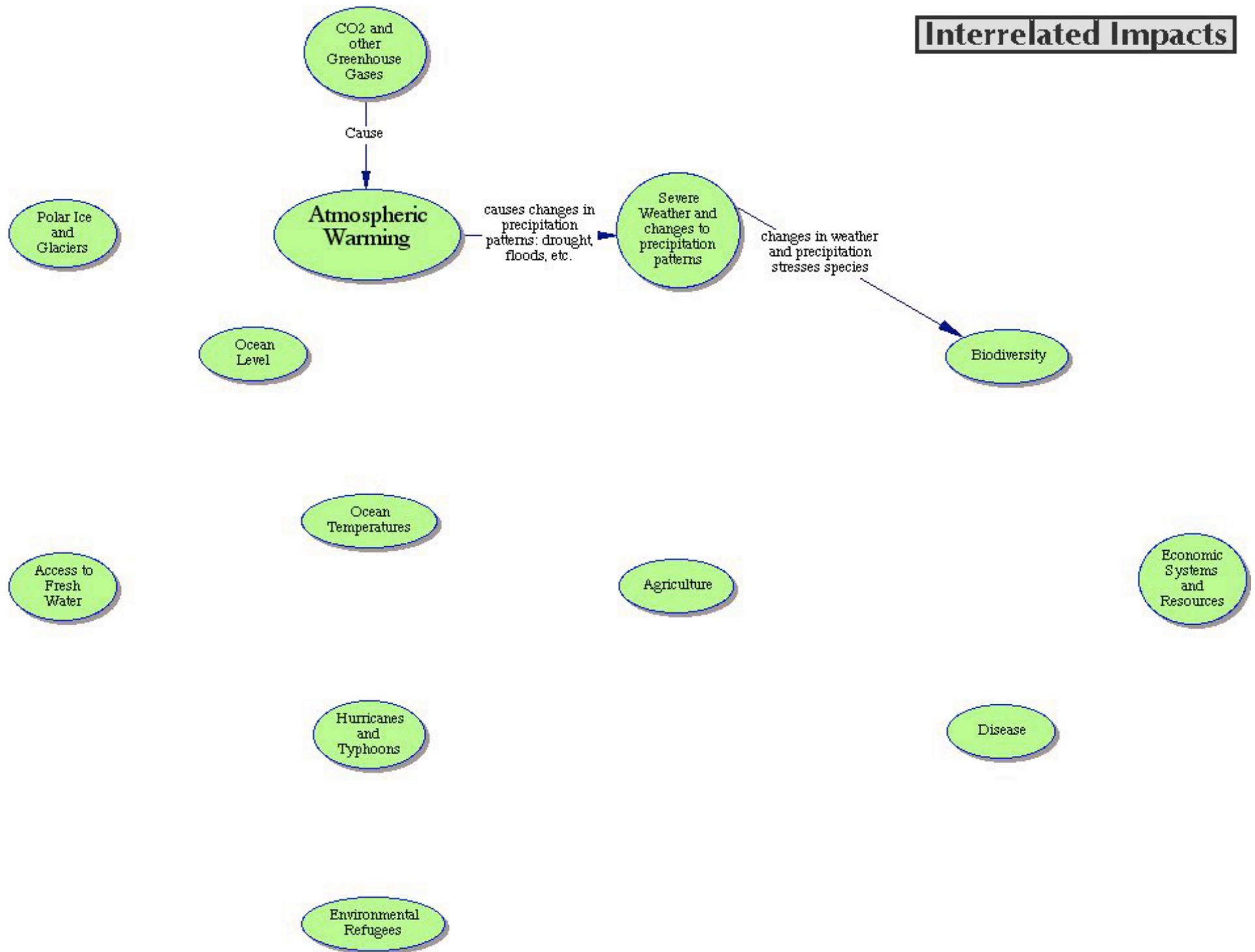
So what? Wilson dutifully runs through the standard biodiversity arguments: that 40 percent of the prescriptions written in this country are for drugs derived from natural sources, from fungi to flowers; that miracle fruit and fibers are waiting to be tapped in the jungle. He points out that the loss of just a few

species can doom an entire ecosystem, and spins a persuasive case that if all the insects died out, humankind would follow within a few months. But the man who loves ants so much that he’s coauthored a Pulitzer Prize-winning book (“*The Ants*”) about them also believes that people need “the rest of life” for their own psychological development.

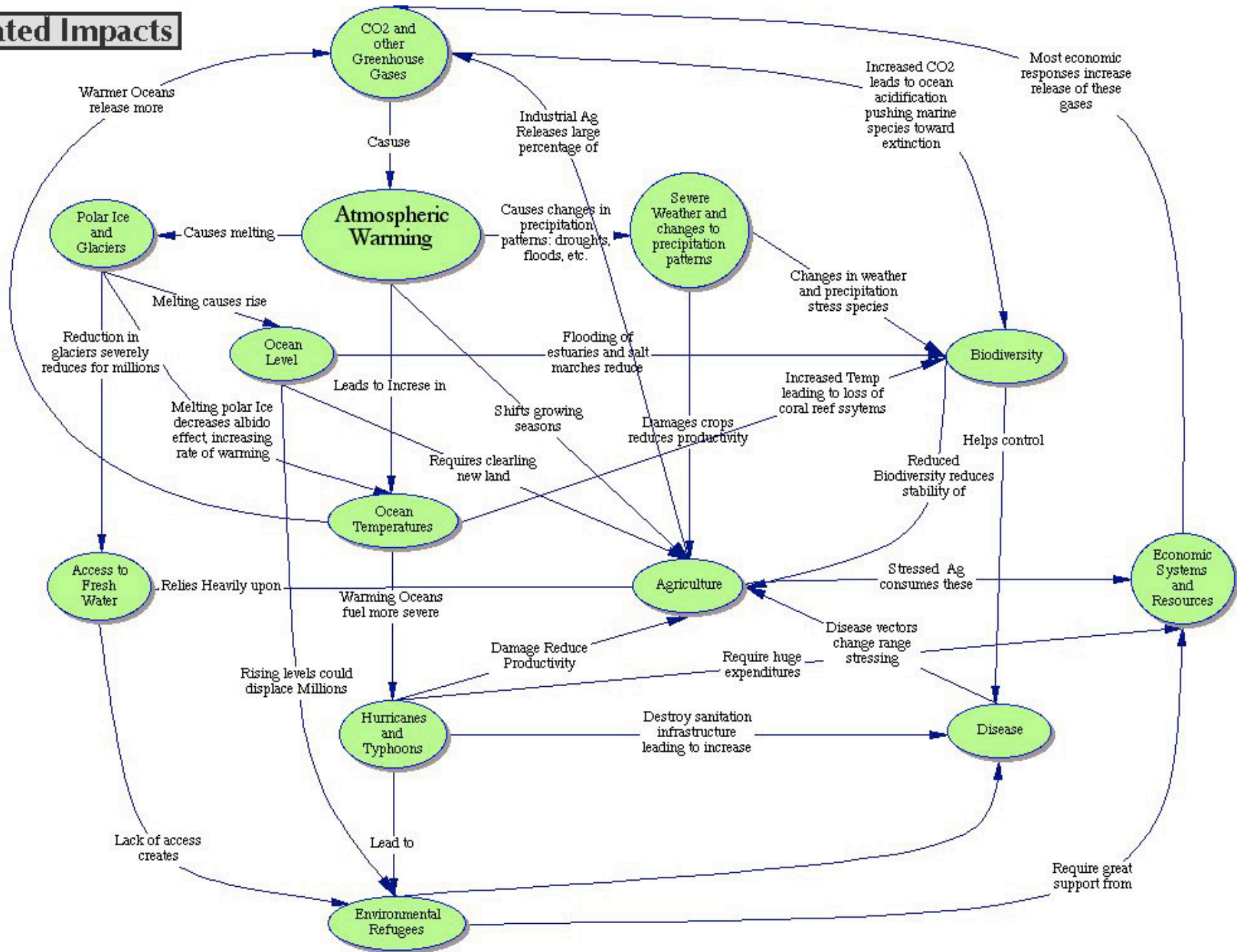
“Biodiversity is the key to the maintenance of the world,” he says. The inner world, too; why else do people grieve so about the passing of the last dusky sparrow, or write checks to save the whales?

Biodiversity holds a paradox, however. Ninety-nine percent of the species that ever existed are now extinct, and yet the number of species alive today dwarfs the count from any time in the past. How can this be? Earth has endured five great extinctions (due to climate change caused by glaciation, volcanic eruptions or meteorite hits). After each, evolution topped off the species inventory, and biodiversity bounced back to higher levels than before. So why should we care if, as Wilson argues, humankind has, through relentless population pressure, destruction of habitats and overhunting, launched the sixth great extinction? Just because it takes 10 million to 100 million years to recover from a wave of extinctions. And even that assumes a stage for recovery; humankind has razed most of the theaters of natural selection. Our descendants will be pretty annoyed to find that they’ll have to wait five times the length of time that humans have been on earth to see species recover from what 20th-century humans managed to do in one little century.

# Interrelated Impacts



# Interrelated Impacts





## Lesson 5, Activity 1 Hurricanes Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

Use the *Student Reading Document 1: Hurricanes* in answering the questions below.  
Prepare to present your answers to questions #1-4 below to the class.

1) Briefly summarize the major impact that climate change is having, and may have in the future, on hurricanes.

2) Prepare to identify the regions on a world map where these impacts will likely be greatest.

Use the map to the right to prepare your presentation.



3) Summarize the scientific debates about the impact of climate change on hurricanes presented in the background reading. Include any reflections on the bias of the reading.

4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on hurricanes and other areas impacted by global warming, including disease, agriculture, sea level rise, severe weather events, fresh water, and biodiversity (see *Interrelated Impacts* in the reading).

Evaluating the Perspective and Bias in a Magazine Article

**“A Hundred Katrinas: Climate Change and the Threat to the U.S. Coast”**

By John McQuaid, *Mother Jones*, August 26, 2007

5) Give your reactions to McQuaid’s article, including reflections on any bias that you see in its construction.

- 6) What conclusion does the article most emphasize? Explain your reasoning.
- a) The scientific uncertainty behind global warming and hurricanes
  - b) Fear of looming catastrophe for coastal cities
  - c) Equally a and b

*Mother Jones* magazine describes itself as “an independent nonprofit whose roots lie in a commitment to social justice implemented through first rate investigative reporting.”

7) Who is the likely audience for *Mother Jones* and how might the article target that audience?

8) Discuss the credibility (believability, trustworthiness) of this article.



## Lesson 5, Activity 1 Diseases Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

Use the *Student Reading Document 2: Diseases* in answering the questions below.  
Prepare to present your answers to questions #1-4 below to the class.

1) Briefly summarize the major impact that climate change is having, and may have in the future, on the spread of diseases globally.

2) Prepare to identify the regions on a world map where these impacts will likely be greatest.

Use the map to the right to prepare your presentation.



3) Use Italy and Britain as examples of the potential impact of global warming on the spread of diseases. Include examples from the article.

4) Summarize conflicting points of view about the impact of global warming on disease.

5) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on the spread of diseases and other areas impacted by global warming, including hurricanes, agriculture, sea level rise, severe weather events, freshwater, and biodiversity (see *Interrelated Impacts* in the reading).

Evaluating the Perspective and Bias in a Magazine Article

**“Tropical Diseases Back as Europe Warms Up”**

By Maurice Chittenden, *Sunday Times* (London), January 7, 2007

- 6) Who is the target audience for this newspaper and how has the article been constructed to address that specific audience?
  
  
  
  
  
  
  
  
  
  
- 7) What words and expressions are used in the article that emphasize the dangers of global warming?
  
  
  
  
  
  
  
  
  
  
- 8) How are statistics and numbers used to emphasize these dangers?
  
  
  
  
  
  
  
  
  
  
- 9) What organizations or experts are used and quoted? How might this reflect a bias?
  
  
  
  
  
  
  
  
  
  
- 10) How does the writer begin and end the article to frame the key messages?
  
  
  
  
  
  
  
  
  
  
- 11) What does the article leave out that might be important to know about this issue? How might this reflect the bias of the article?





## Lesson 5, Activity 1 Agriculture Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

Use the *Student Reading Document 3: Agriculture* in answering the questions below.  
Prepare to present your answers to questions# 1-4 below to the class.

1) Briefly summarize the major impact that climate change is having, and may have in the future, on agriculture.

2) Prepare to identify the regions on a world map where these impacts will likely be greatest.

Use the map to the right to prepare your presentation.



3) Use Africa and Canada as examples of the potential impact of global warming on agriculture.

4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on agriculture and other impact areas, including hurricanes, diseases, sea level rise, severe weather events, fresh water, and biodiversity (see *Interrelated Impacts* in the reading).

Evaluating the Perspective and Bias in a Magazine Article

**“How Will Agriculture Adapt to a Shifting Climate?”**

By Alhagie Jobe, *Daily Observer* (Gambia), December 28, 2006

5) Give your reactions to Jobe’s article.

The *Daily Observer*, founded in 1990 by Liberian publisher Kenneth Best, is the only daily newspaper in The Gambia, a small West African nation where English is the official language.

6) Who is the target audience for this article and how has it been written to target this group?

7) List at least five different ways in which African agriculture is particularly vulnerable to the effects of climate change according to the article.

8) Contrast this article with a few comments by Dr. Timothy Ball in the reading about the effects of climate change on agriculture in Canada.



## Lesson 5, Activity 1 Sea Level Rise Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

Use the *Student Reading Document 4: Sea Level Rise* in answering the questions below.  
Prepare to present your answers to questions #1-4 below to the class.

1) Briefly summarize the major impact of climate change related to sea level rise.

2) Prepare to identify the regions on a world map where these impacts will likely be greatest.

Use the map to the right to prepare your presentation.



3) Explain how Tuvalu and Bangladesh will likely be affected by climate change.

4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on sea level rise and other areas impacted by global warming, including hurricanes, diseases, agriculture, severe weather events, fresh water, and biodiversity (see *Interrelated Impacts* in the reading).

Evaluating the Perspective and Bias in a Magazine Article

**“The Submerging World”**

By Bill McKibben, *Orion* magazine, September 2004

5) Give your reactions to McKibben’s article.

6) This article is best described as... a) news      b) news analysis      c) editorial      d) commentary  
Explain your reasoning.

The following is from the *Orion* magazine website: “It is Orion’s fundamental conviction that humans are morally responsible for the world in which we live, and that the individual comes to sense this responsibility as he or she develops a personal bond with nature.”

7) Explain how this article targets *Orion*’s core mission and readership.

8) Summarize McKibben’s main message to U.S. citizens about climate change expressed in this article.

9) Give examples of how McKibben’s use of dramatic language, imagery, analogies, and irony stresses his main points.



## Lesson 5, Activity 1 Severe Weather Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

Use the *Student Reading Document 5: Severe Weather* in answering the questions below.  
Prepare to present your answers to questions #1-4 below to the class.

1) Briefly summarize the major impact that climate change is having, and may have in the future, on severe weather.

2) Prepare to identify the regions on a world map where these impacts will likely be greatest.

Use the map to the right to prepare your presentation.



3) Summarize any scientific debates about the impact of climate change on severe weather presented in the background reading. Include any reflections on the bias of the reading.

4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on severe weather and other areas impacted by global warming, including hurricanes, diseases, agriculture, sea level rise, fresh water, and biodiversity (see *Interrelated Impacts* in the reading).

Evaluating the Perspective and Bias in a Magazine Article

**“Katrina’s Real Name”**

By Ross Gelbspan, *The Boston Globe*, August 30, 2004

5) Give your reactions to Gelbspan’s article, including reflections on any bias that you see in its construction.

6) List the different types of severe weather events that Gelbspan attributes to global warming.

Founded in 1872, *The Boston Globe* is the most widely circulated daily newspaper in New England.

7) This article is best described as... a) news      b) news analysis      c) editorial      d) commentary  
Explain your reasoning.

8) Which words best describe the article... a) factual, detached, scientific, objective  
Explain your answer with b) emotional, passionate, sensational, alarmist  
evidence from the article.

9) Is it appropriate, or even essential, for newspapers to print articles that take strong and passionate opinions on controversial topics such as global warming? Or, is it important for newspapers to remain dispassionately balanced and stick to the proven facts?



## Lesson 5, Activity 1 **Freshwater** Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

Use the *Student Reading Document 6: Severe Weather* in answering the questions below.  
Prepare to present your answers to questions #1-4 below to the class.

1) Briefly summarize the major impact that climate change is having, and may have in the future, on freshwater.

2) Prepare to identify the regions on a world map where these impacts will likely be greatest.

Use the map to the right to prepare your presentation.



3) Describe how communities dependent upon water from the Himalayan glaciers are being impacted by global warming.

4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on freshwater and other areas impacted by global warming, including hurricanes, diseases, agriculture, sea level rise, severe weather events, and biodiversity (see *Interrelated Impacts* in the reading).

Evaluating the Perspective and Bias in a Magazine Article

**“Millions Face Glacier Catastrophe: Global Warming Hits Himalayas”**

By Robin McKie, *The Observer*, November 20, 2005

5) Give your reactions to McKie’s article.

*The Observer* is a British weekly newspaper out of London. It was the world’s first Sunday newspaper and was first published in 1791. Its sister daily paper is *The Guardian*.

6) This article is best described as... a) news      b) news analysis      c) editorial      d) commentary  
Explain your reasoning.

7) Which words best describe the article... a) factual, detached, scientific, objective  
Explain your answer with b) emotional, passionate, sensational, alarmist  
evidence from the article.

8) Is it appropriate, or even essential, for newspapers to print articles that take strong and passionate opinions on controversial topics such as global warming? Or, is it important for newspapers to remain dispassionately balanced and stick to the proven facts?





## Lesson 5, Activity 1 **Biodiversity** Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

Use the *Student Reading Document 7: Biodiversity* in answering the questions below.  
Prepare to present your answers to questions #1-4 below to the class.

1) Briefly summarize the major impact that climate change is having, and may have in the future, on biodiversity.

2) Prepare to identify the regions on a world map where these impacts will likely be greatest.

Use the map to the right to prepare your presentation.



3) Summarize the scientific debates about the impact of climate change on biodiversity presented in the background reading. Include any reflections on the bias of the reading.

4) Prepare to lead a discussion with the rest of the class about the potential interrelationships between the impact of climate change on biodiversity and other areas impacted by global warming, including hurricanes, diseases, agriculture, sea level rise, severe weather events, and fresh water (see *Interrelated Impacts* in the reading).

Evaluating the Perspective and Bias in a Magazine Article

**“The Sixth Extinction: Why We Need Owls and Ants”**

By Sharon Begley, *Newsweek*, October 19, 1992

5) Give your reactions to the *Newsweek* article, including reflections on any bias that you see in its construction.

*Newsweek* is one of the most popular weekly news magazines in the United States, second only to *Time* magazine. *Newsweek* had over three million readers in 2007.

6) Give examples from the opening paragraph of the use of dramatic imagery and language that would target a large, mainstream audience.

7) Describe the scientific sources that author Sharon Begley references in this article. Explain what impact this might have on the credibility (believability, trustworthiness) of the article.

8) Discuss the scientific credibility of this article.

# Lesson 6: The Precautionary Principle

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LESSON PLAN



Printed Documents

# The Precautionary Principle

## Lesson Objectives:

- Students will identify the potential costs/consequences of different responses to the threat of global warming based on different future scenarios.
- Students will develop and defend personal and group positions on the best policy responses to global warming.
- Students will apply the precautionary principle to policy decisions concerning global warming and evaluate critiques of the precautionary principle.

## Vocabulary:

**costs and benefits, consequences, policy decisions, precautionary principle, resources, mitigation, adaptation**

## Materials Needed:

- Five-page *Teacher Guide: The Precautionary Principle*
- Two-page *Student Worksheet 1: Consequences Grid*
- One-page *Answer Sheet 1: Consequences Grid*
- Four-page *Student Worksheet 2: Four Views*
- Two-page *Answer Sheet 2: Four Views*

## Time

- 45 min for Steps #1-6 (Activities 1 and 2)
- 30 min for Steps #7-9 (Activity 3), or give worksheet as homework

## Lesson Procedures

1. **Activity 1:** Introduce the activity using the information in the *Teacher Guide*.
2. Have students get into groups and distribute *Student Worksheet: Consequences Grid*.
3. Have students work in groups to complete the *Consequences Grid* handout.
4. Discuss answers; use the *Teacher Guide Answer Sheet* to supplement student responses.
5. **Activity 2:** Have students return to their groups for the *Follow-Up Discussions* using the handout, including developing a policy position and then relating their position to the precautionary principle.
6. Have each group report their policy decisions and discuss the precautionary principle.
7. **Activity 3:** Distribute *Student Worksheet: Four Perspectives*.
8. Have students work in groups (or individually) to complete a handout analyzing the four authors' perspectives on the best response to global warming.
9. Discuss the four views using questions and information in the *Teacher Guide Answer Sheet*.



TEACHER GUIDE



Printed Document

# The Precautionary Principle

## Activity 1: Consequences Grid

1. Organize and make copies of the *Consequences Grid Student Worksheet* for the activity.
2. Introduce lesson.

### Activity Introduction

In the realm of climate change, vital decisions rest on a degree of uncertainty. While large groups of scientists worldwide are working to understand just what is causing our climate to warm, how far it will go, and what consequences will likely unfold, no one can predict the future.

Sophisticated climate models are constantly being refined and scientists are using the peer review process to move our understanding forward. As this process proceeds consensus is building, but 100% consensus is virtually unheard of in the realm of science. This leaves both individuals and policy makers in a difficult position. Given the scientific uncertainty, what if anything should be done about global warming?

This activity will ask you to identify the potential costs, benefits, and risks of different approaches given the uncertainty surrounding global warming.

3. Distribute among the groups one worksheet per group. Be sure students read the directions on the grid handout.
4. Give students time to do the assignment.
5. Review group answers. Have one group share the most likely consequences for a particular box. Probe for rationale where appropriate. Have other groups add additional ideas. Use the *Answer Sheet for the Consequences Grid* to supplement student responses.





TEACHER GUIDE



Printed Document

# The Precautionary Principle

## Activity 2: Taking Positions

1. Students should remain in the same group from activity 1 and use the *Consequences Grid Student Worksheet*.
2. Introduce activity 2:

### Activity 2: Taking Positions

Global policy makers, like scientists, do not know for sure how global warming will proceed, but they need to make decisions based on costs, risks, and benefits. Discuss in your group what each of you think is the most appropriate global response given what we currently know about global warming and the potential costs, benefits, and risks presented in the chart. Try to agree as a group on the most appropriate response. Prepare a rationale to share with the class. When you have completed that task, go on to discuss the precautionary principle. A definition is given on your handout.

3. Have students work in groups to discuss the follow-up questions on the *Student Worksheet*. They should first develop a group position on the best policy response to global warming, then go on to relate their policy choice to the precautionary principle.
4. Have groups report their policy choices.
5. Have each group relate their policy choices to the precautionary principle. Where possible, promote dialogue between groups with different perspectives on the precautionary principle.



TEACHER GUIDE



Printed Document

# The Precautionary Principle

## Activity 3: Four Perspectives

1. Introduce the activity.

### Activity 3: Four Perspectives

We will end the lesson by examining four different views on the best response to global warming.

2. Distribute the *Student Worksheet: Four Views*. Have students read and discuss the handout in small groups. Groups should fill the worksheet and answer questions about the arguments of each of the four authors.
3. Discuss the four views. Use the following *Questions and Possible Answers* and the *Answer Sheet: Four Perspectives* to supplement student responses.

OPTIONAL: Have students read the handout and fill in the grid individually, in class, or for homework. You can use the worksheets as prompts for discussion or as individual assessments.

### Questions

1) Which of the arguments and authors do you most agree with and why? Which do you most disagree with and why?

2) Which of the four authors agrees with the precautionary principle and which disagree?

3) Do you think that any of the authors have more or less credibility than the others? Explain.

Explain the following:

4) Do you think the United States should do the same?

### Possible Answers

**Possible Answer:** Conversations may drift quickly from the positions of the four authors. Keep initial conversation text-based, with students clearly connecting their own positions to those of the four authors. More open-ended conversations may follow.

**Possible Answer:** See the *Answer Sheet* for the *Possible Answers*.

**Possible Answer:** See the *Answer Sheet* for the *Possible Answers*.

Some governments, including the European Union, have incorporated the precautionary principle into their environmental policies (Europa, 2007).



**CONSEQUENCES GRID ANSWER GUIDE**

	<p><b>Current warming is part of a natural cycle. It does not have serious consequences.</b></p>	<p><b>Human-induced global warming is real. The consequences are severe.</b></p>
<p><b>The global community responds by allocating huge amounts of resources to decrease greenhouse emissions immediately.</b></p>	<ul style="list-style-type: none"> <li>• Money and other resources that could have been used to address pressing needs are wasted on unnecessary climate controls.</li> <li>• Unnecessary governmental regulations and taxes increase control of people’s lives and hurt the economy.</li> <li>• Taxes and regulation lead to increased (perhaps massive) unemployment, but some new green jobs are created.</li> <li>• Possible recession/depression, resources are limited and jobs are scarce due to unnecessary expenditures on global warming prevention.</li> </ul>	<ul style="list-style-type: none"> <li>• Money and other resources are well spent to mitigate and adapt to climate change.</li> <li>• Necessary governmental regulations and taxes increase control of people’s lives and hurt the economy, but help limit the most devastating effects of global warming.</li> <li>• Taxes and regulation lead to increased (perhaps massive) unemployment, but some new green jobs are created. The economic impact of climate change is less than it would have been without action.</li> <li>• Possible recession/depression, but the most severe impact of global warming is avoided.</li> </ul>
<p><b>The global community funds more research, but does nothing to limit the emissions of greenhouse gases.</b></p>	<ul style="list-style-type: none"> <li>• Little impact.</li> <li>• Funds and other resources are available for actual needs. Global community does not spend resources unnecessarily.</li> </ul>	<ul style="list-style-type: none"> <li>• Sea level rise inundates cities and nations.</li> <li>• Lack of access to fresh water impacts billions.</li> <li>• Disease spreads worldwide.</li> <li>• Severe storms, fires, drought, and floods cause economic and humanitarian devastation.</li> <li>• Massive numbers of environmental refugees impact all nations.</li> <li>• Species loss leads to further instability.</li> <li>• Global economic depression is caused by collapse of agriculture, fending off rising sea levels, habitat relocation, refugee care, and so forth.</li> <li>• Competition over scarce resources leads to human conflict/war.</li> <li>• Synergistic effects of global warming magnify these negative consequences and add others.</li> </ul>



**Richard Lindzen -- Possible Answers**

**1) Summarize Lindzen's main arguments concerning the appropriate response to climate change.**

- The scientific complexity of climate change gets distorted in the media.
- Scientists can only agree that humans have "some impact on the climate."
- Even these claims are based on computer models that have yet to be independently verified.
- Money would be better spent on more science than on "ill thought out attempts to regulate nature."

**2) Describe your response to Lindzen's arguments.**

Answers will vary.

**3) Do you think that Lindzen agrees or disagrees with the precautionary principle? Explain your reasoning.**

Lindzen opposes the precautionary principle. He believes that more scientific study is needed before taking action.

NOTE: In his testimony, Lindzen commented: "Those who insist that the science is settled should be required to state exactly what science they feel is settled. In all likelihood, it will turn out to be something trivial and without policy implications except to those who bizarrely subscribe to the so-called precautionary principle."

**4) What credibility does Lindzen bring to the discussion about climate change?**

Lindzen is a professor of meteorology at MIT and he was an author of part of the 2001 IPCC report. He has enough authority to be called before a Senate committee studying climate change (Michigan Institute of Technology).

NOTE: Lindzen has been criticized for taking funding from the energy industry (Sparrow, 2007).

**Al Gore -- Possible Answers**

**5) Summarize Gore's main arguments concerning the appropriate response to climate change**

- Global warming is a "threat to the survival of our civilization" but there are things we can do to "avoid the worst" if we act fast.
- World leaders are failing to act even as the pollution mounts. They are "imprisoned by a dangerous illusion" that the problem will go away.
- We still have a little time to turn things around before the consequences become "unrecoverable," so we must act now.

**6) Describe your response to Gore's arguments.**

Answers will vary.

**7) Do you think that Gore agrees or disagrees with the precautionary principle? Explain your reasoning.**

Gore is a clear advocate of the precautionary principle. He wants immediate, decisive, and bold action regardless of any scientific debate.

**8) What credibility does Gore bring to the discussion about climate change?**

Al Gore is the nation's, and perhaps the world's, best-known activist against global warming. His film, *An Inconvenient Truth*, won an Academy Award for Best Documentary. He is a politician, not a scientist, but is regarded highly by many in the scientific community.

**George Will -- Possible Answers**

**9) Summarize Will's main arguments concerning the appropriate response to climate change.**

- Global warming will be “problematic,” but “not devastating,” and there may be positive effects, such as new species in the Arctic and less cold-related deaths.
- The costs of trying to stop climate change will damage economic growth and cause millions of needless deaths.
- Money is better spent to address “present dangers” such as AIDS and safe drinking water than on questionable efforts to “turn down the planet’s thermostat.”

**10) Describe your response to Will's arguments.**

Answers will vary.

**11) Do you think that Will agrees or disagrees with the precautionary principle? Explain your reasoning.**

Will is opposed to the precautionary principle. He suggests that global warming is “real,” though hyped (“hyperbole”), and he is opposed to spending money on mitigation. He says that efforts to “fine-tune the planet’s climate” are dangerous.

**12) What credibility does Will bring to the discussion about climate change?**

Will is an award-winning journalist and a columnist for a leading news magazine. He is not a scientist, but quotes an economist in his article.

*(The Washington Post Writers Group, 2010)*

**James Lovelock -- Possible Answers**

**13) Summarize Lovelock's main arguments concerning the appropriate response to climate change.**

- Global warming is too far gone to stop and will lead to massive deaths for human beings. We have already passed the point of no return.
- Efforts to limit greenhouse gas emissions or create sustainable development are too little, too late, or just stupid.
- We need to plan to radically adapt civilization, such as moving whole populations north.

**14) Describe your response to Lovelock's arguments.**

Answers will vary.

**15) Do you think that Lovelock agrees or disagrees with the precautionary principle? Explain your reasoning.**

Lovelock agrees with the precautionary principle that action should be taken even though the science is debated. He believes that global warming will happen even faster than most scientists believe, but he thinks it is fruitless to invest in mitigation. He advocates adapting for the reality of devastating changes and preparing for the worst-case scenario.

**16) What credibility does Lovelock bring to the discussion about climate change?**

Lovelock is an accomplished and famous scientist. He advocates positions outside of mainstream science (earth is an organism), public policy (abandon New Orleans), and environmentalism (sustainable development is stupid).

*(Detailed biography of James Lovelock)*



	<p><b>Current warming is part of a natural cycle. It does not have serious consequences.</b></p>	<p><b>Human-induced global warming is real. The consequences are severe.</b></p>
<p>The global community responds by allocating huge amounts of resources to decrease greenhouse emissions immediately.</p>		
<p>The global community funds more research, but does nothing to limit the emissions of greenhouse gases.</p>		

## Activity 1: Consequences Grid Activity

Use the grid on the other side to help you identify the potential consequences of global warming depending upon:

- **THE HORIZONTAL ROWS** - whether the current rise in global temperatures is human induced and will result in severe climate change or is part of a natural and manageable temperature cycle
- **THE VERTICAL COLUMNS** - whether the global community limits greenhouse gas emissions

For each of the four sections of the grid, talk together about the possible consequences or outcomes represented by the interaction of that particular column and row.

**For example:** Looking at the blank square at the upper left, discuss the most likely consequences if it turns out that global warming is not a serious problem and we as a species choose a “wait and see” strategy of response.

Think in broad global terms to identify the most likely results associated with each box. Include likely economic consequences and the impact that these costs may have on jobs, food, health, and so forth. Think about the impact on people living in both developed and developing countries. Include likely consequences on the natural world as well. Summarize these consequences in each box.

Be prepared to share what you have written in each grid and your rationale (e.g. why you think that jobs will be adversely affected in a particular situation).

## Activity 2: Taking Positions Follow-up Discussion

### Deciding Global Policy

Now that you have thought about possible outcomes, you must make a decision about the best approach to the problem of global warming. If you were a team of global policy makers, what would you do? Think about what you have control over and what you do not. Think in terms of costs, benefits, and risks. Try to come to agreement as a group. Be prepared to offer a rationale for your response

### The Precautionary Principle

**The precautionary principle proposes that action should be taken to prevent damage to human health or the environment when the science is uncertain but the potential consequences are great.**

Is your group policy choice in agreement with the precautionary principle?

Should the precautionary principle guide public policy about the environment?

**Richard Lindzen** is a MIT professor of meteorology and lead author of a chapter in the 2001 IPCC report on climate change.

The following are excerpts from Lindzen's 2001 testimony before a U.S. Senate Committee studying climate change:

"Climate change is a complex issue where simplification tends to lead to confusion, and where understanding requires thought and effort. Judging from treatments of this issue in the press, the public has difficulty dealing with numerical magnitudes and focuses instead on signs (increasing versus decreasing). Science places crucial emphasis on both signs and magnitudes.

"As it turns out, much of what informed scientists agree upon is barely quantitative at all: That global mean temperature has probably increased over the past century; that CO<sub>2</sub> in the atmosphere has increased over the same period; that the added CO<sub>2</sub> is more likely to have caused global mean temperature to increase rather than decrease; and that man, like the butterfly, has some impact on climate.

"That claims that man has contributed any of the observed warming (i.e. attribution) are based on the assumption that models correctly predict natural variability. Such claims, therefore, do not constitute independent verifications of models.

"From my provincial perspective, an important priority should be given to figuring out how to support and encourage science (and basic science underlying climate in particular) while removing incentives to promote alarmism. The benefits of leaving future generations a better understanding of nature would far outweigh the benefits (if any) of ill thought-out attempts to regulate nature in the absence of such understanding."

(Excerpts from Lindzen's testimony before the Senate Environment and Public Works Committee, May 2, 2001.)

**Al Gore** was Vice President of the United States from 1992–2000. His film, *An Inconvenient Truth*, warned of the threat of global warming. He won the 2007 Nobel Peace Prize for his work sounding the alarm about climate change.

The following are excerpts from Gore's Nobel lecture:

"We, the human species, are confronting a planetary emergency, a threat to the survival of our civilization that is gathering ominous and destructive potential even as we gather here. But there is hopeful news as well: We have the ability to solve this crisis and avoid the worst, though not all, of its consequences, if we act boldly, decisively, and quickly.

"However, despite a growing number of honorable exceptions, too many of the world's leaders are still best described in the words Winston Churchill applied to those who ignored Adolf Hitler's threat: 'They go on in strange paradox, decided only to be undecided, resolved to be irresolute, adamant for drift, solid for fluidity, all-powerful to be impotent.'

"So today, we dumped another 70 million tons of global warming pollution into the thin shell of atmosphere surrounding our planet, as if it were an open sewer. And tomorrow, we will dump a slightly larger amount, with the cumulative concentrations now trapping more and more heat from the sun.

"The penalties for ignoring this challenge are immense and growing, and at some near point would be unsustainable and unrecoverable. For now, we still have the power to choose our fate, and the remaining question is only this: Have we the will to act vigorously and in time, or will we remain imprisoned by a dangerous illusion?"

(Excerpts from Gore's speech from December 14, 2007, upon accepting the Nobel Peace Prize.)

**George Will** is a Pulitzer Prize-winning newspaper columnist.

The following are excerpts from Will's 2007 *Newsweek* opinion piece.

"In his book *Cool It: The Skeptical Environmentalist's Guide to Global Warming*, the Danish economist Bjorn Lomborg suggests that global warming, although real, is not apt to be severe; that many of its consequences will be beneficial; and that the exorbitant costs of attempting to substantially curtail it would squander resources that, put to other uses, could have effects thousands of times more ameliorative. He offers cautionary calculations:

"The warming that is reasonably projected might be problematic, although not devastating, for the much-fretted-about polar bears, but it will be beneficial for other species. The Arctic Climate Impact Assessment anticipates increasing species richness.

"Global warming was blamed for 35,000 deaths in Europe's August 2003 heat wave. Cold, however, has caused 25,000 deaths a year recently in England and Wales—47,000 in each winter from 1998 to 2000. In Europe, cold kills more than seven times as many as heat does. Worldwide, moderate warming will, on balance, save more lives than it will cost—by a 9-to-1 ratio in China and India.

"The U.N.'s 2007 report estimates that by 2100, sea levels will rise about a foot—as much as they have risen since 1860. That will mean a number of local problems, not a planetary crisis. ... protecting people and property from the sea would be far less costly than attempting to turn down the planet's thermostat.

"Sums that are small relative to the cost of trying to fine-tune the planet's climate could prevent scores of millions of deaths from AIDS, unsafe drinking water, and other clear and present dangers. If nations concert to impose antiwarming measures commensurate with the hyperbole about the danger, the damage to global economic growth could cause in this century more preventable death and suffering than was caused in the last century by Hitler, Stalin, Mao, and Pol Pot combined. Nobel Peace Prize, indeed."

**James Lovelock** is a British scientist who discovered the presence of CFCs in the atmosphere (leading to ozone depletion). He proposed the Gaia hypothesis in the 1970s that views the Earth is one huge organism.

The following is an excerpt from a 2007 *Rolling Stone* article by Jeff Goodell about Lovelock's views on the climate.

"By 2100, Lovelock believes the Earth's population will be culled from today's 6.6 billion to as few as 500 million, with most of the survivors living in the far latitudes: Canada, Iceland, Scandinavia, the Arctic Basin.

"Our future,' Lovelock writes, 'is like that of the passengers on a small pleasure boat sailing quietly above the Niagara Falls, not knowing that the engines are about to fail.'

"In Lovelock's view, modest cuts in greenhouse gas emissions won't help us—it's too late to stop global warming by swapping our SUVs for hybrids. What about capturing carbon dioxide pollution from coal plants and pumping it underground? 'We can't possibly bury enough to make any difference.' Biofuels? 'A monumentally stupid idea.' Renewables? 'Nice, but won't make a dent.' To Lovelock, the whole idea of sustainable development is wrongheaded: 'We should be thinking about sustainable retreat.'

"Retreat, in his view, means it's time to start talking about changing where we live and how we get our food; about making plans for the migration of millions of people from low-lying regions like Bangladesh into Europe; about admitting that New Orleans is a goner and moving the people to cities better positioned for the future."

**Richard Lindzen**

- 1) Summarize Lindzen's main arguments concerning the appropriate response to climate change.
  
  
  
  
  
  
  
  
  
  
- 2) Describe your response to Lindzen's arguments.
  
  
  
  
  
  
  
  
  
  
- 3) Do you think Lindzen agrees or disagrees with the precautionary principle? Explain your reasoning.
  
  
  
  
  
  
  
  
  
  
- 4) What credibility does Lindzen bring to the discussion about climate change?

**Al Gore**

- 5) Summarize Gore's main arguments concerning the appropriate response to climate change.
  
  
  
  
  
  
  
  
  
  
- 6) Describe your response to Gore's arguments.
  
  
  
  
  
  
  
  
  
  
- 7) Do you think Gore agrees or disagrees with the precautionary principle? Explain your reasoning.
  
  
  
  
  
  
  
  
  
  
- 8) What credibility does Gore bring to the discussion about climate change?

**George Will**

- 9) Summarize Will's main arguments concerning the appropriate response to climate change.
- 10) Describe your response to Will's arguments.
- 11) Do you think Will agrees or disagrees with the precautionary principle? Explain your reasoning.
- 12) What credibility does Will bring to the discussion about climate change?

**James Lovelock**

- 13) Summarize Lovelock's main arguments concerning the appropriate response to climate change.
- 14) Describe your response to Lovelock's arguments.
- 15) Do you think Lovelock agrees or disagrees with the precautionary principle? Explain your reasoning.
- 16) What credibility does Lovelock bring to the discussion about climate change?

# Lesson 7: Assessing Carbon Footprints

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(access online or via Lesson 7 digital media folder)	
<i>Carbon Footprints/Act on CO<sub>2</sub>, Prius, McDonalds, Coco Eco,</i>	
<i>Jonas Brothers, Buy Nothing Day</i>	





**LESSON PLAN**



Video Clips



Document



PowerPoint Slide Show

# Assessing Carbon Footprints

## Lesson Objectives:

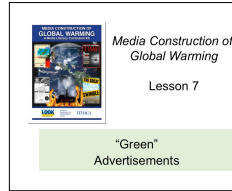
- Students will become familiar with the basic concepts and vocabulary of a carbon footprint.
- Students will analyze and summarize the complex cradle-to-grave carbon footprint implications for various products, including resource extraction and processing, manufacturing, transportation, retail and marketing, product use, and disposal.
- Students will analyze and evaluate “green” advertisements for their accurate, deceptive, and/or incomplete messages about the environment.
- Students will identify the wants and needs that drive consumption of different products and the possibilities for using more environmentally sustainable alternatives. Students will discuss the moral implications of our contemporary consumer lifestyle.

## Vocabulary:

**Carbon footprint, emissions, supply chain, cradle-to-grave, resource extraction and processing, manufacturing, transportation, retail and marketing, product use, disposal, “greenwash,” alternatives**

Student Reading	Associated Vocabulary
Cars	rail, truck, air, raw materials, metals, plastics, glass, fuel, recycling
Hamburgers	fertilizer, corn, grass-fed beef, land use, methane, CAFOs
Clothing	cotton, organic, synthetic, insecticides, pesticides, laundering
Heating & Cooling	energy use, electricity generation, air conditioning, efficiency
Computers	digital promise, efficiency, computer systems, planned obsolescence, toxins, waste
Magazines	paper industry, offices, manufacturing process, printing, carbon offsets
A Music Concert	Live Earth, carbon report, zero-net-impact, audience travel, mass transit, recycle, Buy Nothing Day, consumerism, choices, government policies, economic structure, lifestyle, moral implications, reparations, international law, personal responsibility

**Media**



PowerPoint Slide Show:  
Green Advertisements,  
8 Slides



All Lesson 7 Video Clips  
See **bolded** items below.

**Materials Needed:**

- 24-page *Teacher Guide: Assessing Carbon Footprints*
- Seven different two-page *Student Readings*, one for each member of each group:  
*Assessing the CO<sub>2</sub> Footprint for Cars, for Hamburgers, for Clothing, for Heating & Cooling, for Computers, for Magazines, for A Music Concert*
- Seven different advertisements, one for each group:
  1. Cars – **Prius “Harmony”** :35 sec TV advertisement\*
  2. Hamburgers – excerpt from **McDonalds “Road to Sustainability”** (1:58 min)\*
  3. Clothing – EarthPositive Apparel website excerpt (handout)
  4. Heating and Cooling – Renewable Energy print advertisement and solar energy (handout)
  5. Computers – Eco Friendly Wooden Computer website excerpt (handout)
  6. Magazines – **Coco Eco** advertisement (1:05 min) \*
  7. Music Concert – **Jonas Brothers in Concert** (:53 sec) \*
- Other Video clips on DVD:
  - Carbon Footprints: Act on CO<sub>2</sub>** (1:06 min)\*
  - Buy Nothing Day** (:35 sec)\*

**\*Note:** Access all videos online or via Lesson 7 digital media folder)

**Time**

Approximately four, 40 min class periods, less if students do reading outside of class.

**Lesson Procedures**

1. **Activity 1:** Introduce the concept of carbon footprints using the media clip and prompts in the *Teacher Guide*. (15 min)
2. **Activity 2:** Distribute a two-page reading to seven groups of students, each group studying a different product: cars, hamburgers, clothing, heating and cooling, computers, magazines, and a music concert. Distribute the worksheet, one per student. Allow appropriate time for groups to complete the reading and first part of the worksheet. (30 min) This could be assigned for homework.
3. **Activity 3:** Distribute print and video advertisements, one for each group. Have each group analyze their advertisement together and prepare for their presentation using the worksheet. (15 min)
4. Have each group present to the class including their summary of the carbon footprint of their product and their analysis of the advertisement. Use the *Teacher Guide* with *Possible Answers* to help facilitate the presentations. (60 min)
5. **Activity 4a and 4b:** Lead the culminating activity, *Personal, Policy, and Moral Choices*, using prompts in the *Teacher Guide*, the video clip, and discussing the culminating questions at the end. (40 min)

TEACHER GUIDE



# Assessing Carbon Footprints

## Activity 1: Video Clip Introduction

### *Carbon Footprint*

1. Ensure that equipment is set up to play the video clip: *Carbon Footprint, Act on CO<sub>2</sub>*
2. Introduce concept "Carbon Footprints":

#### Introduction to Footprints

A "carbon footprint" is an accounting of how our behaviors, choices, and lifestyles influence the amount of carbon dioxide released into the atmosphere, thereby affecting climate change. Specifically, a carbon footprint tries to establish how many kilograms of CO<sub>2</sub> we cause to be released (over the course of one year) through our average daily choices and activities.

We will now view a 1 min advertisement from the British government. As you watch the commercial, note the different aspects of one's carbon footprint being referenced in the ad.

3. Play the video clip and use this *Teacher Guide for Questions and Possible Answers* to facilitate the discussion.



**Carbon Footprint, Act on CO<sub>2</sub>**  
**2008, 1:06 min**



Video Clips

## Media Sample Questions & Answers

**1.) What activities does the ad say contribute to our overall carbon footprint?**

**Possible Answer:** lighting, doing laundry, driving a car, playing video games, taking a bath, using a refrigerator, flying, watching TV

**2.) Why would the government of the United Kingdom produce this ad?**

**Possible Answer:**

The British government realizes that global warming will likely have dire economic, social, and political consequences for the nation and the world.

The UK wants their citizens to change their lifestyle and lower their carbon footprints.

### ADDITIONAL INFORMATION

The ad is part of the UK government's *Act on CO<sub>2</sub>* campaign. Its website says: "Climate change is one of the greatest challenges facing the UK today, and ACT ON CO<sub>2</sub> is a key part of the Government's plan to help tackle the issue." The campaign communicates the seriousness of climate change to the public through TV, press, radio and online advertising, explaining the link between CO<sub>2</sub> emissions and global warming.

**NOTE:** There are a number of websites that allow students to assess their individual or family carbon footprint.

TEACHER GUIDE



Printed Documents

# Assessing Carbon Footprints

## Activity 2: Product Footprints Introduction

1. Organize and make copies for the activity: the 7 *Student Readings* and the *Student Worksheet*. Each student should have a copy of the designated reading, and the worksheet.
2. Introduce the concept “Product Footprints” and present the lesson overview:

### Introduction to Product Footprints

While each of us individually leaves a carbon footprint, so do the products that we purchase and use. We typically only witness a small component of that footprint, such as when we drive a car, plug in a computer, or recycle a magazine. But nearly all the products we use today have unseen carbon implications. These products were likely manufactured from raw materials. There was energy used to extract these materials, transport them, and process them into steel, plastic, silicon, and paper. Carbon was released in the manufacturing of these products into their finished forms. More carbon was emitted to store them, transport them, and store them again in a retail store. Thus a substantial footprint is created before a consumer ever sees a product. Many of these products require energy for use, emitting more greenhouse gases. And finally, there is more CO<sub>2</sub> released during their disposal or their recycling.

### Lesson Overview

This lesson will attempt to make visible and understandable the complex supply chain of energy, materials, industries, and economies that are the infrastructure of our modern consumer lifestyles. The intent is to help us recognize the climate consequences of our lifestyle choices. As we explore the carbon footprints of seven common products, we will also look at the wants and needs behind them, the ways in which they are sold to us through “green” advertising, the alternatives that have lower footprints, and finally the moral implications of these choices given our growing awareness of global warming.

**NOTE:** Depending upon the background knowledge of the students, the teacher may want to introduce or review basic information about energy production in the U.S. before beginning the group work activity. Students should have a basic understanding of the carbon implications of:

- different types of fuels (coal, gas, oil, nuclear, hydro, etc.)
- different forms of electricity generation
- different modes of transportation (rail, truck, ship, air)

5. Introduce the Activity:

**Introduce Activity**

Today you will work in teams to learn the cradle-to-grave carbon footprints of seven different products and product areas:

1. Cars and transportation
2. Hamburgers and food
3. Clothing apparel
4. Heating and cooling systems
5. Computers
6. Magazines
7. A music concert

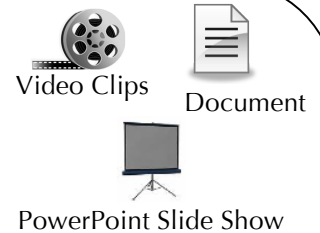
Each team will receive a two-page reading selection for their product that will help each team to prepare a short presentation to the class on the cradle-to-grave carbon footprint for the assigned product.

Each team will also receive a “green” advertisement for their product, either from a website or a short video commercial, to analyze and present to the class.

6. Distribute the one-page *Student Worksheet* that describes the assignment to each student. Review the task and questions on the worksheet with the class.
7. Arrange for students to get into seven groups. Provide the groups with copies of the two-page *Student Reading* for their assigned product. Allow appropriate time for groups to complete the reading and the **first** part of the worksheet.

OPTIONAL: Assign this section for homework.

TEACHER GUIDE



# Assessing Carbon Footprints

## Activity 3: Product Advertisement Analysis

1. Organize and make copies of the three product advertisements for the activity:
  1. Clothing – *EarthPositive Apparel* website excerpt
  2. Heating & Cooling systems, Solar Energy International ad
  3. Computer: Eco Friendly Wooden Computer website excerpt
2. Ensure that equipment is ready to play four product advertisement video clips:
  1. Cars – Prius “Harmony” 30 sec TV commercial
  2. Hamburgers – 2 min excerpt from McDonald’s “Road to Sustainability” video
  3. Magazines – *Coco Eco* 1 min video
  4. Music Concert – *Jonas Brothers in Concert* 1 min video
3. Ensure that students have their *Student Worksheet* from the previous activity.
4. Distribute the print advertisements and arrange to show video ads for the groups that are working with the video clip advertisements.

**\*Note: All video clips are on YouTube channel: [www.youtube.com/projectlooksharp](http://www.youtube.com/projectlooksharp) on DVD. or on our website [www.proiectlooksharp.org](http://www.proiectlooksharp.org).**

5. Allow appropriate time for groups to analyze their advertisement and complete the second part of the worksheet.
6. Each group should prepare for their presentation using the worksheet. (30 min)
7. Review the *Possible Answers* in the *Teacher Guide* in preparation for facilitating the presentations and reviewing the worksheet answers.

### STUDENT PRESENTATIONS:

8. Each group should give a 10 min presentation, first by summarizing their product’s carbon footprint, and then addressing the questions on their worksheet.
9. While students are presenting, project the advertisements using the *Lesson 8 – Green Advertisements* slide show and video clips.
10. Use the *Questions and Possible Answers* in this *Teacher Guide* for each group presentation as a quick guide to general student responses based on the information in the readings and typical analysis of the ads. They are not intended to be the only correct answers.

## Steps, Questions & Answers Guide for Cars

This guide is intended to be used while the students are presenting their products to the class.

**1) Provide an overview of the cradle-to-grave carbon footprint of your product.**

**Include a brief description of the CO<sub>2</sub> emissions of each step in the supply chain, including production, distribution, use, and disposal of the product. Identify the areas (e.g., transportation, manufacturing, etc.) that produce the most carbon.**

**2) Mention any additional information your group would you need to know to have a fuller understanding of the CO<sub>2</sub> implication of your product (e.g. the type of energy used in processing key raw materials).**

### **Possible Answers:**

Overall car use accounts for about 75% of the carbon footprint of a car. Fuel production adds 19%, with other components making up 6%.

#### Production:

**Metals:** Accessing raw materials requires digging and transporting of both ore and overburden. Ore must be refined and purified. Metal must be shaped. All of these steps require machines generally run on petroleum products to transport the materials as well as great amounts of heat to refine and shape.

**Plastics:** These petroleum-based products requires drilling and pumping, heat for refining, and transportation. Add the machines and dealing with waste.

**Fluids:** Oil, transmission fluid, brake fluid, and so forth require refining and transport.

**Glass:** Requires heat of around 4200<sup>o</sup>F, refining, shaping and waste disposal.

**Manufacturing the car itself:** Average of 4,000 spot welds for a car, each requiring heat from electricity. 10,000 parts must be assembled; the building where the car is built must be lit and heated; waste materials must be dealt with.

Distribution: Generally taken to retail locations on ocean going ships or rail, each weighing an average of two tons.

Use: Cars travel over 7 billion miles per day in the U.S. Average mileage in 2006 was just over 22 mpg. Also require addition of fluids, service and repair, and periodic washing. A huge energy requirement is the building and maintenance of our highway system, lights, and so forth.

Disposal: About 84% of the average car is recycled. Even this positive step requires disassembly, refinement, and transport. The materials that are not recycled are transported to landfill sites and buried.

**Possible Answers:** To have a clearer understanding of the carbon footprint of a car, one would need to know what types of fuels were used to complete each step of the supply chain, or at least what percentage were fossil fuels. It would also be helpful to have more information on the energy used to create and maintain roads, and how many miles of roads exist in our country. The information given indicates that this might be a huge energy requirement, perhaps not represented in the car life cycle pie chart provided. It would also help to know how much mileage different types of cars actually get.



3) Have the group present and analyze their advertisement.

Prius "Harmony"  
:38 sec TV commercial  
2010



1) Introduce the ad.

This is a TV commercial promoting Toyota's hybrid car, the Prius.

2) What aspects of the product's CO<sub>2</sub> footprint are addressed in the ad, and which are invisible?

**Possible Answers:**

The imagery (flowering of nature), appealing music and the narration (the world gets fewer smog-forming emissions; it's harmony between man, nature, and machine) speaks to the lower carbon emissions of a hybrid compared with regular cars. It leaves out the carbon in all aspects of the production and disposal of the vehicle as well as the emissions that hybrids do produce.

3) Do you think this ad is "greenwash" or an honest, ethical, and significant attempt to address the environmental implications of this product?

**Possible Answers:**

On the one hand, hybrid cars produce significantly less emissions in their lifetime than traditional gas powered vehicles. On the other hand, the ad implies that driving hybrids will create "harmony between man and nature." This ignores the huge greenhouse implications of hybrid vehicles.

4) What are alternatives to this product that have a lower CO<sub>2</sub> footprint?

**Possible Answers:**

Alternatives include electric vehicles using electricity generated from renewable sources such as wind or the sun, car pooling, a greater use of mass transit options such as buses, car share organizations, more efficient use (e.g. driving only when necessary, living closer to work, buying local, etc.), and human-powered transportation such as biking and walking.

5) What are the obstacles to consumers choosing these lower impact alternatives?

**Possible Answers:**

Obstacles include inability or unwillingness to purchase new and more efficient vehicles; lack of interest or knowledge about the environmental impact of cars; lack of access to lower impact energy sources; inability or unwillingness to bike, carpool, or use mass transit; and greater inconvenience or effort required to use alternatives.

## Steps, Questions & Answers Guide for Hamburgers

This guide is intended to be used while the students are presenting their products to the class.

**1) Give an overview of the cradle-to-grave carbon footprint of your product.**

**Include a brief description of the CO<sub>2</sub> emissions of each step in the supply chain, including production, distribution, use, and disposal of the product. Identify the areas (e.g. transportation, manufacturing, etc.) that produce the most carbon.**

**2) Mention any additional information your group would you need to know to have a fuller understanding of the CO<sub>2</sub> implication of your product (e.g. the type of energy used in processing key raw materials).**

### **Possible Answers:**

Only about 5% of the carbon footprint of a hamburger is due to transportation. Most is released in the agricultural aspects of the supply chain.

Production: Growing the grain to feed cattle requires plowing, cultivating, production of insecticides and fertilizers (which require a great amount of heat to produce), harvesting the grain, separating the grain and chaff, and transporting the cattle. Feedlots require 2,500 gallons of water to produce one pound of beef. Methane (a very concentrated greenhouse gas) is released in cow manure. Cattle are transported and then slaughtered. The meat is processed and then refrigerated.

Distribution: The meat is shipped on refrigerated trucks and rail cars to factories to shape the burgers, which are then packaged and frozen. The frozen patties are then shipped in freezer trucks to stores and restaurants where they are refrigerated until used.

Use: Hamburger patties are kept in cold storage until needed, then cooked on a broiler or fryer. The bun and condiments are added. The hamburger is packaged and kept warm until purchased.

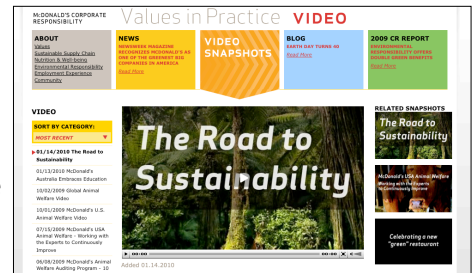
Disposal: Uneaten food is either thrown away to be transported to a landfill or composted.

### **Possible Answers:**

As with all products, the types of fuels used to complete each step of the supply chain (i.e. fossil fuels versus renewables) will impact its overall footprint. It would help to get a breakdown of the CO<sub>2</sub> released through the various agricultural activities involved in raising the cattle. How much is required to grow the grain, create the fertilizers, and transport it to Concentrated Animal Feeding Operations (CAFOs), and how much energy is used to transport the huge amount of water consumed along the way? It would also be interesting to know the comparative carbon footprint of pasture-raised beef.

**3) Have the group present and analyze their advertisement.**

Video excerpt from:  
*The Road to Sustainability*  
1:58 min  
from the McDonald's  
*Corporate Responsibility* website  
2010



**1) Introduce the ad.**

This is an excerpt from a longer video in the *Corporate Responsibility* section of the McDonald's web site.

**2) What aspects of the product's CO<sub>2</sub> footprint are addressed in the ad, and which are invisible?**

**Possible Answers:**

The video promotes many sustainable aspects of McDonalds supply chain, including agriculture ("farming practices in Europe"), logistics ("environmental score-card tracks supplier eco-efficiency," recycling cooking oil, use of biodiesel), and land use (packaging from "renewable materials" and "recycled fibers," rainforest policy, working with Greenpeace, "moratorium on further illegal deforestation"). Although many aspects of the supply chain are referenced, there is no mention of fertilizers, methane from manure, transporting cattle, or refrigeration.

**3) Do you think this ad is "greenwash" or an honest, ethical, and significant attempt to address the environmental implications of this product?**

**Possible Answers:**

On the one hand, this brief video references many different aspects of the supply chain and shows McDonalds' interest in at least promoting itself as a company interested in sustainability issues. To determine the sincerity and depth of its commitment one would need to know a lot more about its practices. What does McDonald's mean by "sustainable agriculture" and "sustainable land use," why are some specific to Europe, and what is its "code of conduct for suppliers"? This does seem to show real effort to address key issues that impact McDonalds' carbon footprint.

**4) What are alternatives to this product that have a lower CO<sub>2</sub> footprint?**

**Possible Answers:**

Alternatives include eating less, eating less meat, switching from beef to chicken, choosing pasture-raised or free-range options, and buying locally raised products.

**5) What are the obstacles to consumers choosing these lower impact alternatives?**

**Possible Answers:**

Obstacles include our reluctance to change the diet and tastes we have become accustomed to; lack of availability or cost of pasture-raised, free-range, or local beef; lack of access to cheap and quick food; and a desire for fast, cheap, and high-fat and salt foods.

## Steps, Questions & Answers Guide for Clothing

This guide is intended to be used while the students are presenting their products to the class.

**1) Give an overview of the cradle-to-grave carbon footprint of your product.**

**Include a brief description of the CO<sub>2</sub> emissions of each step in the supply chain, including production, distribution, use, and disposal of the product. Identify the areas (e.g. transportation, manufacturing, etc.) that produce the most carbon.**

**2) Mention any additional information your group would you need to know to have a fuller understanding of the CO<sub>2</sub> implication of your product (e.g. the type of energy used in processing key raw materials).**

### **Possible Answers:**

Most of the carbon footprint of cotton clothing seems to be involved in the growing of the cotton itself, although this depends on whether this is done through conventional or organic methods. Transport represents a relatively small percentage of the footprint of the product. It is also clear that the footprint of a piece of clothing is strongly influenced by our methods of washing and drying during its use (as much as one-third of the footprint).

Production: Depending on organic or conventional farming practices, growing cotton requires plowing, irrigation, cultivation, and harvesting. If conventional techniques are used, large amounts of fertilizer and pesticides are also used, both requiring fossil fuel energy sources in their own manufacture, packaging, and transport. The cotton needs to be separated from the rest of the plant debris and shipped to a mill, where it is woven into fabric (this could be anywhere in the world). The fabric needs to be cut and sewn into clothing, dyed, and packaged.

Distribution: The clothing needs to be shipped from where it is being manufactured to retail outlets.

Use: The footprint of washing and drying clothing varies greatly depending upon the type of appliance (top versus front loading) the energy source (gas versus electric) and the fuel for electricity generation (coal versus hydro). Consistent use of a clothesline will significantly lower the footprint of clothing.

Disposal: Clothing can be given to a redistribution agency such as the Salvation Army, turned into rags, composted if cotton, or thrown away to be trucked to a landfill site.

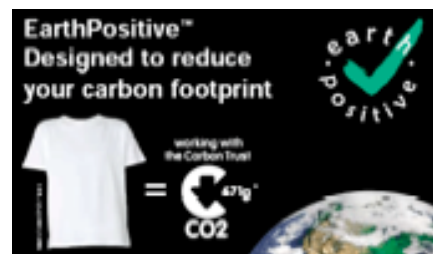
Different fibers have different carbon footprints. According to the International Rayon and Synthetic Fibers Industry in 2008, the fibers, ordered by largest to smallest footprint, are nylon, cotton, polyester, organic cotton, wool, biodegradable Polylactic acid (PLA) polyester, and recycled Polyethylene terephthalate (rPET) polyester (Averous 2009 & Larsen 2008).

### **Possible Answers:**

As with all products, the types of fuels used to complete each step of the supply chain (fossil fuels versus renewables) will impact its overall footprint. It would be good to know more clearly the difference between the amount of CO<sub>2</sub> released in growing cotton conventionally and organically. It would also help to know how this product is able to travel such long distances while having a relatively small transport footprint. Can rPET clothing be recycled?

3) Have the group present and analyze their advertisement.

Excerpt from Web page:  
[www.earthpositiveonline.com](http://www.earthpositiveonline.com)  
EarthPositive Apparel  
Two-page print handout



1) Introduce the ad.

This is an excerpt from a web page advertising “Earth-positive,” “carbon neutral,” “sustainable,” “ethically made,” “organic” cotton clothing.

2) What aspects of the product’s CO<sub>2</sub> footprint are addressed in the ad, and which are invisible?

**Possible Answers:**

The website addresses nearly all of the components of the CO<sub>2</sub> footprint for cotton clothing. It emphasizes the use of wind energy, organic farming, low-impact water use, biodegradable packaging, and “no airfreight” transportation. It includes the implications of, and suggestions for, washing and drying its clothing. The only footprint area not addressed is disposal.

3) Do you think this ad is “greenwash” or an honest, ethical, and significant attempt to address the environmental implications of this product?

**Possible Answers:**

This seems like a very thorough, transparent, and significant attempt to address the climate implications of clothing. They define their terms and give specifics for most of their claims. A number of the claims in the ad are backed by credible-sounding institutions (the Carbon Trust, the Global Organic Textile Standard, the Fairtrade Labeling Organization). They claim not to use carbon offsets to achieve carbon neutrality. They also address ethical issues such as child labor and water use.

4) What are alternatives to this product that have a lower CO<sub>2</sub> footprint?

**Possible Answers:**

Buying clothes from a reputable “green” company like Earth Positive Apparel will help to reduce one’s carbon footprint. In general, one’s clothing will have a lower footprint if one buys organic cotton or a low footprint fiber such as polyester. The lowest footprint will come from buying used clothing. Washing with a front loading machine and drying on a clothesline will lower the footprint significantly.

5) What are the obstacles to consumers choosing these lower impact alternatives?

**Possible Answers:**

Obstacles include the cost and availability of organic, low impact cotton clothing, the more limited options available in “green” clothing, lack of knowledge about the CO<sub>2</sub> implications of clothing, and reluctance to change.

## Steps, Questions & Answers Guide for Heating and Cooling

This guide is intended to be used while the students are presenting their products to the class.

**1) Give an overview of the cradle-to-grave carbon footprint of your product.**

**Include a brief description of the CO<sub>2</sub> emissions of each step in the supply chain, including production, distribution, use, and disposal of the product. Identify the areas (e.g. transportation, manufacturing, etc.) that produce the most carbon.**

**2) Mention any additional information your group would you need to know to have a fuller understanding of the CO<sub>2</sub> implication of your product (e.g. the type of energy used in processing key raw materials).**

### **Possible Answers:**

Production: Each type of fuel used to produce heat or cold involves its own supply chain of energy-requiring steps. Electricity is really an intermediary in the process, given that electricity is produced using many different primary energy sources (mostly coal in this country). Coal must be mined, requiring the removal of such vast amounts of over-burden that the practice is often referred to as “mountain top removal.” The coal must then be distributed generally using rail. Petroleum products must be extracted through drilling and then must be refined and transported. Renewable resources such as wind, solar and hydro are accessed through technology requiring its own supply chain in order to create dams, turbines, towers, panels, and so forth. To use these resources in order to heat or cool a structure requires furnaces and heaters of various types, air conditioners, fans, and pumps.

Distribution: Distributing the primary fuels used in heating and cooling requires transport of such things as coal, natural gas, oil, or wood. Using electricity for these purposes requires the grid infrastructure that carries electricity to our buildings, as well as the energy needed to maintain this structure.

Use: In this case “use” means either burning the energy source ourselves in our own buildings, or using the electricity that was created through the use of primary energy sources. This also includes the maintenance of heaters and air conditioners.

Disposal: This could include disposal of such things as the over-burden removed in order to access coal, the ash left over from generating electricity through the burning of coal, providing for the storage of nuclear waste and decommissioning nuclear facilities, or such things as the disposal of obsolete furnaces and air conditioners.

### **Possible Answers:**

It is important to know the carbon footprint associated with each primary fuel type and the relative green house gas emissions associated with each fuel type. How much CO<sub>2</sub> is released providing and maintaining our electrical grid? How much energy is lost in transmission of the electricity we use? What does carbon neutral mean and how is it related to the use of wood for heat? What are the carbon footprints per unit of energy access for the various renewable energy sources such as wind, solar, geothermal, and biomass?

3) Have the group present and analyze their advertisement.

Magazine advertisement  
from  
Solar Energy International  
Two-page print handset  
2010



1) Introduce the ad.

This is a print and web advertisement for a school that gives classes about renewable energy technologies.

2) What aspects of the product's CO<sub>2</sub> footprint are addressed in the ad, and which are invisible?

**Possible Answers:**

The ads do not overtly address global warming and greenhouse gas emissions, but the technologies they teach will all help to reduce the carbon footprint for the heating and cooling of homes. The carbon cradle-to-grave implications of renewable energy technologies, such as the production and distribution of solar panels and wind turbines, are not addressed. The carbon implications for the classes are not addressed, but they have online classes that are likely to have a smaller carbon footprint than classes that participants have to travel to.

3) Do you think this ad is "greenwash" or an honest, ethical, and significant attempt to address the environmental implications of this product?

**Possible Answers:**

The Solar Energy International School teaches people how to install a range of "renewable" energy technologies including solar, wind, radiant heat, and micro-hydro. These are non fossil fuel based energy technologies that will help to reduce global greenhouse gas emissions. The emphasis on practical and business concerns (e.g. grid design, sales and marketing, finances) may help integrate these technologies into mainstream building practices.

4) What are alternatives to this product that have a lower CO<sub>2</sub> footprint?

**Possible Answers:**

Alternatives include using less space, insulating (especially attics), having buildings checked for leaks, improving window R-values (According to the U.S. Department of Energy in 2009, "An R-value indicates an insulation's resistance to heat flow"), dressing more reasonably for both hot and cold situations, lowering the thermostat, especially at night, using ceiling fans instead of air conditioners, opening windows, using Energy Star appliances, keeping heating and cooling equipment well-tuned and -maintained, using passive solar building designs, heating buildings with carbon neutral biomass such as wood or pellets, installing solar PV and solar hot water systems, installing "on demand" hot water systems, taking shorter showers, using low flow shower heads, and heating and cooling with geothermal heat exchangers.

5) What are the obstacles to consumers choosing these lower impact alternatives?

**Possible Answers:**

Obstacles include the cost and availability of a range of low-impact heating and cooling technologies and systems, education and training in "green" heating and cooling options, the effort involved in researching and choosing alternatives, the invisibility of energy consumption, inconvenience and potential discomfort (e.g. lower temperatures), current infrastructure, current buildings, tradition, and the challenge of change.

## Steps, Questions & Answers Guide for Computers

This guide is intended to be used while the students are presenting their products to the class.

**1) Give an overview of the cradle-to-grave carbon footprint of your product.**

**Include a brief description of the CO<sub>2</sub> emissions of each step in the supply chain, including production, distribution, use, and disposal of the product. Identify the areas (e.g. transportation, manufacturing, etc.) that produce the most carbon.**

**2) Mention any additional information your group would you need to know to have a fuller understanding of the CO<sub>2</sub> implication of your product (e.g. the type of energy used in processing key raw materials).**

### **Possible Answers:**

Although the reading includes conflicting figures for how much each component of the supply chain contributes to the carbon emissions of computers, production and use seem to make up most of the footprint.

Production: Computers are made up of a wide array of different materials that seem to originate all over the world. Major components include silica, plastics, and various metals. Each of these materials has its own carbon footprint associated with extraction, purification and refining, manufacture, transportation, and waste disposal, involving the use of machines, electricity, and heat. According to one source, about 500 pounds of fossil fuels are required to produce one desktop computer, an exceptionally high amount per mass of product.

Distribution: This includes transportation from the assembly plant and the packaging of the computer in Styrofoam and cardboard.

Use: The footprint of a computer at this stage will vary greatly depending on the type of computer, how it is used, how often it is shifted to sleep mode or turned off when not in use, and the electrical source. There is also an “invisible” footprint left when we access websites on the Internet and emissions vary depending upon the type of use (e.g., watching videos online). Printers and paper use may be involved.

Disposal: Computers become obsolete quickly and so are turned over at a relatively rapid rate. If disposed of, a computer must be trucked to a landfill site and buried. If recycled, the computer is often shipped overseas for disassembly and recycling. In 2007, 133,000 PCs were disposed of every day (Greenemeier, 2007). Packaging also requires disposal or recycling, which is difficult to do with Styrofoam.

Given the toxicity of many of the materials used in computer production, there are also many non-carbon related environmental concerns tied to the manufacturing and disposal of computers

### **Possible Answers:**

The fuel source for the electricity that powers the computer and related Internet activities will have a significant impact on the footprint. In terms of use it would be important to have a better sense of how to assess the energy use for different kinds of Internet uses (e.g. watching videos online versus on a DVD). It would also be useful to know how much energy is being conserved in switching from processing to sleep mode. One of the most significant aspects of the overall CO<sub>2</sub> footprint of computers is whether they allow us to consume less energy overall by replacing emissions-heavy activities including travel and paper production, or whether they just add to our existing footprint.



3) Have the group present and analyze their advertisement.

Internet review for a  
Eco Friendly  
Wooden Computer  
One-page print handout  
2007



1) Introduce the ad.

This is an Internet advertisement for a wooden computer.

2) What aspects of the product's CO<sub>2</sub> footprint are addressed in the ad, and which are invisible?

**Possible Answers:**

The advertisement highlights the energy efficiency of the computer ("87% less energy than the conventional plastic computers"), which is one of the largest contributors to a computer's CO<sub>2</sub> footprint. It describes design changes to help efficiency (small size, 40 watts of power, non lit buttons, no fan) and the use of recycled materials and packaging. You will also get an energy-efficient bulb when you buy the computer to offset carbon and a CD instead of paper instructions. There is no reference to the transportation of the computer or its components, or to the CO<sub>2</sub> footprint for the wood.

3) Do you think this ad is "greenwash" or an honest, ethical, and significant attempt to address the environmental implications of this product?

**Possible Answers:**

Given the major role of energy use in the CO<sub>2</sub> footprint of computers, a more energy-efficient computer would help to reduce carbon emissions. If this wooden computer is in fact "87% more efficient" as it claims, that is significant. It would be important to independently verify this claim. Although it would not necessarily improve its CO<sub>2</sub> footprint, the use of less toxins in the production of the computer is also authentically "green."

4) What are alternatives to this product that have a lower CO<sub>2</sub> footprint?

**Possible Answers:**

Alternatives to traditional computer use include using smaller computers that do not require cathode ray tubes, programming your computer to shift to sleep mode soon after you stop using it actively and to go off completely after a short period of time, consciously limiting energy-intensive computer use (e.g. unnecessary searches, video-heavy sites), delaying the upgrade (and disposal) of your computer until really necessary, donating your computer to a reuse center, printing on both sides of paper or reusing one-sided paper in your printer, and shifting activities to your computer that have a large footprint (watching videos instead of traveling by air, reading online rather than using paper, etc.).

5) What are the obstacles to consumers choosing these lower impact alternatives?

**Possible Answers:**

Obstacles include lack of awareness and knowledge of the CO<sub>2</sub> implications of computer production and use, the invisibility of energy consumption, desire for large screen imagery, reluctance to sleep and shut down computers, questionable credibility of "alternative" computer technology, tendency to keep doing things as we have done them in the past, and a fear of change.

## Steps, Questions & Answers Guide for Magazines

This guide is intended to be used while the students are presenting their products to the class.

**1) Give an overview of the cradle-to-grave carbon footprint of your product.**

**Include a brief description of the CO<sub>2</sub> emissions of each step in the supply chain, including production, distribution, use, and disposal of the product. Identify the areas (e.g. transportation, manufacturing, etc.) that produce the most carbon.**

**2) Mention any additional information your group would need to know to have a fuller understanding of the CO<sub>2</sub> implication of your product (e.g. the type of energy used in processing key raw materials).**

### **Possible Answers:**

Approximately two-thirds of the total CO<sub>2</sub> footprint of a print magazine is related to the production of paper.

Production: The *Student Reading* for this product includes an extensive analysis of the cradle-to-grave CO<sub>2</sub> footprint of one issue of *Discover* magazine. The bulk of its emissions were associated with the production of the paper. Additional CO<sub>2</sub> emissions were associated with the office space of the staff writing and producing the magazine, as well as their travel. The ink used released CO<sub>2</sub> as did the actual printing of the magazine. Transportation of the raw materials to the mill and transportation of the paper to the printing facility also contributed to the carbon emissions.

Distribution: This is a small component of the magazine's carbon footprint. It includes transport of the magazines to newsstands and other retail outlets as well as mailing to subscribers.

Use: Using this product generates little or no CO<sub>2</sub>, other than through the requirement of lighting.

Disposal: Most *Discover* magazines associated with this analysis were not recycled. The CO<sub>2</sub> released due to disposal as trash involved both transporting the material to a landfill as well as the methane released through the anaerobic decomposition. It is important to note that the recycling of the magazines, though less than disposal, still results in the release of CO<sub>2</sub>.

### **Possible Answers:**

It would be important to know the types of fuels used during the production and transportation of paper to determine the overall footprint of print magazine. It is unclear from the article just how much difference the use of recycled paper makes. It would be important to have a comparison between the footprint of an online versus a printed magazine.

3) Have the group present and analyze their advertisement.

Magazine advertisement  
*Coco Eco Magazine*  
1:05 min  
from YouTube promo  
2009



1) Introduce the ad.

2) What aspects of the product's CO<sub>2</sub> footprint are addressed in the ad, and which are invisible?

3) Do you think this ad is "greenwash" or an honest, ethical, and significant attempt to address the environmental implications of this product?

4) What are alternatives to this product that have a lower CO<sub>2</sub> footprint?

5) What are the obstacles to consumers choosing these lower impact alternatives?

This is a promotional Web video for *Coco Eco Magazine*.

**Possible Answers:**

The ad has very little information about how it is truly "ecological," let alone about its carbon footprint. However, the very end of the ad it calls itself "paperless." Given the huge CO<sub>2</sub> implications of a print magazine (paper production, transportation, storage, disposal, etc.), a paperless (online only) magazine would have a significantly smaller footprint than a print magazine.

**Possible Answers:**

On one hand, this brief video seems totally superficial in its approach to being environmentally conscious. It flaunts itself as "green" and "eco-friendly" without providing (almost) any evidence. It promotes the kind of conspicuous consumption that is responsible for our carbon-heavy modern lifestyle. On the other hand, if the magazine is truly "paperless" then it will have a much smaller carbon footprint than even the greenest sounding "ecologically correct" magazine like *Discover*.

**Possible Answers:**

An online magazine has a far lower carbon footprint than a paper magazine. One can also share subscriptions with friends groups, recycle the magazines once used, and take out magazines from libraries.

**Possible Answers:**

Obstacles include lack of awareness and knowledge of the CO<sub>2</sub> implications of paper; preference for print magazines over reading online; desire to own, collect, and preserve magazines in hard copy; and a tendency to keep doing things as we have done them in the past.

## Steps, Questions & Answers Guide for Music Concert

This guide is intended to be used while the students are presenting their products to the class.

**1) Give an overview of the cradle-to-grave carbon footprint of your product.**

**Include a brief description of the CO<sub>2</sub> emissions of each step in the supply chain, including production, distribution, use, and disposal of the product. Identify the areas (e.g. transportation, manufacturing, etc.) that produce the most carbon.**

**2) Mention any additional information your group would need to know to have a fuller understanding of the CO<sub>2</sub> implication of your product (e.g. the type of energy used in processing key raw materials).**

### **Possible Answers:**

The reading for this group was based on an exhaustive analysis of the total cradle-to-grave CO<sub>2</sub> footprint of the Live Earth of concerts held in 11 cities around the world on July 7, 2007. At the time, this was perhaps the most comprehensive carbon analysis ever done on a concert.

Eighty-seven percent of the CO<sub>2</sub> emissions for the ecologically conscious Live Earth concerts came from the audience's travel to and from the concert. According to the reading, 80% of the travel footprint came from the small percentage (8%) of attendees who traveled by air. The concerts where participants used mass transit tended to have lower footprints than concerts where most participants attended by car. For instance, three-quarters of concertgoers in Shanghai and Tokyo came by mass transit, compared with less than one-quarter of attendees in New York City. Organizers provided the audience with incentives for carpooling and using mass transit.

Producers reduced the typical footprint of a concert by having it during daylight hours (saving on lighting), facilitating recycling and composting, reusing signage, using high-efficiency lighting, using bio diesel to run generators, and using local products and performers when possible.

Preparations for the concerts used low-carbon strategies, including reducing travel through video conferencing and other non-travel strategies, using fuel-efficient transport for staff and materials (e.g., hybrid cars and shipping of materials), and holding eco-training sessions for employees.

### **Possible Answers:**

To understand the percentages offered in the reading more clearly, it would help to have information on just how effective the carbon reductions, instituted by the producers of these concerts, had been. According to the reading, producers put a great deal of time and effort into reducing the footprint of this event. We are given the resulting footprint, but have no way of knowing the degree of difference these efforts made. Also, it would be interesting to have information on each specific site concerning the secondary and tertiary emissions. According to the reading the use of mass transit by attendees varied greatly (e.g. Shanghai: 78%, NYC: 23%). It would be interesting to know how much difference this made in the emissions of each concert. Finally, it would be important to see a comparable analysis of a typical concert of the same size held at night without any of these carbon saving techniques. Would travel still be the biggest contributor of emissions?

3) Have the group present and analyze their advertisement.

:53 sec YouTube Video  
Jonas Brothers  
from *Chevy Rocks the Future*  
2008 music concert to promote the Chevy Tahoe



1) Introduce the ad.

**Possible Answers:**

This is a short YouTube video about the Jonas Brothers and *Chevy Rocks the Future*, a promotional concert for the Chevy Tahoe hybrid SUV.

2) What aspects of the product's CO<sub>2</sub> footprint are addressed in the ad, and which are invisible?

**Possible Answers:**

The only place where the video addresses the CO<sub>2</sub> footprint of the musical event is the reference to "100% recycled material" for the packaging for the Jonas Brothers' recent CD. There is also a visual reference to fuel cells and hybrid cars. There are no other references to the environmental implications, let alone the carbon footprint, of the Jonas Brothers concert.

3) Do you think this ad is "greenwash" or an honest, ethical, and significant attempt to address the environmental implications of this product?

**Possible Answers:**

Chevy is using this concert to promote its hybrid SUV, the Tahoe, by linking its brand to a popular rock band and a "green" image. The Jonas Brothers are also promoting their "green" image through these concerts and this ad. There is nothing to suggest that the concert is trying to lower its carbon footprint. On the other hand, fuel cell and hybrid technologies do have significant carbon-reducing potentials (E4tech, 2006).

4) What are alternatives to this product that have a lower CO<sub>2</sub> footprint?

**Possible Answers:**

Given that the travel to concerts is a major component of their footprint, carpooling, use of mass transit such as buses or trains, attending local music, and experiencing concerts without travel (on video or making your own music) will all lower the footprint of a concert.

The Live Earth concerts employed many strategies (listed above) to lower the carbon footprint for any large event such as a music concert.

5) What are the obstacles to consumers choosing these lower impact alternatives?

**Possible Answers:**

Obstacles include lack of awareness and knowledge of the CO<sub>2</sub> implications of public performances, our desire to see performers in person and at night, and our preference for individual car travel over mass transit.

TEACHER GUIDE

# Assessing Carbon Footprints

## Activity 4a: Personal, Policy, and Moral Choices

1. Lead a class discussion that helps students to identify and explore the choices involved in lowering one's carbon footprint.

Ask: **What are the obstacles we each face as individuals in lowering our footprint?**

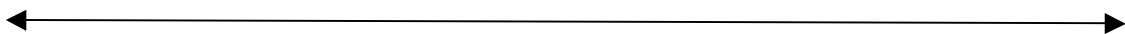
**What can and should we do as individuals to reduce our footprint?**

**What are the obstacles we face as a nation to lowering our national footprint?**

**What role should businesses play in producing and promoting cleaner products?**

2. Lead the "Take A Stand" activity. Clear part of the room where all students can stand in a line. Ask students to move to a space on the continuum reflecting their position on one of the following pairs of statements. Students may be in the middle if they are unclear, have mixed opinions, or take a position that is not reflected in the statements outlined below. If one of the sides has no representatives, alter the statement or argue from that position yourself.

### Continuum Statements:



**The government should play a role in regulating product footprints through laws, mandates, or taxes.**

VS

**Choices about the "greenness" of products should be left up to the consumer and market forces.**

**It is possible to address climate change through technological advances and adaptations to our current system.**

VS

**Global warming requires a fundamental shift of our current economic structure and consumer lifestyle.**



TEACHER GUIDE

# Assessing Carbon Footprints

## Activity 4b: Personal, Policy, and Moral Choices

1. Prepare the necessary equipment to show a video clip to the class.
2. Show the following video clip and lead a discussion of the clip using the *Sample Questions and Answers* in this guide.



**Pig-Buy Nothing Day  
Adbusters, 2006**  
30 sec commercial



## Media Sample Questions & Answers

1.) Who do you suppose produced this commercial, and for what purpose?

**Possible Answers:**

An environmental group to get Americans to use less of the world's resources

An anti-consumerist group to get Americans to shop less

The group Media Foundation, to promote their magazine *Adbusters*

**Explain**

Buy Nothing Day was promoted by the Canadian magazine *Adbusters* that challenges consumerism through "culture jamming." The organization raised money to run ads like this one on Black Friday, the day after Thanksgiving that is typically one of the biggest shopping days of the year in the U.S. However, major television networks (with the exception of CNN) refused to run the ads (Campbell, 2000).



## Media Sample Questions & Answers

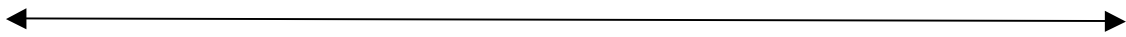
2) Why do you suppose most television networks refused to run Buy Nothing Day commercials like this one?

**Possible Answers:**

These ads might discourage companies from paying for advertisements on the same network that hosts Buy Nothing Day ads.

TV networks survive through selling advertising time, which pays for the programming. A successful Buy Nothing Day campaign could undermine the very consumerism that funds the networks.

3. Lead the “Take A Stand” activity. Clear part of the room where all students can stand in a line. Ask students to move to a space on the continuum reflecting their position on the following statement.



**Anti-consumer activism like this is anti-American and will not help the environment.**

VS

**Modern American consumerism will kill the planet. It must be confronted.**

4. Lead a class discussion about the personal, policy, and moral implications of this lesson using the culminating questions below.

### CULMINATING QUESTIONS

- » What responsibility, if any, do Americans in particular have in addressing global warming given the disparity in the cause and in the consequences?
- » Should the wealthy nations pay climate reparations to the developing world for future climate consequences?
- » Should there be international laws mandating the reduction of greenhouse gas emissions?
- » Do you as individuals bear any moral responsibility for climate change?
- » Is it appropriate to think in terms of individual responsibility, or does global warming need to be thought of in terms of changing larger global systems?
- » Realistically, what will each of you do as individuals as a result of this knowledge?



**Assessing the CO<sub>2</sub> Footprint for:  
CARS**

**Document 1**

The people in the United States have always had a love affair with the automobile. According to the U.S. Department of Transportation, personal vehicles (cars and light trucks), consume 63% of the total energy used for transportation, while commercial vehicles (large trucks and construction vehicles), mass transit (airplanes, trains, and buses), and pipelines account for the rest. It is likely that a good chunk of your personal carbon footprint comes from how you get around (U.S. Department of Transportation, 2009).

CO <sub>2</sub> emissions in grams per passenger-mile for various modes of travel	Rail.....43.7
	Bus.....66.1
	Car.....126.2
	Air.....141.6
(Vergara & Haeussling, 2007)	

The automobile, like nearly all modern products, has a supply chain that is much larger and deeper than appears in the show room. The cradle-to-grave carbon implications of the car includes resource extraction and processing, manufacturing, transportation, retail and marketing, the use of the car, and its disposal. Although all parts of the chain emit carbon, some parts are more polluting than others.

**Resource Extraction and Processing**

According to Durning & Ryan 2007, a typical car is composed of steel (55%), iron (12%), plastics (8%), fluids and lubricants (6%), aluminum (6%), rubber (4%), glass (3%), copper and brass (1%), other metals (2%), and other materials (3%). All metals originate as types of ore in the ground. Typically, in order to gain access to the ore massive amounts of "over burden" must first be removed. Then the ore must be dug and transported for processing. Processing requires extreme temperatures as a means of metal extraction and purification. The purified metal is then transported to factories where it must then be shaped into whatever parts are required.

Plastics are petroleum based products. During the refining process (requiring great amounts of heat), the components of crude oil that are used for plastic are drawn off. This refined material must then be transported to the many different plastic manufacturing facilities where all of the plastic components of the car are then shaped and colored (Schirber, 2009).

Fluids and lubricants involve such things as oil, transmission fluid, brake fluid, radiator fluid, and windshield washer fluid. Each has a convoluted path that involved numerous locations, processes, packaging, and transport.

The main ingredient of glass is silica, one of the most abundant materials on earth. To reach its melting point, silica must be heated to around 4200° F. Numerous additional chemicals are added to the glass in order to give it the characteristics required. Each of these additives must be extracted, processed, packaged, and transported to the location where the glass is being fabricated (Silica-Silicon Dioxide).

**Manufacturing**

Again according to Durning & Ryan 2007, this process involves cavernous buildings where robotic machines perform much of the work. The average car receives over 4,000 spot welds, each created by a flow of electricity causing high enough temperatures to melt the welding materials. In all, the car is composed of over 10,000 parts assembled into about 100 major components by companies around the world. The building itself must be illuminated and kept at a reasonable temperature year round. Wastes generated during the manufacturing process must be hauled to landfills.

**Transportation of Products**

Cars are transported by ocean-going ships, on rail, and by semi-trailers. The average car weight of commonly owned cars in the US in 2004 was just over 4,000 pounds (Hakim, 2004). Depending upon where the car was manufactured, the slide with CO<sub>2</sub> per tonne-kilometer offers a good relative indication of energy spent in shipping cars.

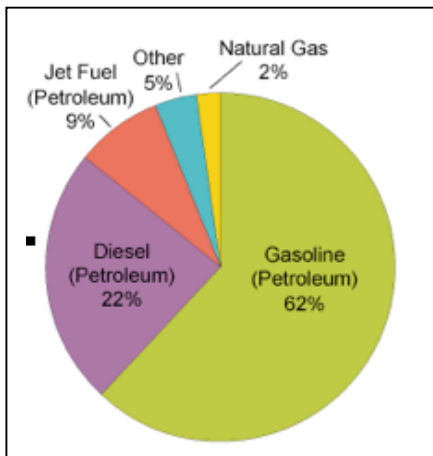
<b>Estimated CO<sub>2</sub> emissions in grams per tonne-kilometer for various modes of freight transport</b>	
<b>Maritime (ocean-going vessels)...</b>	<b>13.9</b>
<b>Rail.....</b>	<b>22.8</b>
<b>Trucks.....</b>	<b>123.1</b>
<b>Air cargo.....</b>	<b>500.0</b>
(European Environmental Agency, 2008)	

**Retail and Marketing**

According to the U.S. Energy Information Administration (EIA), retail and service buildings use the greatest amount of energy of all commercial building types. These buildings must be heated in the winter and cooled in the summer. They are generally well-lit (often 24 hours a day). They must be cleaned regularly and repaired as needed. Water and sewage systems must be used and maintained. The large spaces involved must be well ventilated.

**Product Use**

The average mileage of sedan-style cars in the U.S. was 22.4 miles per gallon in 2006. While estimates vary as to the average number of mile driven each year by the average user, many sources are currently estimating around 12,000 miles driven per driver per year (U.S. Department of Transportation, 2009). According the EIA, cars travel over 7 billion miles per day in the US. They also estimate that about 65% of the crude oil that is refined into gasoline comes from outside of the U.S.



Fuel used for transportation, 2007.

(Davis, Diegel, & Boundy, 2009)

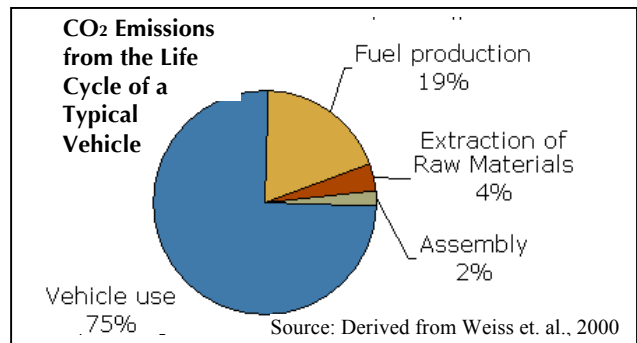
Gasoline is used mainly by cars, motorcycles, and light trucks; diesel is used mainly by heavier trucks, buses, and trains. According to the EIA, gasoline and diesel together make up 86% of all the energy used in transportation. There is currently a push to develop vehicles that run on fuels other than petroleum products or on blended fuels. Today, there are some vehicles that run on electricity, natural gas, propane, and ethanol. Hybrid-electric vehicles combine the benefits of gasoline engines and electric motors, reducing the amount of fuel required for moving a vehicle. This is why hybrid-electric vehicles can get more miles per gallon of gasoline compared to vehicles that run on gasoline alone.

In addition to gasoline, cars use oil as a lubricant and use other fluids that require periodic replenishment. Cars are serviced, repaired, and washed regularly. All of these tasks require various buildings, each with their own energy expenditures.

Then there are the roads themselves. When the CO<sub>2</sub> emissions associated with the refining of oil used for the asphalt, the quarrying and transport of gravel used for the surface, and the machines used to lay the road and plow and maintain it are all considered, building 10 miles of four-lane highway is like putting 46,700 Hummers on the road (Williams-Derry, 2007).

**Disposal**

Today, cars are rarely thrown away. Instead, they are recycled. About 50 to 60% of a junked car is made of steel and 25% of all steel today is composed of recycled steel. In *Ward's Motor Vehicle Facts and Figures* (2007), it was estimated that at least 84% of an average car's material content gets recycled. The "junking" of a car requires that it be transported to a facility and disassembled. The resulting materials need to be separated according to material type. The recyclable components need to be transported to factories where specific materials are processed (usually requiring a great amount of heat and therefore energy) into new raw materials. The non-recyclable materials must be transported to sanitary landfills and buried.



According to the environmental website, *World Resources Institute* (2007), while CO<sub>2</sub> emissions arise at nearly every stage of a motor vehicle's life, including extraction of raw materials and manufacturing of component parts, it is the combustion of gasoline and diesel fuels during vehicle use that accounts for the greatest share of vehicle-related CO<sub>2</sub> emissions.

**Assessing the CO<sub>2</sub> Footprint for:  
HAMBURGERS**

**Document 2**

We all need to eat, and many of us enjoy a juicy hamburger at least once in a while. However, as with other lifestyle activities, we are making choices about what to eat that impact not only our health but also our carbon footprint.

The complete carbon footprint of a hamburger includes many components of the supply chain that we never see or even think about. The futurist Jamais Cascio estimated that between 2.2 and 7.7 pounds of carbon emissions are released per cheeseburger depending upon the type of energy used throughout the supply chain (e.g. electricity and natural gas versus diesel and coal). Cascio’s estimate includes emissions from the restaurant and driving to/from the burger shop as well as methane emissions from the cattle.

**Energy use for a hamburger** [patty] with range of variations in data as a result of more or less energy efficient practices and appliances

	Low, MJ	High, MJ
Crop production, drying, fodder production	3.5	5.0
Stable, slaughtering, cutting	0.23	1.4
Grinding, freezing	0.12	0.16
Storage	0.45	2.3
Frying	0.79	1.0
Transportation	0.44	0.59
<b>Total</b>	<b>5.6 MJ</b>	<b>10 MJ *</b>

(Carlsson-Kanyama & Faist, 2000)

\* A fluorescent bulb uses about 2.5 MJ per 24 hours.

David Pimentel detailed the following in his 2000 book *Ecological Integrity: Integrating Environment, Conservation and Health*. Keep in mind that each step contributes to the hamburger’s total carbon footprint.

**Life Cycle of a Hamburger**

1. Grain is grown, using a variety of fertilizers, herbicides, pesticides, and significant quantities of water. Threshers, combines and tractors are used to sow, grow and reap the grain.

2. The grain is shipped to cattle ranches or feedlots, where it is fed to cattle, along with water. Waste products include manure, methane and uneaten grain.
3. Cattle are shipped by truck or train to market, where they are fed and sold and shipped again to processors.
4. At processing plants, the cattle are slaughtered and cut into large sections called primal cuts. These must be quickly refrigerated and aged. Waste products include unusable animal parts, wastewater and manure.
5. The beef is shipped in refrigerated trucks and rail cars to food service warehouses, where it is ground, formed into patties and boxed and wrapped for use. It is stored and frozen until needed.
6. Beef patties are shipped via freezer truck to stores and restaurants. They are kept in cold storage until needed. They are then cooked on a broiler or fryer, put on a bun, topped with condiments, wrapped and put under hot lights until served.
7. Uneaten portions are thrown away.

“The wheat for the bun probably came from the Great Plains, the lettuce and tomatoes from California, and the cheese might have come from Oregon... The typical mouthful of American food travels 1,200 miles from farm to consumer.”

(Ryan & During, 1997)

**Grain-fed Cattle**

Most U.S. beef cattle are fed grain, typically corn, once they enter a feedlot. According to the Cornell University Cooperative Extension (2008), it takes about 6 pounds of diet (mostly corn) for each pound a cow puts on. According to Pimentel, the U.S. cattle herd of over 100 million animals is the nation’s largest user of grain.

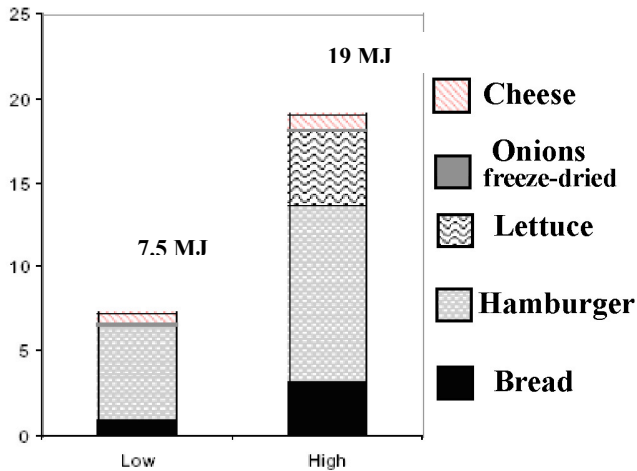
Most U.S. animal feed such as corn is grown using extensive fertilization. According to Ryan and During, “Nitrogen fertilizer is essentially congealed natural gas: a Texas chemical plant heated methane from natural gas to form hydrogen gas, compressed and superheated the hydrogen, added nitrogen distilled from air, and ended up with ammonia [a fertilizer].”

Cows evolved as grass eaters. It is only in the last 50 years that most U.S. beef cattle have been fattened on corn, according to Lindsay Moyer's 2008 *Women's Health* article, "Grass is Greener." In contrast to today's highly industrialized animal feed, grass gets its energy from the sun so that grass-fed cattle require far less fossil fuel energy than grain-fed beef. But cattle fed on an intensive diet of corn put on weight much quicker, resulting in cheaper meat. In essence, fossil fuels in the form of highly fertilized corn keep beef process low but also add to the carbon footprint of our hamburger.

In addition, corn-fed cattle must be given antibiotics to help them adapt to a diet of grain. As stated by John Robbins, author of *The Food Revolution*, this leads to the development of antibiotic-resistant bacteria. Other environmental impacts of feeding millions of cattle massive quantities of antibiotics has yet to be determined.

**Megajoules of energy used to make the components of a cheeseburger,**

low and high estimates (e.g. lettuce grown in a field versus greenhouse, efficiency of machines and appliances).



According to the *Better World Handbook*: "Raising livestock for meat is one of the most inefficient uses of land. One acre of land could produce 50,000 pounds of tomatoes, 40,000 pounds of potatoes, 30,000 pounds of carrots or just 250 pounds of beef. To produce a year's supply of beef for a family requires over 260 gallons of fossil fuel, or approximately one gallon of gasoline per pound of grain-fed beef. Finally, it takes 2,500 gallons of water to produce one pound of beef; to produce one pound of wheat requires 25 gallons."

**Methane**

According to James Cascio, a beef cow is generally slaughtered around two years of age and will have released some 485 pounds of methane through burps, farts, and manure. If you get 2,000 burgers per steer, then that's a little more than 0.22 pounds of methane per burger. Since it's 20 times more effective than CO<sub>2</sub> in trapping heat, it has the equivalent effect of 4.4 pounds of CO<sub>2</sub> per burger.

According to the U.S. Environmental Protection Agency (EPA), methane (CH<sub>4</sub>) is a greenhouse gas that remains in the atmosphere for approximately 9-15 years. Methane is over 20 times more effective in trapping heat in the atmosphere than is carbon dioxide (CO<sub>2</sub>) over a 100-year period. Beef and dairy cattle are the largest contributors of methane, much of it from manure. The EPA estimates that more than half of all cow manure in the country comes from concentrated animal feeding operations (CAFOs). CAFOs are a reflection of the increasing industrialization of agriculture in the United States since World War II.

**CAFOs**

According to the EPA: "CAFOs are facilities where large numbers of poultry, swine, cattle or other animal types are confined within a much smaller area than traditional pasture operations. The concentration of the wastes from these animals increases the potential to impact air, water, and land quality." While the main environmental concern in regard to feedlots is the waste produced and the disposal required for this waste, another issue is the amount of energy needed to transport the feed and other inputs (e.g. antibiotics) in and to cart the waste out.

Food is the third largest contributor to the average U.S. household's carbon footprint after transportation and utilities. There are a number of options for reducing the CO<sub>2</sub> footprint of food, including our burgers. Although switching to local meat helps, only about 5% of emissions from food come from transporting food to market (*Seed Daily*, 2009). However, switching from beef to chicken would reduce emissions by 70%. Red meat used to be a luxury in our diet. If we got back to a healthier diet with a higher percentage of grains and vegetables we would also be lowering our collective footprint (Breitbart, 2008).

**Assessing the CO<sub>2</sub> Footprint for:  
CLOTHING**

**Document 3**

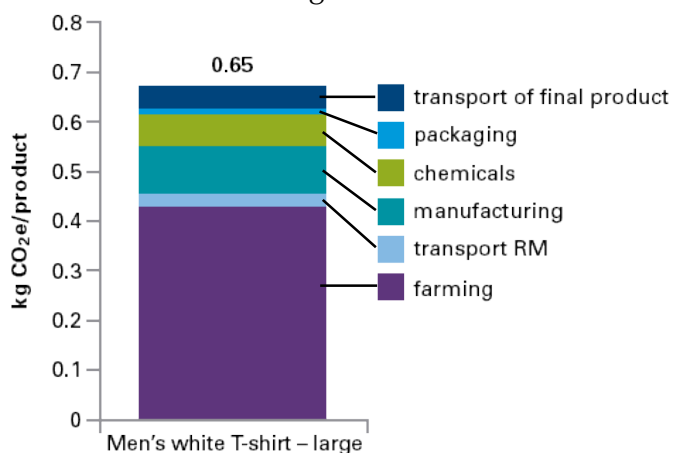
If an organic cotton T-shirt (with an environmental slogan on it) has a larger carbon footprint than a synthetic shirt, which is better for the environment? How does one accurately compare the footprints of each? What about other environmental considerations such as insecticides, pesticides, and synthetic fertilizers? Should one take into consideration the quality of life of the garment workers when evaluating the sustainability of a potential purchase? Assessing the “greenness” of a product is complicated and can be filled with ironies.

The UK company Continental Clothing has collaborated with the Carbon Trust to create the world’s first life cycle carbon footprint labeling model for retail clothing.

According to the 2010 website for the clothing company Patagonia, its organic T-shirt is designed in California, the cotton is grown and picked in Turkey and is shipped back to California where it is knitted, cut, sewed, dyed, and printed before being shipped to Nevada for distribution. At 7,840 miles (from origin as raw materials to delivery), the T-shirt travels less than almost any other Patagonia product (e.g., the women’s scoop top shirt travels 29,000 miles). Patagonia assesses that the T-shirt has a total carbon footprint of 3.5 pounds, or almost 8 times the weight of the shirt.

Stormberg, a Norwegian clothing company, reported in its 2008 *Carbon Footprint Analysis* a smaller carbon footprint for its cotton clothing products, but the difference between Patagonia’s and Stormberg’s figures

**CO<sub>2</sub> Footprint for a Large Men’s White Organic Cotton T-shirt**



(Continental Clothing Company, 2010)

may have more to do with their different carbon assessment protocols than their production strategies. However, there is not yet an international, consistent standard for assessing the cradle-to-grave carbon footprint of different products. This makes it particularly hard for consumers to compare products (Stormberg, 2008).



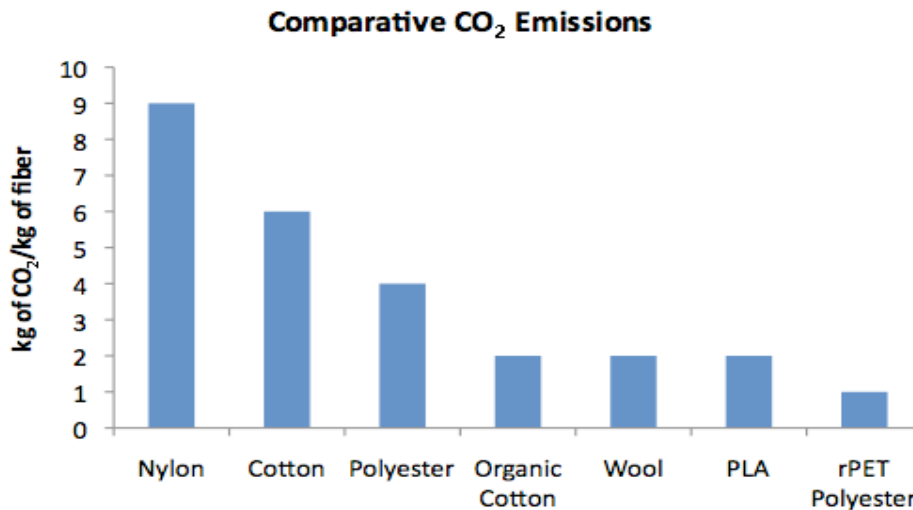
(Iowa 2009)

It is important to evaluate the different parts of a supply chain to assess which stages produce the most carbon. Stormberg’s evaluation does quantify the footprint for different stages, showing that cotton production is by far the largest contributor to the carbon footprint of its T-shirts. This accounting is questioned by the organization Cotton Incorporated (2009): “Cotton has a neutral greenhouse gas (GHG) footprint when the carbon in the fiber and that stored in the soil is accounted for; when credit is given for the energy stored in the cottonseed, cotton actually captures more GHG emissions than those emitted.” The argument for cotton being “carbon neutral” is based on the fact that cotton plants remove carbon from the atmosphere through photosynthesis and as they grow (Gust, 1996). However, one must also take into consideration other inputs in cotton production

**Cotton versus Synthetics**

Depending upon the methodology for assessing carbon emissions in manufacturing, a case can be made that many synthetic fibers have a smaller footprint than cotton. As shown in the chart at the top of the next page, the International Rayon and Synthetic Fibers Industry ranks many synthetics as having lower carbon emissions per kilogram of fiber than cotton. However, one should always consider the source when evaluating the credibility of data.

In the debate between cotton and synthetic fiber, other issues need to be considered. According to the blog *O Ecotextiles*, polyester takes much less water to produce but much more energy, and it is petroleum-based and thus requires the extraction of fossil fuels. To add to the complexities, there are different ways of growing cotton that impact its carbon footprint and environmental impact (Anne & Anne, 2009).



This chart shows the comparative measure of CO<sub>2</sub> emissions per kilogram of fiber. (CIRFS, 2008).

**The Case for Organic**

Although cotton production has a significant carbon footprint, organic farming eliminates the use of chemical insecticides, pesticides and fertilizers, addressing environmental concerns beyond CO<sub>2</sub> emissions. Infants, children, and farm workers are especially vulnerable to exposure to these chemicals. Pesticides and fertilizers also contaminate groundwater, from which half of the U.S. receives its drinking water. Growing organic cotton also helps reduce soil erosion by building up the organic matter in the soil. In addition, the following statistics come from the Organic Trade Association website (2009).

Should one trust this information given the source?

- Cotton uses approximately 25% of the world's insecticides and more than 10% of the pesticides (including herbicides, insecticides, and defoliants) (Allan Woodburn).
- Fifty-five million pounds of pesticides were sprayed on the 12.8 million acres of conventional cotton grown in the U.S. in 2003 (4.3 pounds/ acre), ranking cotton third behind corn and soybeans in total amount of pesticides sprayed (USDA).
- Over 2.03 billion pounds of synthetic fertilizers were applied to conventional cotton in 2000 (142 pounds/acre), making cotton the fourth most heavily fertilized crop behind corn, winter wheat, and soybeans (USDA).
- The Environmental Protection Agency considers seven of the top 15 pesticides used on cotton in 2000 in the United States as "possible," "likely," "probable," or "known" human carcinogens (acephate, dichloropropene, diuron, fluometuron, pendimethalin, tribufos, and trifluralin) (EPA).

(Cotton and the Environment, 2009)

Given the impact of conventional cotton production on the health of cotton workers, consumers and the environment, as well as its carbon footprint, is it worth the extra money to buy to organic cotton?

The carbon emissions resulting from washing and drying may account for up to one-third of a T-shirt's life cycle carbon footprint, according to Continental Clothing Company (2010). For example, avoiding tumble-drying and ironing will save approximately 0.9 kg [about 2 pounds] of CO<sub>2</sub>, or one-third of this garment's carbon footprint in its lifecycle.

According to Durning and Ryan, "laundering will also generate the vast majority of solid waste in the shirt's life cycle, in the form of sewage sludge and detergent packaging" (2009).

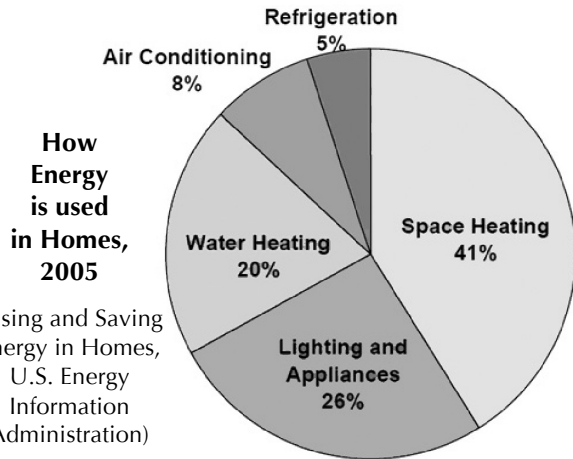
And according to the Federal Trade Commission (2009): "Typically, front-loaders use less water — from one-third to one-half the amount that top-loaders require. The clothes tumble in the tub, rising above the water and then falling back into it as the tub rolls on its side. Because less water is used, less gas or electricity is required to heat the water; because the machines spin faster, clothes get wrung out more completely, reducing the cost of running a clothes dryer." A clothes dryer also uses a significant amount of energy that releases various amounts of carbon depending upon the energy source for the dryer. One can save carbon and money by switching to a low-cost, low-tech, solar-powered dryer better known as... a clothesline.



**Assessing the CO<sub>2</sub> Footprint for:  
HEATING AND COOLING**

**Document 4**

According to the *Encyclopedia of the Earth*, 20% of U.S. greenhouse gas emissions come from home energy use. Heating and cooling usually consumes more energy than any other home appliances (Waiser, 2008).

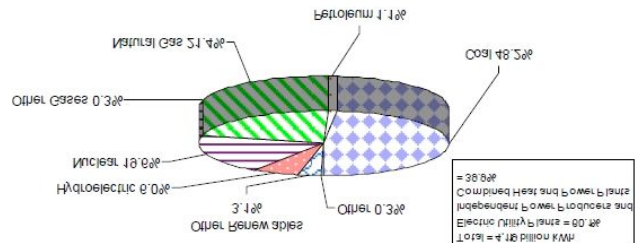


Energy use and related CO<sub>2</sub> emissions vary according to the type of fuel used. In colder states, heating can account for up to two-thirds of the annual energy bills. On average, heating an American home with natural gas produces about 6,400 pounds of CO<sub>2</sub>, while heating with electricity produces about 4,700 pounds. In hotter parts of the country, air conditioning is the biggest energy user (Using and Saving Energy in Homes, U.S. Energy Information Administration). An average Florida home produces 6,600 pounds of CO<sub>2</sub> per year from central air conditioning (Waiser, 2008).

CO<sub>2</sub> emissions for heating and cooling also vary by region depending upon the source for electricity generation. According to the U.S. Energy Information Administration (EIA), though all regions use some fossil fuels for electricity (in 1998 over 40% of CO<sub>2</sub> emissions in the U.S. were attributed to the burning of fossil fuels for electricity), a few states generate almost all their electricity through nuclear or hydro power, resulting in relatively low rates of CO<sub>2</sub> emissions.

According to the U.S. Department of Energy and the U.S. Environmental Protection Agency (2000): “For example, Vermont produces mostly nuclear power, while Washington, Idaho, and Oregon generate almost all electricity at hydroelectric plants. At the other extreme, Colorado, Indiana, Iowa, Kentucky, New Mexico, North Dakota, Ohio, West Virginia, and Wyoming—a group that includes some of the nation's largest coal-producing States—generate most of their electricity with coal. Regions where coal-fired generators dominate the industry show the highest rates of CO<sub>2</sub> emissions per kilowatt-hour.”

**U.S. Electric Power Industry Net Generation, 2008** (U. S. Energy Information Administration)



**Air Conditioning:**

The use of fossil fuels to cool air has enabled dramatic population growth in regions of the U.S. that were previously too hot for huge cities. Phoenix, Arizona has an average of 110 days per year with a high of 100°F or greater according to the National Weather Service. Yet it has grown from just over 100,000 people in 1950 to over one and a half million in 2009. The percentage of U.S. households nationwide with central air conditioning rose from 27% in 1980 to 55% in 2001 (Using and Saving Energy in Homes, U.S. Energy Information Administration).

**Heating the home**

Natural gas is the main fuel used to heat homes in the U.S. (Using and Saving Energy in Homes, U.S. Energy Information Administration).

However, the use of electricity as a main source of heating fuel has increased significantly. According to Hojjati and Battles (2005), "The proportion of households using electricity as a main space heating fuel has increased from 17% in 1981 to 29% in 2001."

### **Lowering the Footprint**

There are many places on the Web to find simple suggestions for saving energy, money, and carbon while heating and cooling the home. According to the 2008 book *Seven Wonders for a Cool Planet* by Eric Sorenson: "A typical ceiling fan uses 50 to 75 watts—less than one-tenth the wattage of a medium-sized room air-conditioner... Other simple measures—such as kicking off your shoes, sipping a cool drink, or growing shade trees around the house—are all energy-efficient ways of cooling down. Because an office worker feels about 5°F warmer in a coat and tie than in a short-sleeve shirt, simply allowing employees to dress casually can save an office \$150 per employee in cooling and electrical equipment costs and \$5 per employee in annual air-conditioning bills."

Efficiency in heating (and cooling) can be greatly enhanced through insulation. According to Greenpeace's 2010 *Stop Climate Change Campaign*: "In moderate and cold climate zones, half of all energy is used for heating. Therefore, proper insulation and ventilation is the first and most important energy saving measure. It can reduce heating needs to one-third ... or even one-tenth ... of what an average house would need. Weather-stripping windows and doors, installing curtains, drapes or blinds, and even planting trees are simple and effective way to save money and lower carbon emissions."

ENERGY STAR is an initiative begun by the U.S. government in 1992 that has become an international standard for energy efficiency. In addition to certifying products, it provides guidance to consumers and businesses. The following tips are from the ENERGY STAR website on maintaining an efficient home

heating, ventilating, and air conditioning (HVAC) system:

- Change your air filter regularly
- Tune up your HVAC equipment yearly
- Install a programmable thermostat
- Seal your heating and cooling ducts
- Consider installing ENERGY STAR qualified heating and cooling equipment

Replacing inefficient furnaces, air conditioners, and water heaters can dramatically save emissions over time. Modern furnaces are 90% efficient or better and can lower emissions by up to 35%. At current energy process, a tankless water heater can pay for itself in 10 years. However, it is important to recognize that each new appliance has a carbon footprint before it reaches your home (from resource extraction, manufacturing, transportation, etc.). One should balance the carbon costs of a new appliance with the financial and environmental savings of keeping an old system running.

There are many new approaches that can lower an existing home's carbon footprint, including installing tankless or solar water heaters, ground-source heat pumps, energy-efficient tinted windows, and programmable thermostats. Although some of these are quite expensive, the future financial and climate costs of heating and cooling using conventional fossil fuels must be considered as well.

"Green" buildings construction is on the rise. New approaches to geothermal heating and cooling are altering the footprint of many new homes. Passive solar building design is being used to maximize solar heat in the winter and shading in the summer. Building codes are requiring greater levels of insulation and new buildings often include higher R-value windows than in the past. Even old approaches like heating with wood are bringing down both the carbon footprint and utility bills in many homes.

**Assessing the CO<sub>2</sub> Footprint for:  
COMPUTERS**

**Document 5**

**Helping or Hurting?**

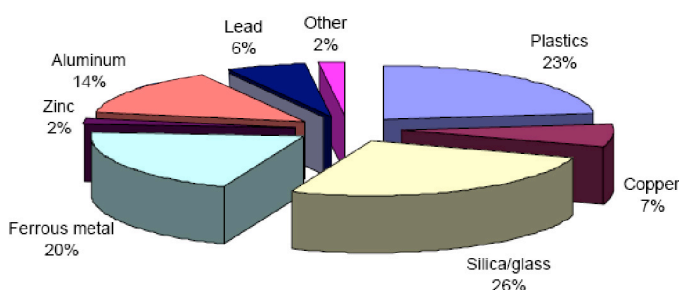
Computers hold the promise of helping reduce global carbon emissions in a number of significant ways. If the digital world were truly paperless, it would save significant carbon emissions. A growing number of people are using computers to work and play from home. If this trend continues, it could ultimately reduce the environmental costs associated with transportation, construction, heating, and cooling. Buying and researching online could also save emissions. But this assumes people will travel less for shopping, work, and pleasure and that they will produce less paper when working on a computer. If we spend time on the computer and continue our old patterns of work, consumption, travel and entertainment, the computer will have only added to our individual carbon footprint. While the digital world holds promise, computers are huge carbon emitters when one considers their cradle-to-grave footprint.

The production of each new computer results in significant emissions before it ever boots up. It takes over 500 pounds of fossil fuels to make a typical desktop computer. "This is very high compared to many other goods: For an automobile or refrigerator, for example, the weight of fossil fuels used for production is roughly equal to their weights. Substantial quantities of chemicals (48.5 lbs) and water (3,307 lbs) are also used" (Kuehr & Williams, 2003).

**Resource Extraction**

Like with other manufactured products, computers are manufactured from raw materials that come from around the world.

Material Composition of a PC (1996)



(Hikwama, 2005)

**Manufacturing and Transportation**

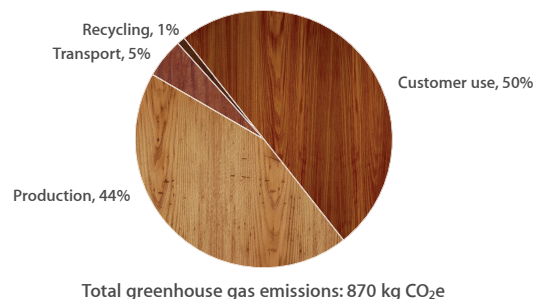
Computer parts are made and assembled all over the world, but particularly in Asia. According to the Center for Research on Information Technology and Organizations (CRITO) at the University of California Irvine, supplies for the Dell Ireland plant come 65% from Asia, 25% from Europe, and 10% from the United States.

In a typical desktop computer:

- The case and PSU is often made in China; the motherboard often in Taiwan.
- The Intel CPU may be assembled in Philippines or Malaysia, Costa Rica or Ireland.
- The RAM from Korea or Taiwan.
- The CD-RW/DVD-ROM drives from Korea or Japan.
- The hard drive from Thailand, Malaysia, or Korea.
- The video cards from China or Taiwan. The sound card from Taiwan or China.
- The computer may have been assembled in Mexico.

The completed computer is packaged in cardboard boxes with Styrofoam before traveling by air and land to its retail destination. There are carbon implications related to each step in production, including at each factory, with the energy used in manufacturing and assembly, as well as the transportation of each component and the finished computer (Chan, 2003).

Greenhouse Gas Emissions for 20-inch iMac



Total greenhouse gas emissions: 870 kg CO<sub>2</sub>e

(Apple, 2009)

Apple's findings that consumer use contributes more carbon than production is contradicted by a 2004 study by Eric Williams of United Nations University that claims that computer production accounts for 81% of a computer's total energy and fossil fuel use, as opposed to operation (19%).

**Retail**

Although it represents a relatively small percentage of emissions, the advertising, sales, packaging, and transport of your computer to your home or office also has carbon implications.

**Computer Use**

Once your new computer is up and running, the next stage of its carbon footprint begins. According to the 2009 Sustainability at Harvard website: "One desktop computer left on all day for one year can result in more than 1,500 pounds of CO<sub>2</sub> being released into the atmosphere. It would take 100 to 500 trees to offset that amount of extra CO<sub>2</sub>."

The amount of energy you use and the amount of resulting carbon emissions is dependent upon many factors. Desktop computers use more energy than laptops. According to the Pembina Institute for Sustainable Energy Solutions, laptops use on average 30 watts of energy compared to 120 watts for a desktop. Energy use is dependent upon how long you keep your laptop on (shutting off at night dramatically reduces energy consumption), the use of low power mode, and the type of monitor. Flat screen monitors use a fraction of the energy consumed by cathode ray tube (CRT) monitors. And the fuel that generates your electricity (coal, hydro, diesel, etc.) will impact the size of your carbon footprint as you use your computer.

**"Performing two Google searches from a desktop computer can generate about the same amount of carbon dioxide as boiling a kettle," or about 7 g (0.25 oz) of CO<sub>2</sub> per search.**

(Leake & Woods, 2009)

Not only is the energy used by your computer significant, but you also need to consider the computer systems to which you are linking. A Google search, for instance, relies on huge and fast servers that use considerable energy to run. Viewing a Web page with complex videos and images may use ten times more energy than viewing a simple page. According to Nicholas Carr, author of *The Big Switch: Rewiring the World, from Edison to Google* (2008): "Maintaining a character (known as an avatar) in the Second Life virtual reality game requires 1,752 kilowatt hours of electricity per year. That is almost as much used by the average Brazilian."

**Disposal, Waste, and Planned Obsolescence**

The total carbon footprint of your computer includes its disposal in a landfill or recycling center. According to authors John Ryan and Alan Durning in their 1997 book, *Stuff: The Secret Lives of Everyday Things*: "By the year 2005, about 150 million personal computers will have been sent to landfills in the United States. They will occupy about 300 million cubic feet, equivalent to a football field stacked a mile high in computer trash."

About 133,000 PCs are thrown out every day (Greenemeier, 2009). The planned obsolescence of computer hardware has huge carbon implications as we dispose of our "outdated" computers and replace them with new models that require greenhouse gas emissions all the way from the beginning of the supply chain.

**Other Environmental Concerns**

It is important to also consider other environmental concerns beyond carbon emissions. Computer manufacturing and disposal exposes humans and the environment to considerable toxins. According to the Environmental Protection Agency, electronic equipment contains toxic materials such as lead, mercury, chromium, cadmium, and beryllium. (Ryan, 2004). CRT monitors contain 4-5 pounds of lead on average, accounting for about 27% of their weight. Cadmium is a known carcinogen, and hexavalent chromium is known to cause high blood pressure, liver disease, and other health problems in animals (Meyer, El Ella, & Young, 2004).

On top of this, the manufacturing of computers, especially mining and refining the raw materials produces a lot of waste. "A lot of energy is wasted in the mining and refining of raw materials. For example, only 4 percent of copper ore is usable, the rest is waste" (Greenemeier, 2009). "For every gram of a microchip [about 0.035 oz], 630 grams of fossil fuels are used [about 22.22 oz]" (Computer Chip Life Cycle, 2008). Because the purification of silicon requires such clean conditions and completely pure materials, large amounts of energy are required. There are also health effects associated with silicon mining, including silicosis, a lung disease caused by prolonged exposure to silica dust that kills thousands of people a year according to the Environmental Literacy Council. Carbon monoxide, a toxic gas, is also a byproduct of silicon purification (Silicon, 2008).

**Assessing the CO<sub>2</sub> Footprint for:  
MAGAZINES**

**Document 6**

According to the organization *Stop Global Warming*, the paper industry is the third greatest contributor to global warming emissions (2010). The Environmental Defense Fund estimates that one ton of copy paper made from timber produces nearly three tons of equivalent CO<sub>2</sub>. Recycled paper produces about 60% as much carbon. Given these facts, it is important to consider the amount of paper we consume and the implications for our individual and collective carbon footprint.

Magazines and newspapers use about 13.1% of the paper produced in the United States each year according to The Green Press Initiative (2007), The PAPER Project (2009), and The Forest Stewardship Council (1996). Although the bulk of the carbon emissions resulting from the production, transportation, and disposal of print magazines comes from the manufacturing of paper, there are many other sources throughout the supply chain. The following information comes from an article in *Discover* magazine from May 2008 that examines the carbon implications of each step from conception to disposal of each issue of the magazine.

Why might *DISCOVER* magazine research and write an article on its carbon footprint?

From "How Big is DISCOVER'S Footprint?"  
by Jennifer Barone, May 2008

*As a publication that keeps a close eye on the state of the planet, DISCOVER decided it was time to look in the mirror and take stock of our own contribution to the greenhouse-gas problem... To define the scope of our analysis and set the standards for our calculations, we turned to the Greenhouse Gas Protocol, a widely used emissions accounting tool for businesses and governments... We then got cracking on the numbers, with an immediate objective in mind: to buy carbon dioxide offsets to make this issue carbon neutral.*

**Tracing the CO<sub>2</sub> footprint for a monthly issue of DISCOVER magazine – 1 million copies**

From *How Big is DISCOVER'S Footprint*, by Jennifer Barone, May 2008

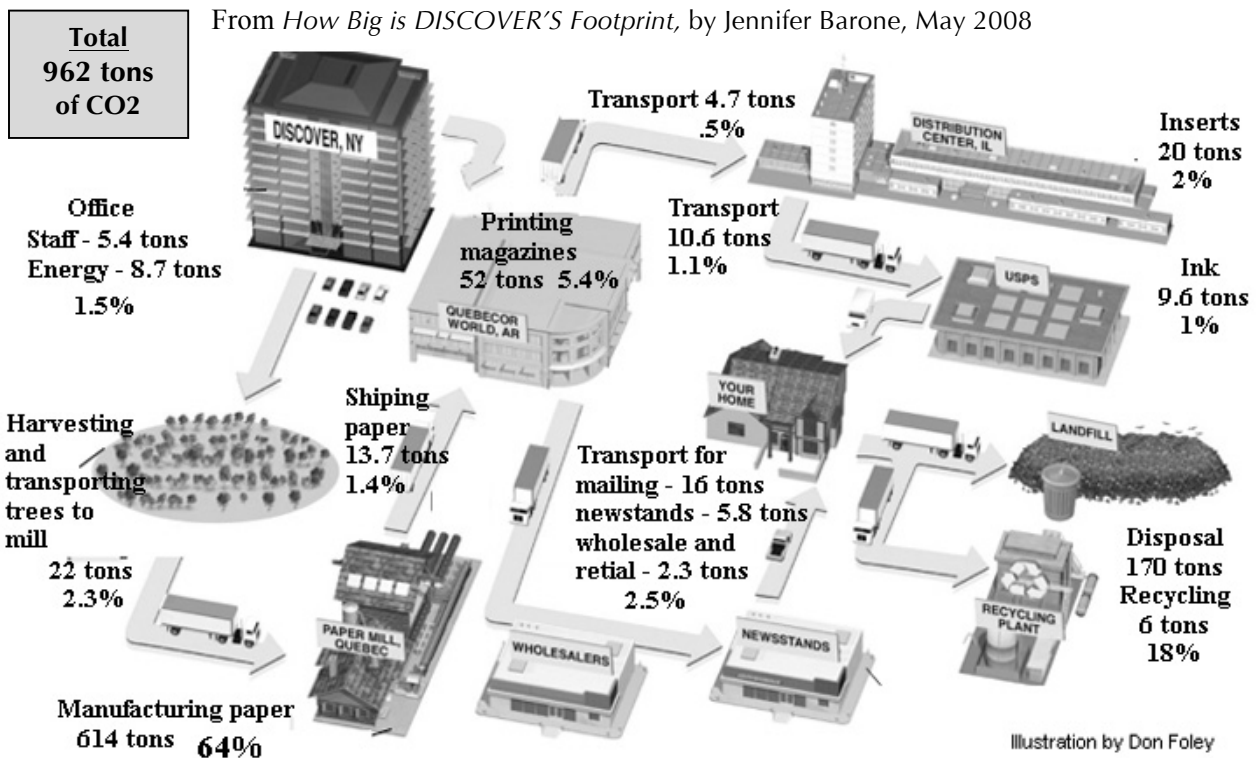


Illustration by Don Foley

**Office – staff and energy – 14 tons of CO<sub>2</sub>**

*Before an issue of DISCOVER can exist as a physical object, it needs to be conceptualized, reported, written, edited, fact-checked, copyedited, designed, and supplemented with advertisements. That requires 35 people to make their way to our New York offices every workday. We surveyed all our staff ... for commuting mileage, mode of transportation, business travel, and messenger trips needed to do their jobs. From there we used government emissions estimates for subways, buses, cars, and air travel to determine that DISCOVER's staff puts out 5.4 tons of carbon dioxide getting around each month.*

*Then there's the office itself. Heat and air-conditioning keep it habitable throughout the year. Its energy-using devices—computers, fluorescent lights, printers, and (of course) the fridge and coffeemaker—allow us to do our work... Using emission rates from the EPA for electricity generation in our region and natural gas emission figures from the Department of Energy, we determined that our office's energy use adds another 8.7 tons of CO<sub>2</sub> to the total.*

**Manufacturing and transporting the paper – 670 tons**

*Making paper is an emission-intensive process on its own. Each magazine begins as a tree in the forests of Quebec (fir, spruce, or pine), which is harvested and transported to a sawmill. Chips and sawdust from here make their way by boat to a paper mill in Quebec, where the wood fibers are separated, creating pulp, and bleached white. Water is mixed with the pulp to form a slurry, which is then spread into a thin sheet, pressed to squeeze out the liquid, and dried. The quantity of that paper DISCOVER uses every month releases 614 tons of carbon dioxide—making it the single largest source of emissions in the production chain. Even so, this takes into account only the manufacturing process.*

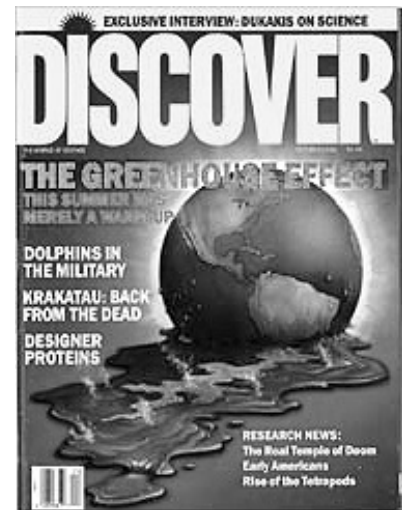
*Harvesting and transporting the trees to the mill bumps up the CO<sub>2</sub> count another 22 tons. Add the magazine inserts and we gain another 20 tons... Once the magazine is ready for printing, we notify our paper supplier, who has paper shipped from a mill in Quebec to our printing plant in Jonesboro, Arkansas. Printing a million or so copies of DISCOVER every month takes over 348,000 pounds of paper.... The shipment makes the 1,450-mile journey by truck in some months and by train in others... Using greenhouse-gas figures for truck and rail from the Greenhouse Gas Protocol ... we found that moving this monthly 174-ton load kicks out 13.7 tons of CO<sub>2</sub>.*

**Printing the magazines – 62 tons**

*At the printing plant, the footprint continues to grow... producing one month's edition of the magazine consumes 63,364 kilowatt-hours of electricity and 1,704 therms of natural gas... these processes account for another 52 tons of CO<sub>2</sub>... Ink accounted for about 1 percent of the total greenhouse-gas emissions... an additional 9.6 tons of CO<sub>2</sub>.*

**Transportation – 40 tons**

*The printed magazine is then distributed throughout the United States and Canada to subscribers (through the mail systems), to wholesalers and retailers and to newsstands. The total estimated carbon emissions associated with this part of the supply chain is about 40 tons of CO<sub>2</sub>.*



**Disposal – 176 tons**

*Ninety percent of magazines that are not recycled end up in a landfill, where they decompose and release CO<sub>2</sub> as well as methane, a greenhouse gas that is much more efficient at trapping heat. The rest are incinerated. Each month's issue of DISCOVER in this process, transportation included, releases the equivalent of 170 tons of CO<sub>2</sub>, whereas recycled magazines—only a small portion of the total—produce about 6 tons.*

**The total – 962 tons**

*The total comes to 962 tons of CO<sub>2</sub> for somewhere in the neighborhood of 1 million monthly copies. Two and one-tenth pounds of carbon dioxide (per copy). That is our best estimate of what is emitted into the atmosphere when we harvest trees, turn the freshly milled paper into your individual copy of DISCOVER, get it into your hands, and see it to its final resting place.*

*This month, Discover says it will purchase a carbon offset for \$4,796 from Carbonfund.org.*

*(Excerpts from How Big is DISCOVER'S Footprint, by Jennifer Barone, May 2008)*

**Assessing the CO<sub>2</sub> Footprint for:  
A MUSIC CONCERT**

**Document 7**

Live Earth was a series of concerts held in 11 cities around the world on July 7, 2007. According to the producers, more than a million people attended and more than 2 billion people saw or heard broadcasts on radio, TV, or the Internet. They claimed that Live Earth was “the largest carbon-neutral public event in history.”

The information in this reading comes from Live Earth Carbon Assessment & Footprint Report (2007), which is available on its website, [www.liveearth.org](http://www.liveearth.org). At the time of this publication it was the most exhaustive and detailed study of the carbon implication of a public music event. As with any reading, you should consider the ways in which the information has been influenced by the source.

*In planning Live Earth, we set out to do something that had never been done before. Live Earth, we decided, would not just be a means of raising awareness about global climate change. Our concerts themselves would be truly earth-friendly, low-impact events. We would set an example of sustainable values and best practices for events, showcasing the very lifestyle changes that we aimed to convince others to make.*

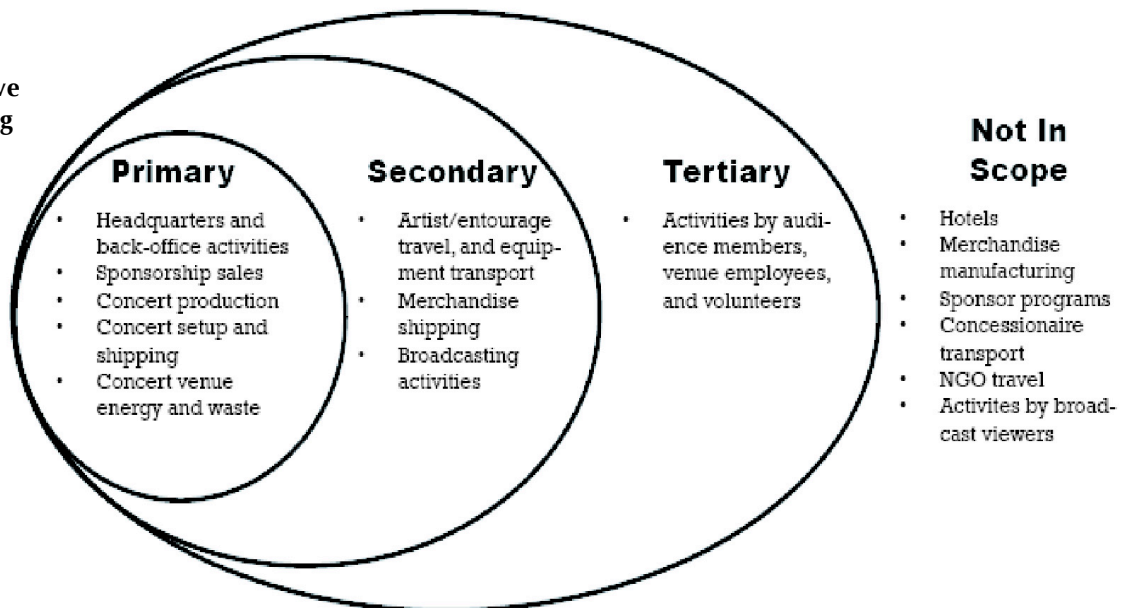
*To make Live Earth a truly low-impact event, we built and deployed the Live Earth Green Team ... to carefully calculate and document our carbon footprint and resource needs, both at our venues and in all our offices and affiliate locations around the world.*

*Our Green Team put comprehensive policies and programs in place to reduce our energy and resource use and substitute lower-impact alternatives. We trained and motivated our personnel around the world to participate. And we vowed to hold ourselves accountable to evaluate and publicize the outcome.*

**Calculated Carbon Emissions** (Live Earth, 2007)

Entity	Emissions (tons)	Percent of Total
P1. Headquarters	548	2.8%
P2. Sponsor Sales	85	0.4%
P3a-b. Production Team and Contractors	151	0.8%
P3c. Generators	221	1.1%
P4a. Facility & Concerts	864	4.4%
P5. Activation Contractor (includes T3, Venue Employees)	29	0.1%
S1-2. Artist Transport & Merchandise Shipping	529	2.7%
S3. Broadcasters	115	0.6%
T1. Audience Travel	17,139	87.0%
T2. Volunteer Travel	27	0.1%
<b>Total (rounded)</b>	<b>19,708</b>	<b>100%</b>

**Activities quantified by Live Earth in assessing the carbon footprint for the event**  
(Live Earth, 2007)



Audience travel made up the vast majority (87%) of the carbon emissions for the event. Eighty percent of those emissions came from air travel, despite the fact that only a small percentage of concertgoers flew to the events (approximately 8% of New York and London audiences). Concert organizers sought musicians who were already on tour or based near concert locations and encouraged commercial travel rather than private charters.

Carbon emissions were reduced when large percentages of the audience traveled to the event using mass transit. This varied dramatically by city.

**Mass transit use by venue**  
(Live Earth 2007)

Venue	Transit Use
Shanghai	78%
Tokyo	75%
London	68%
Sydney	46%
Hamburg	33%
New York City	23%

Concert planners decided to hold events primarily during daylight hours, resulting in a considerable reduction in energy consumption.

**Waste Reduction Strategies**

At all venues, Live Earth sought to reduce waste through the use of fountain dispensers instead of bottled drinks, and by procuring only recyclable containers. Live Earth also worked with venues and concessionaires to tailor menus and reduce packaging. In Johannesburg, the Coca-Cola Dome allowed us to remove items from the menu that required Styrofoam, boxes, or plastic bowls, and instead, provide concessionaires with compostable deli paper. London’s Wembley Stadium switched to burger boxes produced from reed pulp.

The most significant component of waste was related to food and refreshments concessions. At many of the concerts, a corps of volunteers or staff supervised waste collection stations, making sure that recyclables were sorted separately from organic compostable material and trash. And by participating, individual concert attendees played a critical part in ensuring that these diversion efforts were successful.

Stage props and signage were donated or reused wherever possible. In Sydney, signage was created on the back of existing venue signs, which were returned to their normal use after the event. In Hamburg, promotional banners were repurposed into limited-edition messenger bags with straps made from seat belts. In South Africa, banners were donated to a rural township to build shade coverings for school playgrounds.

**Carbon Reduction Strategies** (Live Earth, 2007)

Entity	Key Reduction Strategies
P1. Headquarters	<ul style="list-style-type: none"> <li>Install energy efficient lighting</li> <li>Use video and teleconferencing</li> <li>Hold employee eco-training sessions</li> <li>Review office procurement (paper, food, etc.)</li> </ul>
P2. Sponsor Sales	<ul style="list-style-type: none"> <li>Reduce air travel by stationing employees in relevant areas for extended time</li> </ul>
P3a-b. Production Team and Contractors	<ul style="list-style-type: none"> <li>Design stage with LED or discharge lighting</li> <li>Build with reusable/recyclable materials</li> <li>Furnish rooms with FSC-certified goods</li> </ul>
P3c. Generators	<ul style="list-style-type: none"> <li>Run generators on neat or blended biodiesel</li> </ul>
P4a. Facility & Concerts	<ul style="list-style-type: none"> <li>Reduce waste through procurement process</li> <li>Set up extensive recycling and composting to divert waste from landfills</li> <li>Reduce all non-essential energy use</li> <li>Procure green energy and renewable energy credits</li> </ul>
P5. Activation Contractor (includes T3, Venue Employees)	<ul style="list-style-type: none"> <li>Produce signs from agro-materials</li> <li>Use bio-based inks, VOC-free paints</li> <li>Donate signs and banners for reuse</li> </ul>
S1-2. Artist Transport & Merchandise Shipping	<ul style="list-style-type: none"> <li>Book local artists; plan so as to lessen miles</li> <li>Encourage artists to fly commercial airlines</li> <li>Use alternative-fuel buses and tour vehicles</li> <li>Use fleet of fuel-efficient automobiles</li> <li>Produce merchandise locally</li> <li>Manufacture merchandise from organic or bamboo fibers with agro-inks</li> </ul>
S3. Broadcasters	<ul style="list-style-type: none"> <li>Run generators on neat or blended biodiesel</li> <li>Use recycled tape for recording</li> </ul>
T1. Audience Travel	<ul style="list-style-type: none"> <li>Encourage &amp; educate about mass transit</li> <li>Institute incentives for carpooling</li> </ul>
T2. Volunteer Travel	<ul style="list-style-type: none"> <li>Recruit local volunteers</li> <li>Encourage carpooling</li> </ul>

In pursuing a zero-net-impact event, reducing energy use is the most important tactic. At the end of the day, however, some amount of emissions will be generated, and Live Earth is purchasing carbon offsets (greenhouse gas credits) to mitigate the portion of its carbon footprint that could not be avoided by energy reduction. These credits are being sourced from reputable projects that meet the credible standards recognized in the market.



## PRODUCT HANDOUT FOR CLOTHING ADVERTISEMENT

### Trying to change the world?

EarthPositive™ Apparel is T-shirts and hoods with a 90% lower carbon footprint.

EarthPositive is blank T-shirts and hooded sweats made solely using renewable green wind energy, and from organic cotton



## EarthPositive™ Apparel

### The Most Progressive Ethical Clothing on Earth

EarthPositive™ is a *green* revolution in promotional apparel: Climate Neutral T-shirts. Organic and ethically made, but crucially, manufactured solely using sustainable energy generated from wind and solar power.

#### Carbon Neutral

EarthPositive apparel is made in carbon neutral manufacturing facilities in India, from 'low impact' organic cotton, and is distributed through carbon neutral warehouses and offices in London that use only renewable green electricity.

#### What is Climate Neutral?

Climate Neutral means our industrial greenhouse gas emissions have been reduced to pre-industrial levels through low-impact (low emission) organic agriculture and carbon neutral industrial manufacturing, achieved through substituting energy use from fossil fuel powered power stations with clean renewable energy from wind turbines and solar power.

#### No Carbon Offsets

Carbon neutral is a term most often used to describe a state where CO<sub>2</sub>e emissions have been negated entirely by the purchase of intangible 'carbon offsets'. This represents the 'lowest quality' means of achieving carbon

neutral status and is discarded by EarthPositive as a credible method. The only course of action is to change business-as-usual practices and genuinely reduce any emissions that contribute to global warming. This can only be achieved by the reduction of on-site energy consumption, and a switch from fossil fuel to renewable energy.

#### 100% Organic Product

EarthPositive apparel is a 100% organic product, produced under the Global Organic Textile Standard and certified by The Control Union and The Soil Association.

#### Ethically Made

EarthPositive apparel is made as ethically as possible. The manufacturing facilities have been audited by the Fair Wear Foundation, and are being licensed by the FLO - Fairtrade Labelling Organisation.

### **What is ‘Low Impact’ Farming?**

We have specifically chosen to work in regions where organic cotton is planted and harvested by hand, without mechanization, and because organic farming does not use petroleum based chemical fertilizer, pesticide or herbicide, it is less reliant on fossil fuels.=

### **Pick Your Cotton Carefully**

We guarantee that we will not use cotton from Uzbekistan while the use of forced child labor is endemic. EarthPositive garment labels follow the recommendations of the Environmental Justice Foundation, and state the country of origin of the cotton we use.

### **Ethical, Environmental & Sustainability Specifications**

#### **Low Water Footprint**

It can take more than 20,000 litres of water to produce 1kg of cotton, equivalent to a single T-shirt and pair of jeans. That’s why we chose to work in a region that receives up to 95% of its water from the monsoon rain. This was an important consideration for us, as the monsoon rain reduces the need for large-scale irrigation projects normally associated with conventional cotton farming, which often deprive local villages of scarce water resources by draining lakes and rivers..

#### **Look After Our Water**

The processing of the dye effluent takes place in a controlled closed-loop purification system that uses treatment ponds, sand filtration and reverse osmosis to convert the wastewater into clean water.

#### **Biodegradable Packaging**

EarthPositive apparel is packaged in biodegradable PVC-free packaging, and in 100% recycled cardboard boxes.

### **Transportation**

EarthPositive has a ‘No Airfreight’ policy. We do not transport our goods, by air, instead we use containerised ocean shipping, and therefore the carbon footprint generated by transporting our apparel to Europe, Japan and the USA is negligible, more like a carbon fingerprint. EarthPositive apparel should not be criticised for its inability to solve the world’s transportation and energy security issues, but we can ensure that our own production methods do nothing to contribute to environmental damage, social injustice or climate change.

### **Transparency**

The development project for EarthPositive apparel, that has taken two years to complete, will provide the apparel industry with a blueprint in ethical and sustainable production. The Carbon Trust has asked for EarthPositive to be used as a Case Study, so that the clothing industry will benefit from our research and development.

### **Carbon Labelling**

The Carbon Trust product carbon footprinting method is to become the single standard for a product’s carbon footprint in the UK. EarthPositive apparel has reduced the carbon footprint of a T-shirt by up to 90%. However, consumers require an independent verification process and a label over the claims of individual Earth companies.

### **Save The Climate – Wash Cool**

EarthPositive apparel can be washed at 30°C; however, we ask EarthPositive consumers to consider the effects of domestic machine washing and tumble drying time and time again, which may contribute up to 80% of the energy used by a conventional cotton garment in its lifetime. We label our garments SAVE THE CLIMATE – WASH COOL – LINE DRY in addition to standard wash care instructions. We also recommend eco-friendly detergents, which have minimal aquatic toxicity and will biodegrade quickly and completely.

PRODUCT HANDOUT FOR HEATING AND COOLING

2010 print advertisement for Solar Energy International

RENEWABLE ENERGY EDUCATION



For more than 20 years, Solar Energy International has been teaching hands-on workshops and online courses in renewable energy and sustainable building technologies. Our industry-experienced, certified instructors have trained more than 16,000 people from 66 countries at our eco-campus and locations around the world. Please visit our website or give us a call to learn more about SEI workshops and grassroots outreach programs in your area.

WORKSHOPS & COURSES

- Solar Electric (PV)
- Sustainable Building
- Solar Thermal
- Wind Power
- Micro-Hydro Power
- International-Rural Development
- Renewable Energy for Educators

OUTREACH PROGRAMS

- Solar In the Schools (SIS)
- INVEST
- Women's Program
- SEI Eco-Campus
- Native American Program



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Carbondale, CO 81623  
970.963.8855

From Solar Energy International web site: [www.solarenergy.org](http://www.solarenergy.org)

## Workshop Schedule

List Preview    Calendar Preview	
Search by	<input type="text" value="Start Date"/> <input type="text" value="Location"/> <input type="text" value="Category"/>
Date	Workshop Name
<b>March 2010</b>	
Mar 15-19	PV101 <a href="#">Solar Electric Fundamentals and Grid-Direct Design</a>
Mar 22-22	PV204 <a href="#">Solar Sales and Marketing</a>
Mar 23-23	PV205 <a href="#">Economics of Solar: Making the Financial Case</a>
Mar 23-23	NAB <a href="#">NABCEP Entry Level Exam</a>
Mar 27-27	RE100 <a href="#">Intro to Renewable Energy</a>
<b>April 2010</b>	
Apr 2-11	CU100 <a href="#">Renewable Energy and Energy Efficiency in Cuba</a>
Apr 5-May 9	PVOL101 <a href="#">Solar Electric Fundamentals and Grid-Direct Design - Online</a>
Apr 5-9	PV202 <a href="#">Grid-Direct Solar Electric Systems and Code Criteria</a>
Apr 5-9	ST101 <a href="#">Solar Hot Water</a>
Apr 10-12	ST201 <a href="#">Solar and Radiant Heating</a>
Apr 13-17	MH101 <a href="#">Micro-Hydro Power</a>
Apr 26-30	WP101 <a href="#">Residential Wind Power</a>
<b>May 2010</b>	
May 3-7	PV201L <a href="#">Grid-Direct Solar Electric Lab Week</a>
May 10-14	SB101 <a href="#">Building for the Future: Sustainable Home Design</a>
May 10-14	PV201L <a href="#">Grid-Direct Solar Electric Lab Week</a>
May 10-10	PV204 <a href="#">Solar Sales and Marketing</a>
May 11-11	PV205 <a href="#">Economics of Solar: Making the Financial Case</a>
May 15-24	RD201 <a href="#">Renewable Energy for the Developing World- Hands ON</a>
May 17-Jun 20	PVOL101 <a href="#">Solar Electric Fundamentals and Grid-Direct Design - Online</a>
May 31-Jun 4	MH101 <a href="#">Micro-Hydro Power</a>

## PRODUCT HANDOUT FOR COMPUTER ADVERTISEMENT

# Eco Friendly Wooden Computer



Nobody tells you this, but using and disposing of a computer has negative effects on the environment. Computers are not very energy efficient and are even less so when they have a large monitor screen. In addition, the substances including cadmium, mercury and arsenic that are found in most computers are toxic which makes the discarded computer into toxic waste.

### **Thrown Away Computers = Toxic Waste**

Discarded computers are also making a huge pile in your local dump too as people abandon their old computers for the latest models. During the manufacture of computers, more water is wasted, more energy consumed and more toxic waste is created than that created by the manufacture of automobiles.

### **Wooden Computer will Use Less Energy**

There is good news for anyone who uses a computer and who is interested in reducing his or her ecological footprint. PC World, UK manufacturers, is set to release their wooden computer to the market in October 2007. Their wooden computer, which is not named yet, uses up to 87% less energy than the conventional plastic computers use yet offers the same power and price of conventional computers. This wooden computer will be less expensive to run than

a conventional computer because it will run on only 40 watts instead of other computers that use 300 watts. Another feature that cuts down on energy use is from the replacement of the LED power lit buttons with plain buttons. By using the wooden computer, it will be possible to save money on your energy bills.

### **Recycled Casing**

The eco friendly computer will not use a fan, which will make the computer quieter than its all-plastic counterparts, and this cuts down on energy consumption. The reason it does not need a fan is that the power pack will be on the outside of the computer tower and thus will not need cooling. Also, related to the unnecessary fan issue is the fact that its recycled case will transfer heat away from the computer chip. The case will be made from recycled aluminum such as from soda pop cans and recycled plastic. Sustainable ash, beech or sapele will be used to make the casings for the screen, keyboard and mouse. These wood types were chosen for this purpose because they are sustainable woods.

**For Eco Friendly Computer Nerds** Every aspect of the wooden computer is meant to save the planet. The computer is only about one quarter of the size of an average computer. The computer will come in recycled packaging. Instead of coming with printed instructions, the computer will come with its information as provided on a CD. To compensate for the pollution released in the manufacture and delivery of the computers, the manufacturers will give buyers an energy efficient light bulb.

If the wooden computer is a hit, this will set a standard for other computer manufacturers. Manufacturers of the conventional computer types will have to consider the importance that saving our environment holds for many computer geeks. This is a good thing.





## Lesson 7, Activities 3 and 4 Student Worksheet

NAME \_\_\_\_\_

DATE \_\_\_\_\_

### **Assessing the Cradle-to-Grave Carbon Footprint for a Product**

Read the two-page handout on the cradle-to-grave CO<sub>2</sub> footprint of your product, and then prepare a 10 min presentation to the class in using the guidelines below.

#### **1. Summarize Your Product's Carbon Footprint:**

Give an overview of the cradle-to-grave carbon footprint of your product.

Include a brief description of the CO<sub>2</sub> emissions of each step in the supply chain including production, distribution, use, and disposal of the product. Identify those areas (e.g. transportation, manufacturing, etc.) that produce the most carbon.

Mention any additional information your group would you need to know to have a fuller understanding of the CO<sub>2</sub> implication of your product (e.g. the type of energy used in processing key raw materials).

#### **2. Present and Analyze Your Advertisement:**

View the advertisement for your product and prepare to present your answers to these questions to the class:

- 1) Who produced this ad, and for what purpose?
- 2) What aspects of the product's CO<sub>2</sub> footprint are addressed in the ad and which are invisible?
- 3) Do you think this ad is "greenwash" or an honest, ethical, and significant attempt to address the environmental implications of this product?
- 4) What are alternatives to this product that have a lower CO<sub>2</sub> footprint?
- 5) What are the obstacles to consumers choosing these lower impact alternatives?





# Lesson 8: A History of Global Warming in Science, Politics, and the Media

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PowerPoint Slide Show: <i>History of Global Warming</i> .....	
(access online or via Lesson 8 digital media folder)	



LESSON PLAN

# A History of Global Warming in Science, Politics, and the Media



PowerPoint Slide Show

## Lesson Objectives:

- Students will identify the major scientific and political landmarks in the history of human understanding and response to global warming.
- Students will analyze the evolution of the portrayal of global warming in the media from the 1950s through 2010.
- Students will practice decoding media documents, applying information from the background reading and details from the documents to their analysis.
- Students will identify the factors that have shaped public perception of global warming: changes in science; the weather; the media; political, economic, and cultural factors.

## Vocabulary:

climate change, global warming, skeptics, Louis Agassiz, Svante Arrhenius, greenhouse effect, climate models, Rachel Carson, ecologist, global cooling, Keeling Curve, greenhouse gas emissions, carbon dioxide (CO<sub>2</sub>), fossil fuels, perturbations, anthropogenic, Earth Day, Spaceship Earth, energy policies, EPA, NOAA, ozone hole, Montreal Protocol, IPCC, GCC, James Hansen, Rio Earth Summit, Kyoto Treaty, emissions standards, George W. Bush, Al Gore, consensus, consequences, Michael Crichton, Lieberman-McCain, Hurricane Katrina, *An Inconvenient Truth*, legislation, “cap and trade,” Copenhagen Climate Summit, public opinion, bias, F.U.D. factor, credibility, critical thinking

## Media

newspaper articles, magazine covers, posters, scientific reports, photographs, headlines, opinion polls, film/DVD covers, book covers

## Materials Needed:

- 50-page *Teacher Guide: The History of Global Warming in Science, Politics, and the Media*
- Eight-page *Student Reading: The History of Global Warming in Science, Politics, and the Media*
- PowerPoint slide show: *The History of Global Warming in Science, Politics, and the Media* (access online or via Lesson 8 digital media folder)

## Time

50 minutes to 2 hours depending upon how quickly the teacher moves through the slides

## Lesson Procedures:

1. Distribute the eight-page *Student Reading*. Students should read for homework or in class.
2. Lead students through the PowerPoint slide show, reviewing key information from the background reading, probing for understanding, and presenting new information using the *Teacher Guide*.



TEACHER GUIDE



PowerPoint Slide Show

# SLIDE #1: A History of Global Warming in Science, Politics, and the Media

**NOTE:** Students should have read the eight-page Student Reading before beginning the PowerPoint slide show.

→ Project the document

QUESTION

**When do you think the U.S. media first started reporting on the idea that humans might be having an effect on the Earth's temperature?**

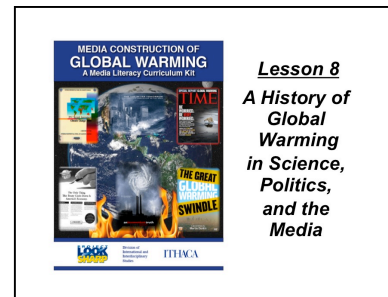
POSSIBLE ANSWERS

Answers will vary, and are likely to include some information from the Student Reading, including the 1957 *Christian Science Monitor* presented in the next slide.

EXPLAIN

**This interactive slide show will give you an overview of the history of global warming in science, politics, and the media from the 1950s through 2009, and will explore the intersections between those three influences on public opinion and action. You will apply information from the reading, *A History of Global Warming in Science, Politics and the Media*, to the analysis of these slides. As you analyze the messages, also keep in mind the source and purpose for which each message was created.**

SLIDE #1



## A History of Global Warming in Science, Politics, and the Media

**TEACHER GUIDE**

# SLIDE #2: Are Men Changing the Earth's Weather? *The Christian Science Monitor*, 1957

→ Project the document

**EXPLAIN** This article appeared in *The Christian Science Monitor* in 1957.

**QUESTION** What is the significance of this article in the history of global warming?

**POSSIBLE ANSWER** This article was one of the first in a major newspaper to report on the connection between carbon dioxide and changing temperatures. It framed both the understanding and uncertainty in the scientific community in the 1950s.

**QUESTION** How does the headline differ from the subhead in drawing conclusions about human contributions to global warming?

**POSSIBLE ANSWER** The headline poses the issue as a question ("are men changing the weather?"), while the subhead states it as a fact ("it is changing the earth's heat balance") but raises the question of whether it will lead to and increase or decrease in temperatures.

**SLIDE #2**



**Are Men Changing the Earth's Weather?**  
*The Christian Science Monitor*,  
Dec. 4, 1957

TEACHER GUIDE

## SLIDE #3: The Emerging Science of Survival, *TIME* magazine cover, 1970

→ Project the document

QUESTION

What does this *Time* magazine cover communicate about changing cultural and political attitudes towards the environment in the 1960s? Give evidence from the cover to back up your conclusions.

POSSIBLE ANSWER

People are concerned about environmental destruction.

EVIDENCE

Positive images of colorful sun-drenched Earth, water and sky, contrasted by scary black and white images of pollution, factories, a dam and a nuclear explosion

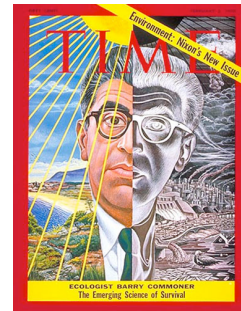
POSSIBLE ANSWER

President Nixon created the EPA and NOAA in 1970 in response to growing environmental concerns.

EVIDENCE

Text: "Environment: Nixon's New Issue"

SLIDE #3



The Emerging Science of Survival,  
*TIME* magazine cover,  
Feb. 2, 1970

### ADDITIONAL INFO

Barry Commoner is a highly respected cellular biologist who established the Center for the Biology of Natural Systems in 1966 to study man's relationship with the environment. He was one of the first scientists to study pollution and the ozone layer, advocating for solar and other forms of renewable energy. In 1970, *Time* magazine called him "the Paul Revere of Ecology." He wrote *The Closing Circle* in 1971, in which he proposed Four Laws of Ecology: 1) Everything is Connected to Everything Else; 2) Everything Must Go Somewhere; 3) Nature Knows Best; and 4) There is No Such Thing as a Free Lunch (Egan, 2007).\_

TEACHER GUIDE

## SLIDE #4: Whole Earth Week in Davis, Peter Max poster, 1970

QUESTION

**What event is this poster advertising?**

POSSIBLE  
ANSWER

This promotes Whole Earth Week at the University of California at Davis in what would become known as the first Earth Day.

QUESTION

**Who do you think was the target audience for this event? What's your evidence in the poster?**

POSSIBLE  
ANSWER

The poster seems to target young people, hippies, and artists.

EVIDENCE

Many people will recognize the poster art of Peter Max, who also drew the cover of the Beatles' *Yellow Submarine* album; the people on the cover have long hair and hippie clothes; the text reads "An Aquarian Festival," "Artisans, Artists and Craftsmen Gather," and "Geodesic Dome Inhabited by Spiritual Groups"



**Whole Earth Week  
in Davis,  
Peter Max poster,  
April 1970**

### ADDITIONAL INFO

During the early 1970s, the "Age of Aquarius" was associated with enlightenment and the expansion of consciousness (Reid, 1971), showing up in artwork and music including a popular song from the Broadway musical *Hair*. Aquarian Festivals were counter-culture arts and music festivals celebrating alternative thinking and sustainable lifestyles. Geodesic domes were spherical structures created from intersecting triangles; one of the most famous is "Spaceship Earth" at Epcot in Walt Disney World.



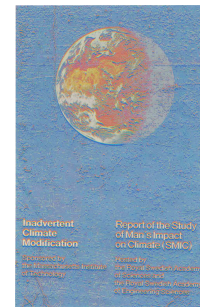
TEACHER GUIDE

## SLIDE #5: *Report of the Study of Man's Impact on Climate, Report Cover, 1970*

→ Project the document

QUESTION	<b>What is the significance of this 1970 report?</b>
POSSIBLE ANSWER	This was the report from the first international conference on climate change. The group's final report, "The Study of Man's Impact on Climate," was subtitled "Inadvertent Climate Modification" and spoke directly to the dangers of greenhouse gas emissions such as carbon dioxide.
QUESTION	<b>What messages are conveyed by the image on the cover of the report?</b>
POSSIBLE ANSWERS	The report includes effects on the entire Earth. The whole world is affected by climate change. The Earth is beautiful and fragile. The whole Earth's environment is at risk.

SLIDE #5



### *Report of the Study of Man's Impact on Climate, Report Cover, 1970*

ADDITIONAL INFO

The cover of this report shows a view of planet Earth as seen from space. Although we are now accustomed to seeing photos like this, in 1970 it was still a new and quite dramatic view of our home planet. On Christmas Eve 1968, Apollo 8 astronauts sent back photos of an Earthrise as seen from behind the moon (NASA, 2007). These photos of the "whole Earth" dramatized the fragility, unity, and beauty of what came to be called "Spaceship Earth." The image of the whole Earth has become an icon of the environmental movement.

TEACHER GUIDE

## SLIDE #6: Headlines from News Reports Between 1971 and 1977

→ Project the document

QUESTION

**What do these headlines communicate about scientific discourse about climate change during the 1970s?**

POSSIBLE ANSWERS

There was lot of disagreement and uncertainty. Some headlines warned of cooling and a possible ice age while others warn about overheating and global warming. Some question the predictions made about future disaster.

QUESTION

**What terms are used in the headlines that reinforce uncertainty and fear about the future?**

POSSIBLE ANSWERS

“on the brink,” “decry predictions,” “disaster,” “farms may be hit,” “is energy use overheating the world?”

QUESTION

**Why might scientists have been so split on whether the Earth was cooling or warming?**

POSSIBLE ANSWERS

Climate models at the time were unable to accurately determine the impact of variables like CO<sub>2</sub> on the Earth’s complex planetary systems. Global temperatures had actually dropped between 1940 and 1970, leading some scientists to speculate that we might be entering a new ice age.

### SLIDE #6

What do these headlines communicate about scientific discourse on climate change during the 1970s?

*Study Says Man Alters Climate*  
NEW YORK TIMES, Sept. 23, 1971

*Climate Experts Assay Ice Age Clues*  
NEW YORK TIMES, Jan. 27, 1972

*Climatic Change: Are We on the Brink of a Pronounced Global Warming?*  
SCIENCE, August 1975

*2 Climate Experts Decry Predictions of Disaster*  
NEW YORK TIMES, Feb. 22, 1976

*Even U.S. Farms May Be Hit by Cooling Trend*  
U.S. NEWS & WORLD REPORT, May 31, 1976

### Headlines from News Reports Between 1971 and 1977

TEACHER GUIDE

# SLIDE #7: The Ice Age Cometh? Climate Change: Chilling Possibilities, *Science News*, 1975

→ Project the document

QUESTION

Why would this popular magazine (*Science News*) dramatize an impending ice age on its cover rather than highlighting the scientific uncertainty over climate change that existed in 1975?

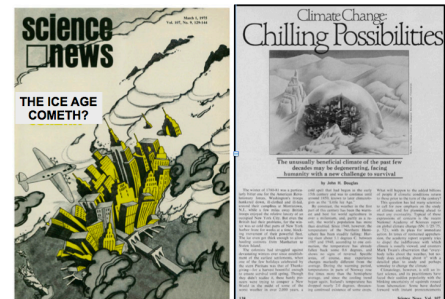
POSSIBLE ANSWER

The dramatic image on the cover of ice destroying a modern city is more likely to sell magazines than a cover highlighting the uncertainties among the science community.

NOTE

Covers of magazines are typically seen by the publishers as advertisements rather than journalism, particularly for popular magazines that sell at news stands.

SLIDE #7



**The Ice Age Cometh?  
Climate Change:  
Chilling Possibilities  
*Science News*  
March 1, 1975**

ADDITIONAL INFO

*Newsweek* also ran a major story about “global cooling” in 1975. In 2006, it ran a follow-up article arguing that the 1975 predictions were reasonable given the science of climatology at the time. According to the article, “predictions of global cooling never approached the kind of widespread scientific consensus that supports the greenhouse effect today” mostly because of the vastly more sophisticated science of climate prediction in 2006 (Adler, 2006).

TEACHER GUIDE

## SLIDE #8: President Carter with White House Solar Panels, 1979

→ Project the document

EXPLAIN

**Confronted with fuel shortages and political conflict in the Middle East, President Carter proposed a new national energy policy that included price controls, use of coal and nuclear energy, conservation, and new technologies such as these solar panels.**

QUESTION

**Why would President Carter have been promoting both “dirty” coal and “clean” solar energy in the late 1970s?**

POSSIBLE ANSWERS

The government’s focus was on energy independence from whatever sources possible. There wasn’t much awareness about greenhouse gas emissions yet.

QUESTION

**Why would the installation of solar panels at the White House have drawn a lot of attention from the press?**

POSSIBLE ANSWERS

The White House would have promoted this as a “photo op.” Solar panels provided nice pictures. New technologies would be of interest to younger audiences.

SLIDE #8



**President Carter with White House Solar Panels, June 20, 1979**

### ADDITIONAL INFO

While nuclear power was another domestic alternative to imported fossil fuels, the 1979 accident at the Three Mile Island nuclear power plant in Pennsylvania undermined public support for any new nuclear power plants. In 1979, President Carter gave a speech urging Americans to reduce their personal energy use in order to decrease the nation’s reliance on foreign sources of oil for energy. Then in his State of the Union address in 1980, Carter said, “Let our position be absolutely clear: An attempt by any outside force to gain control of the Persian Gulf region will be regarded as an assault on the vital interests of the United States of America, and such an assault will be repelled by any means necessary, including military force” (Carter, 1980). This policy became known as The Carter Doctrine, later reflected in U.S. actions in the Persian Gulf and Iraq Wars.

TEACHER GUIDE

# SLIDE #9: A Vast ‘Interdisciplinary Effort’ to Predict Climate Trend Urged, *The New York Times*, 1979

→ Project the document

QUESTION

**What does this headline imply about the state of climate science in 1979?**

POSSIBLE ANSWERS

The ability to accurately predict climate change was going to require a huge effort that would bring together scientists from many fields. Putting “interdisciplinary effort” in quotes implies that scientists were acknowledging that previous efforts to predict climate change had been limited to a narrow, single discipline of research. Accurate predictions about the trend in temperatures would be necessary in order to move ahead in addressing concerns about global warming and climate change.

SLIDE #9



**A Vast ‘Interdisciplinary Effort’ To Predict Climate Trend Urged, *The New York Times*, Feb. 24, 1979**

ADDITIONAL INFO

Many of the world’s climatologists attended the World Climate Conference in Geneva, Switzerland, in February 1979. Sponsored by the World Meteorological Organization, this event was one of the first major international meetings on climate change. There was agreement among the scientists in attendance that the world was warming, and the published conclusions of the conference identified the causes of global warming as increased atmospheric concentrations of carbon dioxide resulting from the burning of fossil fuels, deforestations, and changes in land use. The resulting declaration urged governments “to foresee and to prevent potential man-made changes in climate that might be adverse to the well-being of humanity” (World Meteorological Organization, 1979).

TEACHER GUIDE

# SLIDE #10: Public Opinion Poll, Union of Concerned Scientists, 1981

→ Project the document

NOTE This slide is animated so that it will first show the poll without the percentages, and on the second click the percentages will appear.

QUESTION **What percentage of Americans do you think reported having heard about “the greenhouse effect” in 1981? What is your reasoning?**

NOTE Elicit responses and reasoning before showing the answers.

EXPLAIN **In 1981, 50% of respondents had not heard of the greenhouse effect, but 38% had (and the other 12% weren’t sure if they had or not). The poll is significant in that it show that knowledge of global warming issues had begun to move into the mainstream.**

## SLIDE #10a

Public Opinion Poll  
May 1981  
*Union of Concerned Scientists*

Question:  
**Have you heard or read anything about the Greenhouse Effect?**

Had heard      \_\_\_%

Had not heard    \_\_\_%

## SLIDE #10b

Public Opinion Poll  
May 1981  
*Union of Concerned Scientists*

Question:  
**Have you heard or read anything about the Greenhouse Effect?**

Had heard      **38%**

Had not heard    **50%**

## Public Opinion Poll, Union of Concerned Scientists, May 1981

### ADDITIONAL INFO

The National Resources Defense Council defines “the greenhouse effect” as “the process that raises the temperature of the air in the lower atmosphere due to heat trapped by greenhouse gases, such as carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and ozone” (National Resources Defense Council, 2009).

TEACHER GUIDE

# SLIDE #11: Study Finds Warming Trend That Could Raise Sea Levels, *The New York Times*, 1981

→ Project the document

EXPLAIN

This was the first time that *The New York Times* ran an article about global warming on its front page.

QUESTION

What does the phrasing of the headline imply about the status of scientific understanding of climate change in 1981?

POSSIBLE ANSWER

The terms “trend” and “could” imply that scientific conclusions about global warming were still quite tentative in 1981.

SLIDE #11

THE NEW YORK TIMES  
**Study Finds Warming Trend That Could Raise Sea Levels**

By WALTER SULLIVAN

A team of Federal scientists says it has detected an overall warming trend in the earth's atmosphere extending back to the year 1880. They regard this as evidence of the validity of the "greenhouse" effect, in which increasing amounts of carbon dioxide cause steady temperature increases.

precedented magnitude" in the next century. It might even be sufficient to melt and dislodge the ice cover of West Antarctica, they say, eventually leading to a worldwide rise of 15 to 20 feet in the sea level. In that case, they say, it would "flood 25 percent of Louisiana and Florida, 10 percent of New Jersey and many other lowlands throughout the world" within a century or less.

**Study Finds Warming Trend That Could Raise Sea Levels,**  
*The New York Times*  
Aug. 24, 1981

ADDITIONAL INFO

The article quotes a team of federal atmospheric scientists who predicted that the “greenhouse” effect would lead to global warming of “almost unprecedented magnitude,” including a worldwide sea level rise of 15 to 20 feet within a century. It is notable that in 1981 *The New York Times* still put “greenhouse” in quotes when referring to the greenhouse effect.

TEACHER GUIDE

# SLIDE #12: The Heat Is On: How the Earth's Climate is Changing, Why the Ozone Hole is Growing, *TIME* magazine cover, 1987

→ Project the document

QUESTION	What is <i>TIME</i> communicating about the climate in this 1987 cover? Give evidence from the document to explain your answers.
POSSIBLE ANSWER	The greenhouse effect is warming the planet.
EVIDENCE	The image of a greenhouse over the earth and the glowing red atmosphere
POSSIBLE ANSWER	The ozone hole is growing.
EVIDENCE	Text: "Why the ozone hole is growing."
POSSIBLE ANSWER	Climate change is an important fact but not something that someone should be too scared about.
EVIDENCE	It is important enough to put on the cover with factual statements ("The Heat <u>Is</u> On," "Climate <u>Is</u> Changing"), but the image is light and airy and not particularly scary.

SLIDE #12



**The Heat is On:  
How the Earth's Climate  
is Changing, Why the  
Ozone Hole is Growing,  
*TIME* magazine cover,  
Oct. 19, 1987**

ADDITIONAL INFO

The 1983 climate report by the National Academy of Sciences, like the EPA report of the same year, concluded that CO<sub>2</sub> was a concern but there was no need for panic (NAS, 1983).



TEACHER GUIDE

# SLIDE #13: IPCC Mission Statement, 1988; GCC Mission Statement, 1989

→ Project the document

QUESTION

**Who was behind the creation of the IPCC?**

POSSIBLE ANSWERS

The IPCC was created by the United Nations in 1988. Based on the logos appearing with the description, the IPCC seems to be sponsored by the WMO (World Meteorological Organization) and the UNEP (the United Nations Environment Programme).

QUESTION

**Who was behind the creation of the GCC?**

POSSIBLE ANSWER

The GCC was formed in 1989 by a group of businesses, most from the U.S.

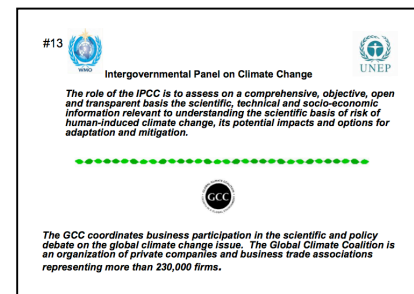
QUESTION

**From what you read in the background reading, what role did each of these organizations play in the debate over global warming?**

POSSIBLE ANSWERS

The IPCC has been the leading international voice from the scientific community about global warming. It put out a series of reports that have been highly influential in the debate over global warming. The GCC representing corporate interests in the debate over global warming. From its inception in 1989 to its dissolution in 2002, it disputed claims that global warming was a threat to humanity.

## SLIDE #13



**IPCC Mission Statement,  
1988;  
GCC Mission Statement,  
1989**

**ADDITIONAL INFO**

The IPCC brought together thousands of leading scientists from around the world to be an international voice on climate change. It was not charged with conducting original climate change research but based its reports on published peer-reviewed studies. The IPCC produced reports in 1990, 1995, 2001, and 2007. Each of the successive reports became less ambiguous and more definitive that global warming was taking place, that the causes were anthropogenic, and that the consequences would be dire if no changes were made in stemming greenhouse gas emissions.

The GCC was formed in 1989 in response to the creation of the IPCC a year earlier, and ended its work in 2002. At that time, its website ([www.globalclimate.org](http://www.globalclimate.org)) stated, "The Global Climate Coalition has been deactivated. The industry voice on climate change has served its purpose by contributing to a new approach to global warming."

TEACHER GUIDE

# SLIDE #14: The Big Dry, *TIME* magazine cover, 1988

→ Project the document

QUESTION

**What messages about climate change are given in this *TIME* cover and text from July 4, 1988? Give your evidence from the document.**

POSSIBLE ANSWER

The country is drying out like it did in the dustbowl during the Great Depression in the 1930s.

EVIDENCE

Text: "THE BIG DRY" with brown image of dry crops and empty cabin reminiscent from Dustbowl-era photos

QUESTION

**What event prompted this *TIME* cover?**

POSSIBLE ANSWER

The cover references the heat waves and drought of the summer of 1983.

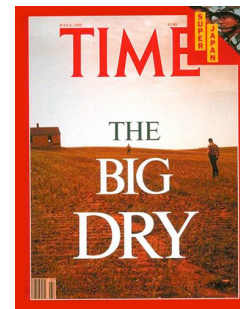
QUESTION

**How might the heat waves of the summer of 1988 have influenced public opinion on global warming?**

POSSIBLE ANSWERS

People are more likely to be concerned about an issue if they feel a direct connection to it themselves. Although no one knew for certain if the heat waves in the summer of 1988 were actually caused by global warming, people became more concerned when the weather seemed to confirm the predictions of scientists.

SLIDE #14



**The Big Dry,  
*TIME* magazine cover,  
July 4, 1988**



**TEACHER GUIDE**

# SLIDE #15: His Bold Statement Transforms Debate on Greenhouse Effect, *The New York Times*, 1988

→ Project the document

**SLIDE #15**

**QUESTION** Who is James Hansen and what was his “bold statement”?

**POSSIBLE ANSWERS** James Hansen was a respected atmospheric physicist and the director of the Goddard Institute of Space Studies. In Senate hearings during the summer of 1988, he testified that he was 99% confident that a long-term warming trend was underway and that it was likely to bring more frequent storms and floods as well as life-threatening heat waves.

**QUESTION** Why might Hansen have waited for this particular day in June to testify?

**POSSIBLE ANSWER** He waited for a record-breaking day during the heat wave to dramatize his warning about climate change.

**QUESTION** Why might *The New York Times* have included this picture of Hansen holding up dice?

**POSSIBLE ANSWER** The photo emphasizes the odds that global warming will lead to hotter weather.

**EXPLAIN** Dr. Hansen was quoted as saying: “If our climate model calculations are approximately correct, greenhouse warming the 1990s will be sufficient to shift the possibilities such that the chances of a hot summer will be in the range of 55 to 80%. Four sides of the die are red. I believe it is obvious that the man on the street will notice that by then the dice are loaded. There will be more hot summers than normal and the hottest ones will be hotter than they used to be.”



**His Bold Statement Transforms the Debate on Greenhouse Effect, *The New York Times*, Aug. 23, 1988**

**ADDITIONAL INFO**

Dr. Hansen's predictions for the 1990s were correct. Summer temperatures in New York City in the 1990s, for example, were the hottest on record (NASA, 2010).

This article appeared in a new science section of *The New York Times* called "The Environment."

TEACHER GUIDE

# SLIDE #16: Headlines from News Reports Between 1987 and 1989

→ Project the document

QUESTION

**These are selected headlines from news reports between 1987 and 1989. What do you notice about the political response to global warming in the late 1980s?**

POSSIBLE ANSWERS

The U.S. and other countries are talking about taking action on global warming. There are disagreements among industrial nations about how to address global warming. Political responses include many different actions like reforestation, reducing emissions, and increasing energy efficiency. There have been several summits and treaties about global warming.

NOTE

In responses, probe for evidence from the headlines—especially if student responses do not seem to relate to the headlines themselves.

SLIDE #16

What do these headlines communicate about the political response to global warming in the late 1980s?

- Policy Makers, Spurred by Ozone Treaty, Consider Tackling 'Greenhouse Effect'  
WALL STREET JOURNAL, Sept. 17, 1987
- Baker Urges Steps on Global Warming; Reduce Emissions, Energy Efficiency, Reforestation Recommended  
WASHINGTON POST, Jan. 31, 1989
- U.S., in a Shift, Seeks Treaty on Global Warming  
NEW YORK TIMES, May 12, 1989
- World Leaders to Focus on Environment at Economic Summit, Document Shows  
WALL STREET JOURNAL, July 7, 1989
- House and Senate Recognize a 'Pork Barrel' When They See One, Warm to the Environment  
WALL STREET JOURNAL, Aug. 16, 1989
- Industrial Nations Can't Reach Pact to Fight Warming  
WALL STREET JOURNAL, Nov. 9, 1989

## Headlines from News Reports Between 1987 and 1989

ADDITIONAL INFO

The "ozone treaty" refers to the Montreal Protocol on Substances that Deplete the Ozone Layer, which was ratified by all of the countries in the United Nations, including the U.S. in 1987 (EPA, 1987).

James Baker was the Secretary of State in the administration of President George H.W. Bush from 1989-1992.

"Pork barrel" refers to member items proposed for government funding by individual members of Congress to benefit their individual districts or states.

TEACHER GUIDE

# SLIDE #17: Public Opinion Poll, Union of Concerned Scientists, 1990

→ Project the document

EXPLAIN

**This is a poll from 1990 researching public opinion on global warming. [Read aloud the poll question.]**

QUESTION

**Who produced this poll and for what purpose?**

POSSIBLE ANSWERS

The Union of Concerned Scientists. They might have wanted to document public opinion about the need to set limits on CO<sub>2</sub> emissions at that time for research purposes, to sway politicians by the poll results, or to provide information embedded in the poll question to the people being surveyed.

QUESTION

**In what way could the phrasing of this poll question influence respondents?**

POSSIBLE ANSWERS

Most of the “question” is actually a statement that might bias respondents. It gives information about why “many industrialized nations” are curbing CO<sub>2</sub> emissions and why Bush “refuses” to “join other countries.” The information and wording of the choices are likely to encourage respondents to say, “Join other countries.”

## SLIDE #17

Public Opinion Poll  
1990  
Union of Concerned Scientists

**Question:**  
*Because of their concerns about global warming, many industrialized countries have recently made commitments to limit or reduce their amount of carbon dioxide from fossil fuels released into the air. The Bush administration believes that scientific predictions of global warming are too uncertain and refuses to commit the U.S. to any such carbon dioxide limit. Do you believe that the U.S. should join other industrialized countries in committing to carbon dioxide emissions limits, or should we wait for greater scientific certainty before making a commitment?*

Join other countries **69%**  
U.S. should wait **26%**

## Public Opinion Poll, Union of Concerned Scientists, 1990

### ADDITIONAL INFO

The Union of Concerned Scientists was formed in 1969 with a membership of more than 250,000. Their mission statement describes the organization as “a nonprofit partnership of scientists and citizens combining rigorous analysis, innovative policy development, and effective citizen advocacy to achieve practical environmental solutions” (Union of Concerned Scientists, 2010). Polls such as this one are called “push polls.” They are used to provide or imply information in the guise of a poll question that assumes certain facts as true when they might not be. Push polls are most often used in political campaigns in order to spread negative information about an opposing candidate (e.g., “How upset are you that members of the National Party have been taking bribes?”).



TEACHER GUIDE

## SLIDE #18: First Assessment Report, IPCC, 1990

→ Project the document

QUESTION

**According to the reading, why was there little media coverage of the first IPCC report in 1990?**

POSSIBLE ANSWER

The report failed to gain media attention because of the lack of scientific consensus, due in part to the inconsistencies of climate modeling, that led to ambiguous conclusions.

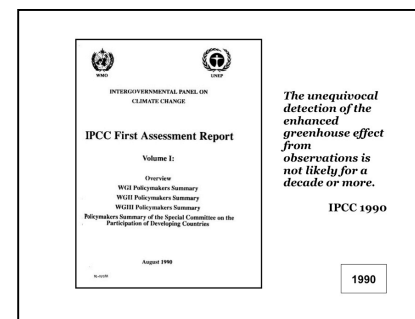
QUESTION

**What does the quote taken from the report imply about the content of the report?**

POSSIBLE ANSWERS

The IPCC is not willing to make any firm statements. They believed that solid data and conclusions were a long way off.

### SLIDE #18



### First Assessment Report, IPCC, 1990

#### ADDITIONAL INFO

Unlike the summer of 1988 with its record warm temperatures, heat waves, and droughts, the summer of 1990 was relatively cool. This may have contributed to the limited media coverage of the IPCC report, as people did not feel the immediacy of global warming in their own lives.

TEACHER GUIDE

## SLIDE #19: Rio: Coming Together to Save the Earth, *TIME* magazine cover, 1992

→ Project the document

QUESTION **What event prompted this *TIME* cover and what was its significance?**

POSSIBLE ANSWER The cover was prompted by the 1992 Earth Summit in Rio de Janeiro, Brazil.

QUESTION **According to the reading, what global warming initiative came out of Rio and what was the U.S. response?**

POSSIBLE ANSWERS The international delegates at Rio adopted emissions standards that included setting targets for the United States that would require cutting emissions to 1990 levels by the year 2000. The Bush Administration disregarded the targets and instead enacted several inexpensive policies to promote energy efficiency.

QUESTION **What are the messages in the cover about people's relationship to the environment? Give evidence from the document.**

POSSIBLE ANSWERS The cover gives a positive and optimistic message that humans and nature can live together in harmony. The goals of Rio had divine guidance.

EVIDENCE Text: "coming together to save the Earth"; a colorful mix of jungle plants and animals with urban imagery; a Christ statue overlooking the scene; lack of pull down or other news text to distract from the peaceful scene.

SLIDE #19



**Rio: Coming Together to Save the Earth, *TIME* magazine cover, Jan. 6, 1992**

TEACHER GUIDE

## SLIDE #20: Second Assessment Climate Change, IPCC, 1995

→ Project the document

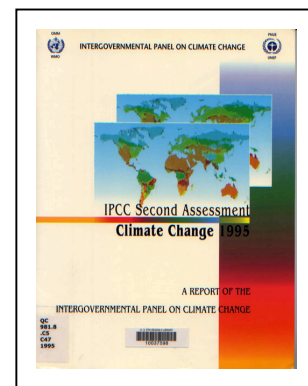
QUESTION

**What changes had occurred between the 1990 and 1995 IPCC reports, based on the excerpts from each report shown in the slide?**

POSSIBLE ANSWERS

The scientists were moving closer to determining that global warming is anthropogenic (caused by humans). The data and methodology for assessing climate change was leading to firmer conclusions earlier than they had originally predicted.

SLIDE #20



**Second Assessment  
Climate Change,  
IPCC, 1995**

### ADDITIONAL INFO

The 1995 IPCC report included separate sections with specific summaries of information for policymakers from three working groups: 1) the science of climate change; 2) scientific-technical analyses of impacts, adaptations, and mitigation of climate change; and 3) the economic and social dimensions of climate change. It also included a general assessment of various response strategies as well as the estimated costs of the different response options.



**TEACHER GUIDE**

# SLIDE #21: Headlines from News Reports Leading Up to the Kyoto Conference, 1997

➔ Project the document

EXPLAIN

**These are headlines from news reports and editorials leading up to the Kyoto Conference in December of 1997.**

QUESTION

**What do these headlines communicate about various political, corporate, and international opinions on Kyoto? Be prepared to explain your evidence from the headlines.**

OPTIONAL

Divide the class into groups to look for 1) political and civic responses; 2) corporate responses; and 3) international responses.

POSSIBLE ANSWER

Political and civic responses  
Clinton is caught between industry, which opposes the treaty, and the public and environmental groups that support it.

EVIDENCE

“Clinton struggles to appease all sides over climate proposals”; “waning influence provokes green groups’ frustrations”; “public backs tough steps for a treaty on warming”; “new U.S. proposal on emissions reductions”; “treaty harms economy”

POSSIBLE ANSWER

Corporate responses  
Industry is generally opposed to the treaty and to mandatory emissions cuts because of its economic impact.

**SLIDE #21**

**What do these newspaper headlines communicate leading up to the Kyoto Conference in December 1997?**

Industry Expects Economic News Following Carbon Emissions Cuts <small>CHEMICAL MARKET REPORTS, Oct. 6, 1997</small>
Exxon Urges Developing Nations to Shun Environmental Curbs Hindering Growth <small>WALL STREET JOURNAL, Nov. 14, 1997</small>
Clinton Struggles to Appease all Sides Over Climate Proposals <small>NATURE, Oct. 30, 1997</small>
Waning Influence Provokes Green Groups' Frustration <small>NATURE, Nov. 20, 1997</small>
Public Backs Tough Steps for a Treaty on Warming <small>NEW YORK TIMES, Nov. 28, 1997</small>
Climate Change: EU SSB in the Vanguard on the Eve of the Kyoto Conference <small>EUROPEAN REPORT, Nov. 28, 1997</small>
Industrialized, Developing Nations Clash at Kyoto Climate Change Talks <small>OIL AND GAS JOURNAL, Dec. 1, 1997</small>
China Attacks Proposed Gas Cuts <small>FINANCIAL TIMES OF LONDON, Dec. 6, 1997</small>
Ford Shifts on Global Warming: Automaker Declines to Join Coalition Battling Kyoto Treaty <small>THE WASHINGTON POST, Dec. 7, 1997</small>

## Headlines from News Reports Leading Up To Kyoto Conference, 1997

EVIDENCE

“industry expects economic havoc following carbon emissions cuts”; “Exxon urges developing nations to shun environmental curbs hindering growth”; “Ford shifts on global warming: automaker decides to quit coalition battling Kyoto treaty”; “treaty harms economy”

POSSIBLE ANSWER

International responses  
Developing nations oppose emission reductions that would limit their economic growth while some industrial nations (the EU, but not the U.S.) promote curbs.

EVIDENCE

“climate change: EU still in the vanguard on the eve of the Kyoto Conference”; “industrialized, developing nations clash at Kyoto climate change talks”; “China attacks proposed gas curbs”

QUESTION

**How might the selection of the particular headlines chosen for this slide have biased your understanding of this history?**

POSSIBLE ANSWER

The people who created these materials biased the results for this question by selecting certain headlines and leaving out others, giving an impression that may or may not be reflective of different perspectives and the history we are studying.

NOTE

Wherever possible, students should be encouraged to analyze the choices and biases that went into creating these (and all classroom) materials.

TEACHER GUIDE

## SLIDE #22: Climate Change: The Scientific Basis, IPCC, 2001

→ Project the document

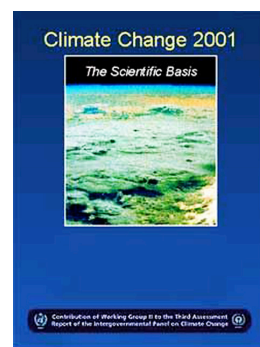
QUESTION

**What changes from the two previous IPCC reports can you identify from the excerpts?**

POSSIBLE ANSWERS

The scientists are continuing to feel more certain that recent global warming is caused by human actions (anthropogenic). There is increased specificity in the conclusions (e.g., 50 years).

SLIDE #22



### ADDITIONAL INFO

The 2001 IPCC report consisted of four separate volumes: scientific basis; impacts, adaptation, and vulnerability; mitigation; and general synthesis. The synthesis report laid out nine key questions about climate change that guided the research, including:

- 1) What can scientific, technical, and socio-economic analyses contribute to the determination of what constitutes dangerous anthropogenic interference with the climate system?
- 2) What is the evidence for, causes of, and consequences of changes in the Earth's climate since the pre-industrial era?
- 3) What is known about the potential for, and costs and benefits of, and time frame for reducing greenhouse gas emissions?
- 4) What is known about environmental, social, and economic costs and benefits and implications of...integrating climate change response strategies in an equitable manner into broad sustainable development strategies?

This report also included the controversial “hockey stick graph” (see Lesson 2).

TEACHER GUIDE

## SLIDE #23: Foot-in-Mouth Disease, editorial cartoon, 2001

→ Project the document

QUESTION **What messages does this political cartoon give about President Bush’s global warming policy? Give evidence from the document.**

POSSIBLE ANSWER Bush flip-flopped on global warming.

EVIDENCE Text: “broke his promise”; “foot-in-mouth” refer to Bush’s reversal of a campaign promise to support Kyoto and work to cut greenhouse gas emissions at home

POSSIBLE ANSWER Bush’s energy policy supports polluting industries.

EVIDENCE Text: “Energy Policy: Pollute & Pillage”; image of belching smoke stacks outside White House windows

QUESTION **Why might editorial cartoons be a particularly effective form of political commentary?**

POSSIBLE ANSWERS They combine humor, satire, and visual imagery. They are intriguing to figure out. They make fun of people in power.

SLIDE #23



**Foot-in-Mouth Disease, editorial cartoon, 2001**

ADDITIONAL INFO

According to a report by Democratic Congressman George Miller, “President Bush has stocked his administration with former oil industry and gas lobbyists. And energy interests have funneled millions of dollars into Republican campaign coffers...With special interests so closely tied to the White House, it should come as no surprise that when the President’s Energy Task Force – led by Vice President Cheney – sat down to make recommendations from the nation’s energy policy, they invited corporate interests to the White House to write the agenda and the legislation” (Miller, 2004).



TEACHER GUIDE

## SLIDE #24: Global Warming, *TIME* magazine cover, 2001

→ Project the document

QUESTION

What messages are being communicated about global warming by *TIME* magazine in this cover? Give evidence from the document to back up your answers.

POSSIBLE ANSWERS

Global warming is a serious and scary threat that the federal government is ignoring. Global warming is having direct effects all around the world and individuals

EVIDENCE

Text: "All over the Earth we are feeling the heat. Why isn't Washington?" Image of an egg frying, with the yolk in the image of the Earth

SLIDE #24



Global Warming,  
*TIME* magazine cover,  
April 9, 2001

ADDITIONAL INFO

This image is a take-off on a well-known public service announcement created in 1987 by the Partnership for a Drug-Free America in which a man speaks directly to the camera and holds up an egg, saying, "This is your brain." He points to a hot frying pan, saying, "This is drugs." He cracks the egg into the frying pan where it immediately fries and sizzles, saying, "This is your brain on drugs. Any questions?" That PSA won numerous awards and can be seen at the Museum of Television Broadcasting and at the Smithsonian; it has also been frequently spoofed and satirized (Partnership for a Drug-Free America, 2006).

TEACHER GUIDE

## SLIDE #25: Comparison of *TIME* magazine covers in 1987 and 2001

→ Project the document

QUESTION

**Compare these two *TIME* covers about global warming from 1987 and 2001. Give evidence to back up your answers.**

POSSIBLE ANSWER

The 1987 cover is much less scary and alarmist than the 2001 cover.

EVIDENCE

The text in 1987 is factual (“How the Earth’s Climate is Changing, Why the Ozone Hole is Growing”) while the text in 2001 is disconcerting and personal (“Melting Glaciers, Rising Seas, All Over the Earth We Are Feeling the Heat”); the imagery in 1987 is cool (blue), removed (in the clouds), and precise (greenhouse lines) while the imagery in 2001 is hot (red and yellow), metaphorical (frying an egg), and alarming (the Earth is frying)

QUESTION

**Why might *TIME* have emphasized fear in its 2001 cover but not in 1987?**

NOTE

There are many possible answers building from information in the reading and media literacy questions.

POSSIBLE ANSWERS

The science was less clear in 1987. By 2001, people were more receptive to alarming messages about global warming. The editors at *TIME* were more concerned in 2001 and wanted to use fear to spread concern about the issue. News media are increasingly more likely to use fear in their reporting.

SLIDE #25



**Comparison of *TIME* magazine covers in 1987 and 2001**

TEACHER GUIDE

# SLIDE #26: *New York Times* headlines from 2002 and 2003

→ Project the document

EXPLAIN

These are headlines from *The New York Times* reports about legislation on global warming between 2002 and 2003.

QUESTION

What do these headlines communicate about the legislative response to global warming in 2002 and 2003?

POSSIBLE ANSWERS

There is some headway in federal legislation (e.g., McCain-Lieberman), but mostly action is happening at the state and local levels.

QUESTION

How might the inclusion of only *New York Times* headlines bias your interpretations about the state of federal responses about global warming?

POSSIBLE ANSWERS

*The New York Times*, like all media, has its own biases. Using headlines from only one source will limit the perspectives and information through the selection of stories reported, word choice, and editorial spin.

QUESTION

What laws, programs, and actions do you know about that are aimed at reducing carbon emissions in your state and local area?

POSSIBLE ANSWERS

Answers will vary; this might be an opportunity to assign students the task of investigating local efforts.

## SLIDE #26

What do these headlines communicate about government response to global warming in 2002 and 2003?

*U.S. Sees Problems in Climate Change: Report, a Shift for Bush, Says Nation Will Need to Adapt*  
NEW YORK TIMES, June 8, 2002

*Senate Committee Approves Bill Mandating Big Cuts in Emissions*  
NEW YORK TIMES, June 28, 2002

*State Officials Ask Bush to Act on Global Warming*  
NEW YORK TIMES, July 17, 2002

*McCain and Lieberman Offer Bill to Require Cuts in Gases*  
NEW YORK TIMES, Jan. 9, 2003

*Panel of Experts Faults Bush Plan to Study Climate*  
NEW YORK TIMES, Feb. 26, 2003

*The Warming is Global but the Legislation, in the U.S., is All Local*  
NEW YORK TIMES, June 28, 2002

### *New York Times* headlines from 2002 and 2003

TEACHER GUIDE

## SLIDE #27: *The Day After Tomorrow*, film poster, 2004

→ Project the document

QUESTION

**What messages are communicated about global warming in this poster for the film *The Day After Tomorrow*, which shows the Statue of Liberty under water?**

POSSIBLE ANSWERS

Global warming will inundate New York City with rising sea levels. Global warming is going to lead to catastrophic consequences similar to those that occurred in other disaster films (like *Independence Day*, by the same director).

QUESTION

**What might the “drowning” of the Statue of Liberty symbolize?**

POSSIBLE ANSWER

The Statue of Liberty symbolizes our nation, liberties, and values, which will all be overcome by global warming.

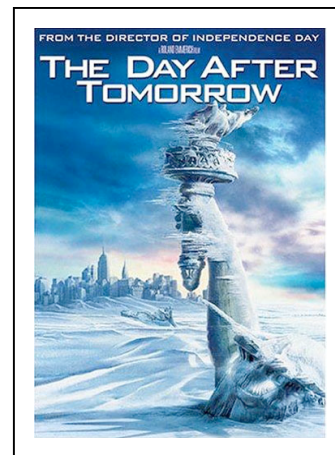
QUESTION

**What is the significance of the title?**

POSSIBLE ANSWER

This will all happen very soon.

SLIDE #27



### ADDITIONAL INFO

The film *The Day After Tomorrow* was a science fiction disaster epic focused on the consequences of global warming, which include a 40 foot rise in sea levels, huge snow and hailstorms, and a superstorm that engulfs New York City with temperatures of -150° F, ushering in a new ice age. The title was a take-off of the 1983 television film *The Day After*, which realistically dramatized the effects of nuclear war.

TEACHER GUIDE

## SLIDE #28: Michael Crichton's *The State of Fear*, book cover, 2004

→ Project the document

QUESTION

According to the reading, what messages about global warming did well-known author (*Jurassic Park*) and TV producer (*ER*) Michael Crichton give in his science fiction book, *State of Fear*?

POSSIBLE ANSWERS

The book centered on eco-terrorists who are trying to create a state of fear in order to advance their agenda regarding global warming. There was a lengthy author's note and appendix questioning the state of research about global warming and arguing that the causes, extent, and consequences of global warming are unknown.

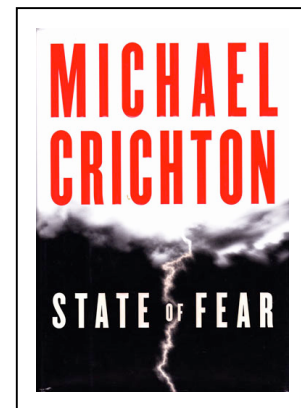
QUESTION

What role did Michael Crichton play in congressional hearings about global warming?

POSSIBLE ANSWER

Senator James Inhofe (R-OK), a well-known disbeliever in global warming, arranged for Crichton to testify as a "climate expert."

SLIDE #28



Michael Crichton's  
*The State of Fear*,  
book cover,  
2004

### ADDITIONAL INFO

In *State of Fear*, Crichton argues that several institutions have a vested interest in keeping the public in a state of fear – in particular, the media, politicians, and lawyers. Like all of his science fiction books, footnoted scientific information is incorporated throughout the story. Unlike his earlier books, however, this book included 10 pages of additional content questioning the scientific consensus about the causes and likely consequences of global warming along with 18 pages of annotated references. Crichton used these same arguments in his congressional testimony (Crichton, 2005). His arguments were considered very controversial, and the Pew Center on Global Climate Change created an extensive set of answers to key questions that he raised in the book and in public comments, concluding that “despite his research and the book’s many footnotes, Crichton has a less-than-commanding understanding of climate change science” (Pew Center, 2006, p. 1).

TEACHER GUIDE

## SLIDE #29: Are We Making Hurricanes Worse? *TIME* magazine cover, 2005

→ Project the document

QUESTION

**What event prompted this *TIME* magazine cover?**

POSSIBLE ANSWER

The cover was prompted by Hurricane Katrina's destruction of New Orleans in late August 2005.

QUESTION

**What impact did Hurricane Katrina have on the debate over global warming?**

POSSIBLE ANSWERS

Media reports that global warming will increase the frequency and severity of hurricanes were embedded in pictures of the storm-ravaged Gulf Coast. For many Americans, the once abstract idea of global warming now had tangible victims.

SLIDE #29



**Are We Making Hurricanes Worse?**  
*TIME* magazine cover,  
Oct. 3, 2005

### ADDITIONAL INFO

Worldwide media coverage increasingly began to link hurricanes with global warming, including a front page story in the British newspaper *The Independent* which coupled a graph showing the path of Hurricane Katrina with the screaming headline "This is Global Warming" (Black, 2005). Consequently, the Pew Center on Global Climate Change created a Web page of "Hurricanes and Global Warming FAQs" that included predictions of other types of severe weather patterns likely to result from global warming, such as heavy precipitation and heat waves (Pew Center, 2008).

TEACHER GUIDE

## SLIDE #30: Al Gore's *An Inconvenient Truth*, film poster, 2006

→ Project the document

QUESTION

**What are the messages about global warming communicated by the title of Al Gore's award-winning film, *An Inconvenient Truth*?**

POSSIBLE ANSWERS

Global warming is a reality that will require us to change our ways by limiting greenhouse gas emissions. It is time to face the truth about global warming, even if it makes us uncomfortable and requires us to give up our conveniences.

QUESTION

**What messages do the images and text imply about global warming? What is your evidence in the document?**

POSSIBLE ANSWER

Industrial pollution causes (more frequent) hurricanes.

EVIDENCE

The smokestack (industrial pollution) is spouting a hurricane.

POSSIBLE ANSWER

Humans are causing great environmental destruction.

EVIDENCE

Factories are metaphors for human industrialization; smoke, storm cloud, and hurricane image all represent environmental destruction.

POSSIBLE ANSWER

The reality of global warming is more terrifying than any fictional disaster film.

EVIDENCE

Text: "by far the most terrifying film you will ever see"

SLIDE #30



Al Gore's *An Inconvenient Truth*,  
film poster, 2006

### ADDITIONAL INFO

Al Gore's film won numerous awards, including the Academy Award for best documentary film. According to one source on climate change: "The impact of *An Inconvenient Truth* is unprecedented. Since its release in 2005, the film has helped to galvanize governments, leaders, organizations and individuals worldwide to take action on global warming. More than a billion people are now aware of the issue and have been motivated to act" (Climate Crisis, 2010). Others assessments of the film were less positive, however, and many media sources reported errors in the factual evidence and demonstrations included in the film. In the UK, a lawsuit was filed over the distribution of the film in schools, and while the judge refused to block the distribution of the film, in his ruling he concluded that "Gore committed nine counts scientific inaccuracy" in the film (Brahic, 2007).

**NOTE:** Lesson 4, "What is Causing Global Warming?" includes an exploration of the inaccuracies in *An Inconvenient Truth* and other documentary films about global warming.



TEACHER GUIDE

# SLIDE #31: Climate Change Synthesis Report, IPCC, 2007

→ Project the document

QUESTION

**What changes from the previous IPCC reports can you identify from the excerpts on the slide?**

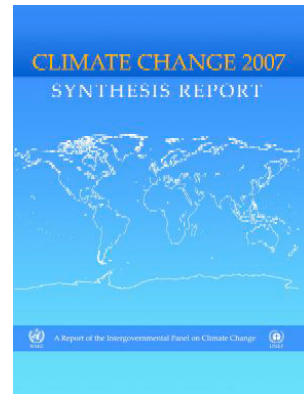
POSSIBLE ANSWERS

Since the 2001 report, the committee has gone from concluding that there is “strong evidence” that global warming is anthropogenic to concluding that there is a greater than 90% likelihood that it is human-caused. There is now total consensus that global warming is occurring.

EXPLAIN

**The IPCC report concluded “there is *high agreement and much evidence* of substantial economic potential for the mitigation of global GHG emissions over the coming decades that could offset the projected growth of global emissions or reduce emissions below current levels” (p. 58).**

SLIDE #33



**Climate Change Synthesis Report, IPCC, 2007**

## ADDITIONAL INFO

The 2007 Nobel Peace Prize was awarded to the Intergovernmental Panel on Climate Change (IPCC) and Al Gore “for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change” (Nobel Prize, 2007).



**TEACHER GUIDE**

# SLIDE #32: Washington Post-ABC news poll, 2009

→ Project the document

NOTE

This slide is animated so it will first show the poll without the percentages, and on the second click the percentages will appear.

EXPLAIN

**Before giving you the results of this poll from 2009 during the Copenhagen Summit, I'd like to take a survey of your own views. Raise your hand if you think that most scientists agree with one another about whether or not global warming is happening. Raise your hand if you think there is a lot of disagreement among scientists about whether or not global warming is happening.**

[Summarize the results from the class's vote before going on.]

QUESTION

**Why do you suppose that most Americans think that there is so much disagreement among scientists about whether global warming exists?**

POSSIBLE ANSWERS

Global warming skeptics have effectively influenced the debate. A successful PR campaign has been waged by those in the energy industry to discredit the science. Some media outlets have promoted skepticism, debate, and public questioning of the growing scientific consensus, either for political purposes or to gain readership. The question is confusing, since there is still some confusion among scientists about some aspects of global warming (but not about whether it is happening). The public may not understand the process of scientific debate.

**SLIDE #32a**

Washington Post-ABC News Poll  
December 13, 2009

**Question:**  
*Do you think most scientists agree with one another about whether or not global warming is happening, or do you think there is a lot of disagreement among scientists on this issue?*

Most scientists agree \_\_\_\_\_%

There is a lot of disagreement (among scientists) \_\_\_\_\_%

**SLIDE #32b**

Washington Post-ABC News Poll  
December 13, 2009

**Question:**  
*Do you think most scientists agree with one another about whether or not global warming is happening, or do you think there is a lot of disagreement among scientists on this issue?*

Most scientists agree **35 %**

There is a lot of disagreement (among scientists) **64 %**

**Washington Post-ABC news poll, Dec. 13, 2009**

**ADDITIONAL INFO**

The considerable debate about whether global warming is occurring that is referred to in the poll question is actually one that is occurring in the media and in the political realm, but not among scientists themselves. The 2,500+ scientists who make up the United Nations International Panel on Climate Change agree that our climate is warming. This consensus is supported by The American Meteorological Society, the American Geophysical Union, and the American Association for the Advancement of Science (AAAS). According to a 2004 analysis by the journal *Science*: “scientists publishing in the peer-reviewed literature agree with the IPCC, the National Academy of Sciences, and the public statements of their professional societies. Politicians, economists, journalists, and others may have the impression of confusion, disagreement, or discord among climate scientists, but that impression is incorrect.” The article concludes, “The scientific consensus might, of course, be wrong” (Oreskes, 2004, p. 1686).

TEACHER GUIDE

**SLIDE #33: *New York Times* headlines from 2007 to 2010**

→ Project the document

QUESTION

**What significant trends or developments do you see in these *New York Times* headlines leading up to the Global Climate Summit in Copenhagen in December 2009? Give your evidence from the headlines.**

POSSIBLE ANSWER

Scientists are reaching greater agreement about climate change, but much of the public is still skeptical.

EVIDENCE

“In the Face of Skeptics, Experts Affirm Climate Peril”; “Gap Between Scientists and the Public”; “Public Remains Split”

POSSIBLE ANSWER

There is mounting evidence of the current impact of global warming.

EVIDENCE

“Melting Pace of Glaciers is Accelerating”

POSSIBLE ANSWER

The political responses to global warming are slow and controversial.

EVIDENCE

“Obama Aide Concedes Climate Law Must Wait”; “China Insists That Its Steps on Climate Be Voluntary”

POSSIBLE ANSWER

The Copenhagen Summit is more about hopes than concrete steps to control climate change.

EVIDENCE

“Peace Prize”; “Hopenhagen”

**SLIDE #33**

What significant trends or developments appear in these *New York Times* headlines from 2007 to 2010?

Public Remains Split on Response to Warming April 27, 2007
Gore Shares Peace Prize for Climate Change Work Oct. 13, 2007
Melting Pace of Glaciers is Accelerating, Report Says March 20, 2008
Survey Shows Gap Between Scientists and the Public July 10, 2008
Obama Aide Concedes Climate Law Must Wait Oct. 3, 2009
In Face of Skeptics, Experts Affirm Climate Peril Dec. 7, 2009
Global and Local Concerns Meet in 'Hopenhagen' Dec. 11, 2009
China Insists That Its Steps on Climate Be Voluntary Jan. 30, 2010

***New York Times* headlines from 2007 to 2010**



TEACHER GUIDE

# SLIDE #34: Copenhagen Summit and Leadership on Global Warming Reflected in Editorial Cartoons, 2009-2010

**OPTIONAL:** Students can be divided into four groups, with each group taking one of the four political cartoons to analyze, then share their analysis with the class.

→ Project the document

QUESTION

**What are the criticisms of the Copenhagen Summit and political leadership on global warming presented in these four editorial cartoons? Explain what events or information is depicted in each cartoon and give evidence for your interpretation from visual or textual elements in the cartoon.**

POSSIBLE ANSWER

TOP LEFT: The leaders attending the Summit are hypocritical and added huge amounts of carbon dioxide to the atmosphere just by getting to Copenhagen.

EVIDENCE

images of airplanes, helicopters, and limousines; people coughing and gasping

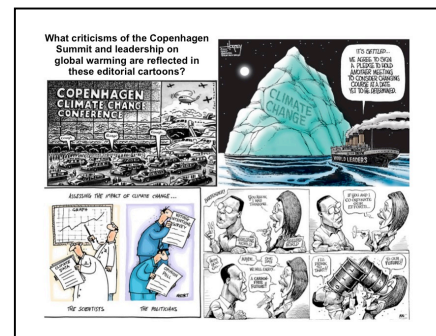
POSSIBLE ANSWER

TOP RIGHT: The leaders are delaying and equivocating while keeping us on course for a global calamity.

EVIDENCE

ship labeled "world leaders" heading towards an iceberg labeled "climate change"; leader's statement that reflects delay in making a decision about what to do

## SLIDE #34



## Copenhagen Summit and Leadership on Global Warming Reflected in Editorial Cartoons, 2009-2010

POSSIBLE  
ANSWER

**BOTTOM LEFT:** While scientists are identifying the reality of global warming, self-serving politicians are only interested in opinion polls.

EVIDENCE

scientists studying graph and data, politicians reading opinion polls about the intentions of likely voters

POSSIBLE  
ANSWER

**BOTTOM RIGHT:** While both the developed and developing nations talk about change, they still remain addicted to oil.

EVIDENCE

individuals labeled “developed” and “developing” agree to work together to have a carbon-free future, but “drink to that” by chugging oil



TEACHER GUIDE

## SLIDE #35: Collection of Magazine Covers, 2004-2010

**NOTE:** The goal of the next series of 10 slides (#36-45) is for students to identify patterns in the representation of global warming in a relatively quick collage of magazine covers. Show the 10 slides fairly quickly (e.g., 10 seconds each) as students note trends, patterns, and details. Discuss the students' observations about the collection of 10 covers showing the second composite slide (#46), drawing from the possible answers in the *Teacher Guide*.

Optional: Educators may want to go through each magazine cover individually. Here are some key questions to guide those analyses:

- What messages are conveyed about global warming by the text and visuals on this cover, and how are those messages communicated?
- Who is the target audience for this magazine and how is the message targeted specifically to them?
- Who might benefit from, and who might be harmed by, this cover?
- Is this a credible source for information about global warming? Why or why not?

EXPLAIN

These are selected magazine covers from 2004 through 2010 that focus on global warming and climate change.

I'm going to show these 10 covers individually. As you look more carefully at each one, notice the trends or developments you see reflected in this collection of covers. We'll wait to discuss them after you've seen all 10.

NOTE: Go on to slides #36-45

What trends or developments do you see reflected in these magazine covers?



Collection of Magazine Covers, 2004-2010

**TEACHER GUIDE**

# SLIDES #36-46: Individual Magazine Covers, 2004-2010

**NOTE:** Project the 10 individual magazine covers in Slides #36-45, showing each one for about 10 seconds. End with Slide #46 (the collage of all 10 covers) and then start the discussion using the questions below.

→ Project the documents

QUESTION

**Looking at the entire collection of magazine covers, what trends or developments do you see reflected?**

POSSIBLE ANSWER

Global warming is definitely happening.

EVIDENCE

*Business Week*, *TIME*, and *National Geographic* text and visuals; red and yellow colors indicating heat and fire; images of ice melting, polar bears, and penguins in danger.

POSSIBLE ANSWER

Many different groups are concerned about global warming.

EVIDENCE

Businesses – *Business Week*, religious communities – *United Church Observer*, celebrities like George Clooney and Julia Roberts – *Vanity Fair*

POSSIBLE ANSWER

Global warming and climate change will have serious consequences for many cities and will affect people individually.

EVIDENCE

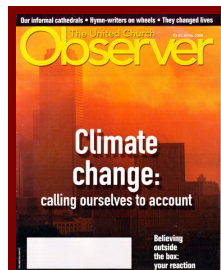
*TIME* text – “Climate change isn’t some future problem...Here’s how it affects you, your kids, and their kids as well”; “How it threatens your health”; *Vanity Fair* text – “How much of New York, Washington, and other American cities will be under water?”

**SLIDE #36**



**Global Warming: Why Business is Taking it So Seriously, *Business Week* magazine cover, 2004**

**SLIDE #37**



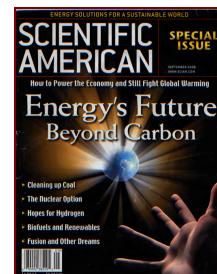
**Climate Change: Calling Ourselves to Account, *United Church Observer* magazine cover, 2005**

**SLIDE #38**



**Special Report: Global Warming; Be Worried. Be Very Worried, *TIME* magazine cover, 2006**

**SLIDE #39**



**Energy's Future: Beyond Carbon, *Scientific American* magazine cover, 2006**

POSSIBLE ANSWER

Humans – and some countries in particular – are responsible for causing global warming.

EVIDENCE

*United Church Observer* – text; *TIME* – “How China and India can help save the world - or destroy it”

POSSIBLE ANSWER

There are actions that we can take individually to help combat global warming.

EVIDENCE

*TIME* – “51 things you can do to make a difference” “How to win the war on global warming”; *National Geographic* – “what you can do”

POSSIBLE ANSWER

Science holds the key to global warming solutions.

EVIDENCE

*TIME* – “the climate crusaders”; *Scientific American* – text and images

POSSIBLE ANSWER

It is patriotic to fight global warming.

EVIDENCE

*TIME* – visual image representing the raising of the flag at Iwo Jima during World War II; *Vanity Fair* – “New American Revolution”

POSSIBLE ANSWER

There is still a lot of conflict and controversy about global warming.

EVIDENCE

*Newsweek* – “Global warming is a hoax, or so claim well-funded naysayers who still reject the overwhelming evidence of climate change”; *Rolling Stone* – “Inside the battle over global warming”

POSSIBLE ANSWER

Global warming skeptics are dangerously wrong.

EVIDENCE

*Newsweek* – “Inside the denial machine”; *Rolling Stone* – “You Idiots! Meet the planet’s worst enemies”

**SLIDE #40**



**Special Green Issue:  
A New American  
Revolution, *Vanity  
Fair* magazine  
cover, 2006**

**SLIDE #41**



**Global Warming is  
a Hoax\*,  
*Newsweek*  
magazine cover,  
2007**

**SLIDE #42**



**The Global  
Warming  
Survival Guide,  
*TIME* magazine  
cover, 2007**

**SLIDE #43**



**Changing Climate:  
What You Should  
Know, What You  
Can Do, *National  
Geographic*  
magazine cover,  
2008**

POSSIBLE ANSWERS

Global warming skeptics are dangerously wrong.

EVIDENCE

*Newsweek* - "Inside the denial machine"; *Rolling Stone* - "You Idiots! Meet the planet's worst enemies"

POSSIBLE ANSWERS

Addressing global warming is analogous to military action.

EVIDENCE

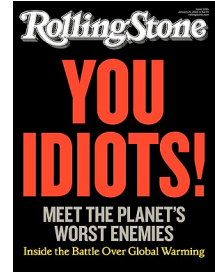
The words "fight" and "battle" - *Scientific American*, *Rolling Stone*; images and text invoking wars - *Vanity Fair*, *TIME*

**SLIDE #44**



**How to Win the War on Global Warming, TIME magazine cover, 2008**

**SLIDE #45**



**You Idiot! Meet the Planet's Worst Enemies, Rolling Stone magazine cover, 2010**

**SLIDE #46**

What trends or developments do you see reflected in these magazine covers?



**Collection of Magazine Covers, 2004-2010**

TEACHER GUIDE

# SLIDE #47: Public Opinion Polls, 2006-2009

→ Project the document

QUESTION

**What patterns do you see in these public opinion polls about global warming?**

POSSIBLE ANSWERS

The public is less concerned about global warming now than in recent years. People are more skeptical about the seriousness of global warming despite growing scientific consensus.

QUESTION

**What do you attribute this change in opinion to?**

POSSIBLE ANSWERS

The economic recessions focused concerns on issues other than global warming. People have become desensitized to the concerns and hype about global warming. Global warming skeptics have effectively influenced the debate. The PR campaign by the energy industries to discredit the scientific evidence has swayed public opinion. Unusual weather patterns such as the huge snowstorms during the winter of 2009-2010 have led people to question the validity of global warming.

SLIDE #47

**What changes do you see in public opinion on global warming?**

*Is there solid evidence the earth is warming?*  
(Pew Center)  
YES: April 2008 – 71% October 2009 – 57%

*How serious a problem is global warming?*  
(Pew Center)  
VERY SERIOUS: January 2007 – 44% October 2009 – 35%

*Global warming is a very serious problem and should be one of the highest priorities for government leaders.*  
(CBS New York Times)  
AGREE: April 2007 – 52% December 2009 – 37%

*The seriousness of global warming is generally exaggerated.*  
(Gallup)  
AGREE: March 2006 – 30% March 2009 – 41%

## Public Opinion Polls, 2006-2009

ADDITIONAL INFO

Contrary to popular belief, severe winter weather like the historic blizzards in Virginia and Washington, D.C. during the winter of 2009-2010 may be related to increased moisture due to rising temperatures..

**TEACHER GUIDE**

# SLIDE #48: Public Opinion about Global Warming, by Political Affiliation

→ Project the document

QUESTION

**What conclusions can you draw from these poll results?**

POSSIBLE ANSWERS

Republicans are much more likely to doubt global warming and to think that it is exaggerated than Democrats and Independents. Skepticism by all political groups is on the rise.

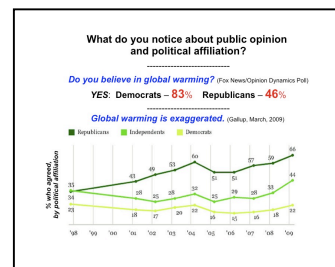
QUESTION

**What would you attribute this to?**

POSSIBLE ANSWERS

Conservative news outlets like *Fox News* promote global warming skeptics, while liberal media sources like *The Huffington Post* tend to promote concerns about global warming. Republicans are uninformed, duped, or stupid. Democrats are uninformed, duped, or stupid. Most of us have already made up our minds about global warming, and the media we read, watch, or listen to tend to reinforce what we already believe. We tend to reject information that contradicts what we already think.

**SLIDE #48**



## Public Opinion about Global Warming, by Political Affiliation

**ADDITIONAL INFO**

According to Don Braman from George Washington University, "People tend to conform their factual beliefs to ones that are consistent with their cultural outlook, their world view." In research on attitudes about global warming for the Cultural Cognition Project, Braman found "it doesn't matter whether you show them negative or positive information, they reject the information that is contrary to what they would like to believe, and the glom onto the positive information" (Joyce, 2010).

TEACHER GUIDE

## SLIDES #49-52: Reflection Questions

For these final reflections, teachers may want to have students respond in writing prior to engaging in a full class discussion. Another option would be to break the class into small groups to discuss the reflection questions, and then share their responses with the rest of the class through discussion, a discussion board, or Wiki. During the full class discussion, teachers may want to list responses on the board.

→	Project the documents
QUESTION	<b>What have you learned from this history about the science, politics, and media representations of global warming?</b>
NOTE	Answers will vary. Teachers should probe for the sources of the students' conclusions and emphasize synthesis of ideas and information rather than for isolated facts and examples.
QUESTION	<b>What are the ways that you can seek more informed truths when evaluating scientific claims in the media?</b>
NOTE	This question was also posed in Lesson 3.
NOTE	Answers will vary. Teachers should help students understand that there is no one simple truth, particularly concerning scientific controversies like global warming. Stress the importance of accessing different sources of information, particularly authorities that conflict with the students' own biases. One cannot seek truth without becoming well informed which necessitates making choices about what is important to study and sources of information.

SLIDE #49

What have you learned from this history about the science, politics and media representation of global warming?

**What have you learned about the science, politics, and media representations of global warming?**

SLIDE #50

What are the ways that you can seek more informed truths when evaluating scientific claims made in the media?

**What are the ways that you can seek more informed truths when evaluating scientific claims in the media?**

QUESTION

**What questions can we ask to help us determine the scientific credibility of information we read, see, and hear?**

POSSIBLE ANSWERS

You may want to brainstorm other questions besides those on this list:

- To what degree has the science been peer-reviewed?
- How many scientists/studies have corroborated the information?
- Is the source credible? What are its biases?
- How do my own biases influence my response to this information?

QUESTION

**What questions can we ask to help us think critically when analyzing media messages?**

POSSIBLE ANSWERS

These questions are taken from the NAMLE *Key Questions to Ask When Analyzing Media Messages*.

- Who made and who sponsored this message?
- What is the purpose of the message and who is the target audience?
- What ideas, information, and perspectives are communicated?
- What has been left out that may be important to know?
- How credible, current, and accurate is the information?
- Who might benefit from, and who might be harmed by, this message?
- How do my own biases influence my understanding of this message?

QUESTION

**What are your views? Is global warming happening? Is it caused by humans? How serious a threat is it? What should we do about it?**

POSSIBLE ANSWERS

Answers will vary, but this is an opportunity for students to articulate and debate their own views and perspectives. As always, they should use evidence to back up their opinions.

**SLIDE #51**

**Identify scientific credibility through asking:**

To what degree has the science been peer reviewed?  
How many of scientists/studies have corroborated the information?

Is the source credible, what is its bias?  
How do my own biases influence my response to this information?

**Think critically about any media message by asking:**

Who produced and who sponsored this message?  
What is the purpose of this message and who is the target audience?

What ideas, information, and perspectives are communicated?  
What has been left out that may be important to know?

How credible, current and accurate is the information?  
Who might benefit and who might be harmed by this message?

How do my own biases influence my understanding of this message?

**SLIDE #52**

**What are your views?**

**Is global warming happening?**

**Is it caused by humans?**

**How serious a threat is it?**

**What should we do about it?**



## A History of Global Warming in Science, Politics and the Media

### Background Reading

Few issues have evoked as much conflicting debate about science as climate change. Global warming skeptics deplore the media-induced “hysteria” over climate change and claim that the facts have been manipulated to promote environmental activism and government regulation. Others have countered with cataclysmic predictions of rising sea levels and mass extinctions unless we take drastic action to reduce greenhouse gas emissions immediately. Both arguments claim to be backed by science and both positions are promoted in the mass media. Is global warming “the greatest scam in history” as argued by radio and TV host Glen Beck, or are the skeptics like Beck “the planet’s worst enemies” as claimed on the January 2010 cover of *Rolling Stone* magazine?



What are your media sources on global warming?

When evaluating the credibility of complex scientific claims we need to examine the scientific evidence, assess our own biases, and ask critical questions about our information. Who produced this message, and for what purpose? What are their biases – including political or commercial interests - that might influence their conclusions? Is the science behind the claims current and accurate? How do our own biases shape our assumptions about conflicting information from different sources?

This reading and the accompanying slides will provide a brief overview of the history of global warming: the science, the politics, and the media constructions. As you read this history, reflect on the ways in which scientific and public understanding of global warming has changed over time, and the role of the media in shaping public opinion. Ultimately it will be the voters, not the scientists, who will determine how we respond to the threat of climate change. An informed and media literate public may be our best hope for the future.

For hundreds of years, people have suspected that human activity could change the climate. Scholars who poured over old texts discovered that deforestation, irrigation and grazing had dramatically altered the landscape of the Mediterranean region, and as a consequence the day-to-day lives of the peoples who lived there. In 1837 a young Swiss naturalist named Louis Agassiz proposed that the earth had been through a series of ice ages in the distant past (Lurie, 1960). Although his theory was at first ill-received by the scientific community, it set into motion the idea that climate could change all by itself, and at times radically. Many scientifically-minded people of the day speculated about the cause of the newly discovered fluctuations in climate including variations in the sun’s heat, volcanoes, and the raising and lowering of mountain ranges.

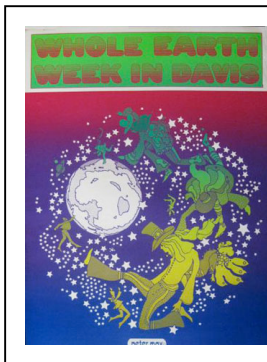
In early 1896 a Swedish scientist, Svante Arrhenius, proposed that changes in the concentration of carbon dioxide in the atmosphere could alter the earth’s surface temperature because of the natural greenhouse effect (Maslin, 2004). He further speculated that humans may raise global temperature by burning fossil fuels like coal. Arrhenius was the first in a long line of scientists to explore the link between human activity and climate change.

Systematic research into climate change began in the 1950s. In 1955 the head of the U.S. Weather Bureau said in a news conference that a significant general rise in average temperature (3.6°F) had been seen in the previous fifty years (Reichelderfer, 1955). In 1957 *The Christian Science Monitor* was one of the first major newspapers to report on the connection between carbon dioxide and rising temperatures. The first paragraph of the article titled, “Are Men Changing the Earth’s Temperature?” framed both the understanding and uncertainty within the scientific community in the 1950s: “Every time you start a car, light a fire, or turn on the furnace, you are joining the greatest “weather experiment” men have ever launched.”(Cowan, 1957, p. 1) The article went on to conclude that scientists had little sense of what consequences the burning of fossil fuels would have on the atmosphere. Climate models at the time were so simple that they could not accurately analyze the impact of perturbations, like anthropogenic CO<sub>2</sub>, on complex systems like the oceans and atmosphere.

What was significant about the publication of this 1957 article?



By the 1960s environmental awareness was growing. The publication of Rachel Carson's seminal book *Silent Spring* in 1962, and concern over urban smog, highlighted the consequences of unchecked technological development. As scientists continued their research of Earth's systems it became increasingly evident that the planet's systems were truly interconnected. By 1968, when the Apollo astronauts sent back the first "whole Earth" photos from space, a new environmental ethic had begun to develop in America.



How does this poster reflect the new ethic about the environment that emerged during the 1960s?

In April of 1970 the first Earth Day was held throughout the country. That same year President Nixon created the Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA). The EPA was charged with protecting human health and with safeguarding the natural environment (air, water, and land), while NOAA aimed to develop a better understanding of the total environment. That year also saw the first international conference on climate change. The group's final report, "A Study of Man's Impact on the Environment," spoke directly to the dangers of greenhouse gas emissions such as carbon dioxide. But the scientific community was far from agreed that the world was warming. Global temperatures had actually dropped between 1940 and 1970, leading some scientists to speculate that we might be entering a new ice age (Weart, 2009).

Despite uncertainty within the scientific community, the mainstream media reported on the potential catastrophes of a coming ice age. In 1975 *Science News* ran this cover article: "Climate Change: Chilling Possibilities."



Why might this popular magazine have highlighted global cooling rather than the scientific uncertainty about climate change in the 1970s?

While some in the media were hyping "global cooling" and scientists were debating climate change, the U.S. economy was dealing with an energy crisis that fueled an economic recession. Spurred by an Arab Oil Embargo, the average price of gasoline had jumped from 39 cents per gallon in May of 1973 to 55 cents per gallon a year later (Frum, 2000). The crisis pushed presidents Nixon, Ford and Carter to develop energy policies that included funding alternative energies such as solar power but also a renewed emphasis on exploiting the nation's extensive coal reserves. Although coal is a particularly dirty energy source, the government's focus at this time was energy independence, not greenhouse gas emissions.

Although a third of Americans had heard of "the greenhouse effect" by 1981 (Weart, 2009), climate change received little attention during the Reagan administration in the 1980s. Despite scarce funding for research, a 1983 EPA report declared that global warming was real and that it could have "catastrophic" consequences for humans in the not so distant future (Seidel & Keyes, 1983). Over the next few years media coverage focused more on other environmental concerns including acid rain, fear of nuclear winter, and a recently discovered hole in the ozone layer.

In 1985 the ozone hole had been discovered by British researchers (Farman, Gardiner & Shanklin, 1985) and for many years it was widely covered by the media. In response to strong public concern over

potential health effects, the global community came together for the first time to solve an environmental crisis. In September 1987 The Montreal Protocol was forged in Canada, with the directive of gradually halting production of ozone-destroying substances across the globe. Media coverage of the hole in the ozone layer taught the public that human activity could change the composition of the atmosphere in a relatively short period of time with potentially catastrophic effects.

Meanwhile new interdisciplinary studies of climate change were indicating that only a few degrees of warming could have severe consequences on natural and human systems, including harming agriculture, killing coral reefs, and increasing the likelihood of diseases. Several climate-related bills were introduced in Congress in 1987, four of which specifically mentioned global warming. A year later President Reagan signed the "Global Climate Protection Act" requiring his administration to assess and create a plan to stabilize the level of greenhouse gas emissions (Pomerance, 1989). Concern throughout the international community became serious enough that the United Nations established the Intergovernmental Panel on Climate Change (IPCC) in 1988.

One year after the IPCC was formed, a group of businesses - most from the U.S. - formed the Global Climate Coalition (GCC) to represent corporate interests on the issue of global warming. Early members of the GCC included Amoco, the American Forest & Paper Association, American Petroleum Institute, Chevron, Chrysler, Cyprus AMAX Minerals, Exxon, Ford, General Motors, Shell Oil, Texaco, and the United States Chamber of Commerce. Over the next decade the GCC disputed claims that global warming was a real threat to humanity and attempted to influence public policy (Shrope, 2001).

As the summer of 1988 approached, the issue of global warming remained below the radar for most of the public until deadly heat waves rocked the nation in June. Many mainstream media sources ran articles and news broadcasts that linked images of withered crops and cracked earth to the possibility of global warming. That same month, James Hansen, a respected atmospheric physicist and the Director of the Goddard Institute of Space Studies, appeared before the Senate for the second time in two years. Hansen waited to testify until a day when temperatures reached record highs. Hansen testified that he was 99% confident that a long term warming trend was underway and that it was likely to bring more frequent storms and floods as well as life-threatening heat waves (Hansen, 1988).

Throughout the rest of the summer scorching weather and droughts continued. Communities imposed water rationing, the level of the Mississippi River fell so low that commerce was paralyzed, and the nation watched much of Yellowstone National Park go up in flames. The summer of 1988 represented a turning point in which the story of global warming had begun to shift from the realm of scientific abstraction to a real possibility that affected everyone from farmers and campers to the owners of beach houses.



What events in the summer of 1988 influenced public opinion on global warming?

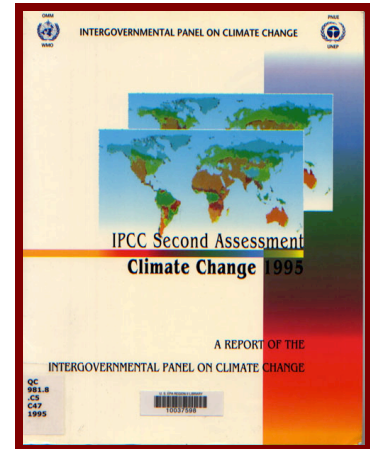
1800	1850	1900	1950	1960	1970	
	1837 Naturalist Louis Agassiz proposes Ice Age theory	1896 Svante Arrhenius proposes CO <sub>2</sub> impact on earth temperature creating "greenhouse effect"		1955 U.S. Weather Bureau reports significant rise in earth's temperature over past 50 years	1958-1961 Charles Keeling collects first quantitative data on atmospheric CO <sub>2</sub> (the Keeling Curve)	1968 Astronauts send images of "whole earth" from space
				1957 <i>Christian Science Monitor</i> article, "Are Men Changing the Earth's Temperature?"	1962 Rachel Carson's <i>Silent Spring</i> published	

Although the focus on global warming caught the attention of the federal government, little was done. George H.W. Bush had issued promises during the 1988 presidential campaign to take real action on the greenhouse effect, but when in office his administration did little beyond funding more climate research. An unintentionally released White House memo at the time argued that the best way to deal with climate change would be to focus on the uncertainties around the climatologist's findings (Wear, 2009).

Despite inaction on the part of federal government, the American public had become more aware of the issue. A poll taken in 1990 showed that 90% of Americans had heard about global warming and 69% felt that the United States should join the international community in limiting carbon dioxide emissions (Wear, 2009). The first IPCC report was released during the same year, but failed to gain media attention since the lack of scientific consensus, due in part to the inconsistencies of climate modeling, had led to ambiguous conclusions. Although the scientific community as a whole was slowly moving towards agreement that global warming was a reality, a few scientists and special interest groups (funded in part by the GCC) continued to speak out about the uncertainties of global warming and the role of humans in creating it (Shrope, 2001). These skeptics appeared often in the media where the drive for ratings and the need to appear "balanced" lead to an emphasis on controversial debate rather than tentative agreement.

In June of 1992 world leaders gathered in Rio de Janeiro, Brazil, for the first "Earth Summit." The International delegates at Rio adopted emission

Who is the IPCC? Are they a credible group, and what was the significance of their 1995 report?



standards that included setting targets for the United States that would require cutting emissions to 1990 levels by the year 2000. The Bush administration disregarded the targets and instead enacted several inexpensive policies to promote energy efficiency (Wear, 2009). In the wake of Rio, the U.S. government remained resistant to serious action against global warming.

Media coverage of global warming dropped after Rio until the IPCC released its second assessment report in 1995. This time the IPCC panel agreed that the world really was getting warmer, and that the warming was probably caused by human activity. Once again media coverage of the issue began to climb, in part because of an upcoming international climate conference to be held in Kyoto, Japan in December of 1997. In the lead-up to Kyoto, groups representing all sides of the debate stepped up their lobbying and media campaigns. Many environmental groups like Greenpeace lobbied for strict emissions standards, while industry-funded organizations opposed any international agreement that included limits on the burning of fossil fuels (Shah, 2002).

1970	1975	1980	1985	1988
<b>1970</b> First International Conference on Climate Change; issued report <i>Study of Man's Impact on Climate</i>	<b>1974</b> British TV documentary on climate change		<b>1985</b> British researchers discover hole in ozone layer	
<b>1970</b> First Earth Day Celebration	<b>1975</b> <i>Science News</i> cover story on climate change emphasizing global cooling	<b>1981</b> 1/3 of U.S. citizens have heard of the "greenhouse effect"		<b>1987</b> The Montreal Protocol halts production of ozone destroying substances
<b>1970</b> EPA and NOAA created	<b>1973-74</b> Arab Oil Embargo and resulting U.S. energy crisis <b>1974</b> Washington Energy Conference <b>1975</b> Energy Policy & Conservation Act	<b>1983</b> EPA reports global warming real, potential catastrophic consequences		<b>1987</b> Reagan signs Global Climate Protection Act

By 1997 when delegates gathered in Kyoto, the United States remained the most powerful holdout against mandatory greenhouse gas reductions. Industries that relied on fossil fuels put pressure on Congress and the administration to oppose mandatory cuts in emissions. In the lead-up to Kyoto, special interests groups (including the GCC) promoted the idea that agreeing to the Kyoto Protocol would result in economic ruin (Shah, 2002). The U.S. Senate voted 95-0 to oppose any treaty that failed to set limits for developing countries such as China and India. In the years that followed Kyoto, media coverage of global warming decreased as attention moved to other issues.

By the end of the 1990s the American public had become increasingly confused by the barrage of conflicting facts, figures, and opinions on global warming, and politicians paid little attention to the matter. During the 2000 presidential campaign, global warming came up only a few times, despite the fact that the Democratic candidate, Al Gore, had been a leading advocate for addressing global warming since his days as a U.S senator in the 1980s. George W. Bush made a campaign promise after he received the Republican nomination to support Kyoto and work to cut greenhouse gas emissions at home. After he became president however, he changed his position on Kyoto and avoided the issue of global warming. Bush's policies reflected the position of industrial groups like the GCC (Vidal, 2005), and he didn't mention global warming or climate change in any State of the Union address until 2007.

In 2001, the same year that Bush had become president, the IPCC released its third report. In much more forceful language this report concluded with certainty that the world was rapidly getting warmer and that strong new evidence pointed to the fact that most of the warming over the past fifty



What messages does this cartoon give about George W. Bush's position on global warming?

years was caused by human activity, in particular the burning of fossil fuels. Improved computer models allowed the panel to confidently conclude that the temperatures would continue to increase. In unambiguous language the IPCC said that they believed there was a 90-99% chance that current rates of global warming would continue (IPCC, 2001). As the international scientific community became more assured that global warming was real and would have severe consequences, some corporations began to change their position on the issue. The GCC lost membership as some businesses shifted their public relations stances to acknowledge the realities of climate change. The organization disbanded in 2002 when President Bush instituted a new energy policy that reflected the interests of GCC members. Exxon-Mobil, the largest of the original members of the GCC, however, continued to fund think tanks and media campaigns that raised questions about the science behind global warming (Vidal, 2005). Again the U.S. media promoted this "debate" even as scientists were moving towards growing consensus on the issue.

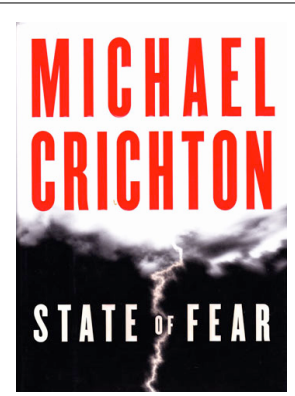
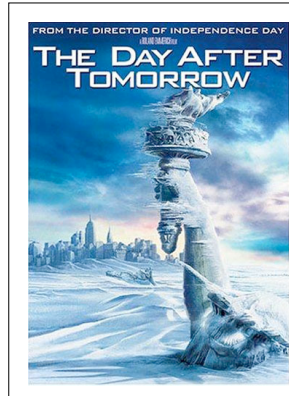
1988	1990	1992	1994	1996	1998
1988 Deadly heat wave	----- 1990s are the warmest decade of the millennium -----				
1988 James Hansen testifies to Senate about warming trend			1993 Greenland ice cores show great climate changes can occur in a single decade		1997 Toyota introduces the Prius, 1 <sup>st</sup> mass-market electric hybrid car
	1989 Global Climate Coalition formed supporting commercial interests and oil companies				1997 International Climate Control Conference, Kyoto, Japan; develop Kyoto Protocol
1988 UN establishes Intergovernmental Panel on Climate Change (IPCC)		1992 First Earth Summit, Rio de Janeiro, Brazil; adopted emissions standards			
	1990 First IPCC Report			1995 Second IPCC Report	

In 2003 a bill sponsored by Republican John McCain and Democrat Joseph Lieberman sought to create a limited carbon emissions trading system, but was met with opposition from both the Bush administration and senators who believed that any restrictions would have detrimental effects on the American economy (Pew, 2003). Although the bill failed to pass, the narrow margin of defeat showed that there was growing support in the federal government to address the issue.

During this time period, popular media tended to focus on the dramatic consequences that might follow a sudden shift in temperature. Popular media picked up on fears over global warming. The 2004 film *The Day After Tomorrow* was the first major motion picture to frame its entire plot around the catastrophic consequences of climate change. The movie portrayed political leaders who had tenaciously held to inaction until it was too late, only to admit their mistakes after entire states had to be evacuated.

Popular media also picked up on the controversy concerning the science of global warming. In 2004, the book *State of Fear* sold 1.5 million copies. The author, Michael Crichton, was a well-known science fiction writer (*Jurassic Park*). Crichton's novel about eco-terrorists who work to create a state of fear in order to advance their agenda regarding global warming included a lengthy author's note that the cause, extent, and threat of climate change is largely unknown and beyond human grasp. A year after the book's release, Crichton was called on by Senator James Inhofe, a widely-reported disbeliever in global warming, to testify at a Congressional hearing on climate change as a "climate expert."

Despite well-known skeptics like Michael Crichton and Senator Inhofe, by 2004 much of the mainstream media had begun to present global warming as a reality. Respected journals like



What messages have been communicated in the popular media about global warming?

*National Geographic*, *Business Week* and *Scientific American* ran cover stories that emphasized the long-term and immediate consequences of climate change. Grass-root organizations lobbied for legislation and emphasized actions that individuals could take to develop "sustainable lifestyles," and the Internet spread awareness of the issue through countless blogs, web pages and videos.

Although the federal government took little concrete action on climate change, groups outside Washington were beginning to shift their stance. In 2006 an influential group of evangelical leaders issued a statement calling for government controls on emissions. The business community also continued to change their policies and some corporations took action to fight global warming. Notably among them was the British oil giant BP. Following their lead, in 2005 General Electric and Wal-Mart announced that they would seek to limit their emissions.

Another turning point in public opinion came in the summer of 2005, as one of the worst Atlantic hurricane seasons on record inundated Florida and

1998	2000	2002	2004
1998 Borehole data confirm extraordinary warming trend	2000 GCC disbanded after membership declines	2001 Warming observed in ocean basins	
1998 Super El Niño causes weather disasters and warmest year on record to date		2001 Phil Cooney, lobbyist for oil industry, named to White House Council on Environmental Quality	2003 Lieberman-McCain Climate Stewardship Act proposing caps on emissions levels, defeated
		2001 Third IPCC Report	

the Gulf Coast. In September 2005 Hurricane Katrina devastated the city of New Orleans. Although most scientists were reluctant to tie Katrina directly to global warming, many Americans saw a connection. Media reports linked global warming to the frequency and severity of hurricanes with pictures of the storm-ravaged Gulf Coast. For many Americans the once abstract idea of global warming now had tangible victims. As the images of Katrina settled into the American psyche, Al Gore released his feature documentary, *An Inconvenient Truth*. In the year following its 2006 release, the lecture/film about global warming amassed the third highest box-office receipts of any documentary in history and won an Academy Award for best documentary film, while his book reached the top of *Amazon.com's* best-seller list. In 2007, he was awarded the Nobel Peace Prize for his work on climate change.

By 2007 political leaders began to sense that the tides were shifting concerning the public attitudes about global warming. Scientific, international, environmental and now business and religious communities were pressuring politicians to take action. In the absence of significant legislation on the national level, state and local governments began debating their own initiatives to limit greenhouse gas emissions. The Supreme Court weighed in when it ordered that the Environmental Protection Agency to reconsider regulating greenhouse gas emissions as a pollutant under the Clean Air Act (NOAA, 2007).

At the same time, scientists were linking extreme weather events to climate change, from floods in India to a heat wave in Europe. The science behind global warming was also becoming clearer as more sophisticated climate models enabled more accurate predictions concerning human impact on the Earth's complex systems. In 2007 the IPCC released its fourth report, unambiguously stating that scientists

What criticisms were leveled against the scientific statements made in Al Gore's documentary film, *An Inconvenient Truth*?



were now confident that the worst was certain to come if action was not taken quickly.

While the scientific community moved towards consensus on the causes and likely consequences of global warming, U.S. public opinion moved in the opposite direction. A March 2009 Gallup poll found a record number of Americans (41%) believed that global warming was “exaggerated” (Gallup, 2009), up from 31% in 1998. A 2006 Pew study had shown earlier that attitudes about global warming varied by political affiliation; only 24% of Republicans said that global warming was “a very serious problem” compared to 54% of Democrats, which may reflect differences in the way the issue was presented in liberal and conservative news media reports.

Though Barack Obama had spoken convincingly about the threat of global warming during the 2008 presidential campaign, lobbying by the energy industry, particularly U.S. coal companies, helped to defeat a 2009 “cap and trade” bill that would have imposed limits on greenhouse gas emissions. Amid great controversy, world leaders met in December 2009 in Copenhagen to try to hammer out an agreement to limit global greenhouse gases. While some leaders felt the summit was a good first step,

2004	2006	2008	2010
	2005 Warmest year on record	2007 U.S. Climate Change Program issues 1 <sup>st</sup> State of Carbon Cycle report	2009 Copenhagen Climate Change Conference
2004 Michael Crichton's book <i>State of Fear</i> published	2005 Hurricane Katrina hits Gulf Coast		
	2006 Al Gore's film <i>An Inconvenient Truth</i> wins Oscar for best documentary film	2007 Al Gore awarded Nobel Peace Prize for his work on global warming	
	2005 Crichton testifies before Congress as a “climate expert”	2007 George W. Bush's first mention of global warming in a State of the Union address	2009 “Cap and Trade” bill defeated by Congress
2004 Film <i>The Day After Tomorrow</i> released, plot revolves around consequences of climate change	2005 Kyoto treaty goes into effect, signed by all major industrial nations except U.S.	2007 Fourth IPCC Report	

others criticized “Hopenhagen” for failing to get any legally binding agreements to limit temperature increases. The summit did result in a commitment by wealthy nations to help developing nations cope with the impacts of climate change.

Enacting policies to address global warming at the national and international levels will be influenced - if not driven - by U.S. public opinion, which is in turn influenced by media coverage. Corporate media, unlike public or independent media, tend to be driven by ratings and advertising. As we have seen in this reading, U.S. media coverage typically emphasizes fearful and dramatic imagery and controversies. In the case of global warming, this has led to both an emphasis on global catastrophe as well as deceptive debates that often ignore scientific theory and evidence.

As students and citizens attempting to understand global warming, we need to tease apart the hype from the science. We need to ask critical questions about the sources of our information. We rely on the media to help inform us about the most important issues of the day but we must be aware that media messages are likely to reflect the political and commercial interests of their producers and sponsors. We also need to evaluate our own biases that may lead us to accept or reject certain views without question. We need to stay open to conflicting claims, while consistently evaluating the credibility and biases of our sources and the accuracy of the science. If the majority of the world’s scientists are correct, we are entering a challenging era of climate change. Our ability to think critically about the mediated messages we receive will help us make truly educated decisions as citizens of an increasingly interdependent world.

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What do each of these covers suggest about the changing representation of global warming in the media between 2005 and 2010?



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