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- Increase funding for agricultural research and investment
- Recognize the important role that women farmers have in producing food in the developing world
- Recognize the role of small farmers in food production and compensate them for carbon sequestration projects

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Questions and Answers about Global Warming and Abrupt Climate Change

Worldwatch has assembled this fact sheet to explain what climate change and global warming are, how these trends affect people and nature, and what people can do to slow warming and climate change.



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The Science of Climate Change

1. What are climate change and global warming, and how are they related?

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A. Global warming refers to an increase in average global temperatures, which in turn causes climate change.

Climate change refers to changes in seasonal temperature, precipitation, wind, and humidity for a given area. Climate change can involve cooling or warming.

Temperature readings taken around the world in recent decades, and scientific studies of tree rings, corals, and ice cores, show that average global temperatures have risen since the industrial revolution began, with increases accelerating over the past few decades. The overwhelming consensus among climate scientists is that most of the increase is due to human economic activity, especially the burning of fossil fuels and deforestation. These activities contribute to a build-up in carbon dioxide (CO₂) and other gases in Earth's atmosphere.

Our atmosphere is made up of gases, such as nitrogen, oxygen, and CO₂, and water vapor, which act like a "blanket" draped around the planet. Some of these gases—such as CO₂, water vapor, and methane—absorb heat, reducing the amount that escapes to space, and increasing global temperatures. This is what is called the "greenhouse effect," and these gases are often referred to as "greenhouse gases."

Without this process, the temperature of Earth's atmosphere would average about 30 degrees Celsius (50 degrees Fahrenheit) colder than it is today, making it difficult for Earth to sustain life as we know it. However, if this blanket were to become too "thick," with too many gases trapping too much heat, Earth would be uninhabitable. In the atmosphere of Venus, for example, a buildup of carbon dioxide has led to a broiling temperature of 500 degrees Celsius.

2. What is abrupt climate change?

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A. While most climate change generally happens slowly over time, there is evidence that episodes of rapid cooling have occurred in the past, with temperatures falling dramatically over periods of 10 to 20 years. Scientists have found evidence that this has happened at least twice within the past 12,700 years.

3. Can abrupt climate change really happen in a matter of days?

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A. There is no scientific evidence that abrupt climate change can happen in a matter of hours or days. What is true is that climate change is real and it's already happening. It's a big problem, but one that we already know how to address on both the societal and individual levels. (See "[How does climate change affect ME](#)" and "[What can I do?](#)")

4. Can global warming lead to an ice age?

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A. According to the best available science, this is very unlikely. Here's why:

Around the globe, a natural ocean "conveyor belt" slowly winds its way through the oceans, helping to regulate our planet's climate. For example, it brings warm waters from the tropics to the North Atlantic, making places like Iceland and Western Europe warm enough to be comfortable.

As Earth's average temperature increases due to global warming, melting glaciers and increased rainfall and runoff will inject additional freshwater into the North Atlantic. The saltiness of the conveyor current is critical for maintaining the flow, and an influx of freshwater, which significantly reduces the salinity of the North Atlantic branch of the current, can slow the movement of the conveyor belt. In theory, a major reduction or halting of this flow—especially if it happened suddenly enough—could destabilize the global climate, causing some regions of the globe to become much cooler, even as average global temperatures continue to increase.

However, the general climate conditions during the two most recent episodes of abrupt cooling were vastly different than they are today. For instance, those episodes were probably triggered by sudden, massive injections of freshwater into the North Atlantic, released when melting ice dams collapsed and vast quantities of freshwater from pent-up glacial lakes were rapidly dumped into the ocean. That can't happen today, because those lakes are all long gone.

There is some evidence that the water in the North Atlantic seems to be growing less salty due to global warming and that the conveyor belt may be slowing. But scientists currently believe that even if part of the ocean conveyor were to fail, it wouldn't be for several decades, and any cooling effects would be overpowered by the continued general warming over the same period.

There is little disagreement that the real concern is climate warming, which is real and will have serious consequences. That's what we need to worry about—and work to fix—right now. ([Learn what you can do to curb climate change.](#))

5. What is the scientific consensus on the causes and consequences of climate change?

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A. Global warming is real. The global average temperature in 2003 was the third hottest since record keeping began in the late 1800s (1998 was the first, 2002 was second), and the ten warmest years on record have occurred since 1990. The 1990s was the warmest decade in the Northern Hemisphere in the past 1,000 years.

What some scientists continue to debate is the extent to which *humans* are affecting global temperatures and causing climate change. But the majority of scientists who study these issues around the world—including those with the World Meteorological Organization, the Intergovernmental Panel on Climate Change (IPCC), and the U.S. National Academy of Sciences—agree that humans are the main force behind the sharp global warming trend of the past century.

Most scientists agree that the climate changes caused by global warming will never be completely predictable, but that they present serious risks—more extreme temperatures (hot and cold), greater storm intensity and frequency, more frequent droughts and floods, and rising sea levels—that warrant immediate efforts to reduce emissions from fossil fuels.

6. What role does human activity play in the current global warming trend?

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A. A variety of heat trapping—or "greenhouse"—gases collect in Earth's atmosphere and keep the planet warm enough to sustain life. This occurs through natural processes. For example, humans and animals inhale oxygen and exhale carbon dioxide (CO₂). Plants absorb CO₂ while growing, but release it as they decompose. The decomposition of cattle manure and peat releases methane, an even stronger, but shorter-lived heat-trapping gas.

Human activities also produce greenhouse gases. Carbon dioxide is released when we burn fossil fuels to produce electricity; heat our homes with oil, coal or gas; drive our cars; or switch on our natural gas stoves for cooking. And landfills release methane into the air as our garbage decomposes. Such activities have significantly increased the quantity of several heat-trapping gases in the atmosphere over the past few centuries. For example, carbon dioxide concentrations in the Earth's atmosphere are 34 percent higher today than they were at the onset of the industrial revolution in 1750—higher than at any time in the last 400,000 years.

Scientists have determined that as atmospheric levels of carbon dioxide have increased, largely due to human activities, the average global temperature has risen significantly. In 2003, the average global temperature was the third highest ever recorded, just slightly below the 1998 and 2002 averages. Scientists predict that average surface temperatures will increase during this century at rates unprecedented in the past 10,000 years.

7. What role do natural forces play in the current global warming trend?

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A. While some scientists continue to believe that global warming could be due to changes in sun spots, natural cycles of warming and cooling, or other factors, most scientists who study this issue now agree that it's extremely unlikely that these changes in temperature are wholly natural in origin. Instead, they believe the warming we are experiencing today is due to rising concentrations of heat-trapping gases that form a "blanket" around Earth. These gases are put into the atmosphere primarily by human activities—particularly the burning of fossil fuels.

8. Will climate change actually bring benefits to some areas?

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A. As a result of global warming and climate change, some regions—such as Siberia—will likely become warmer and more habitable. The growing seasons in some regions will lengthen, as spring arrives earlier and winter frosts set in later.

But betting on the climate is like a game of Russian roulette. Our planet’s climate is a highly complex system that we still don’t fully understand. Likewise, we do not know exactly what the impacts of climate change will be on particular countries or regions. Even an area that welcomes warmer days and lighter jackets might also experience more frequent and intense storm activity, or the arrival of tropical diseases like malaria. At the same time, other places might experience problems like rising sea levels or more extreme heat or cold. And as temperatures rise and become more “comfortable” in some regions of the U.S. or Europe, for example, the number and range of agricultural pests such as insects and diseases will increase, counterbalancing benefits due to warming.

Developing countries will likely be hit hardest as warming continues because they have fewer resources with which to address and adapt to the impacts of climate change. But residents of the United States and other industrial countries will also experience negative consequences, such as increased coastal flooding and more frequent and intense heat waves, droughts, storms, and wildfires as well as the associated economic and health costs.

Most scientists believe that, at least on a global basis, the costs of climate change will far outweigh any benefits that it might bring to a given region.

How Does Climate Change Affect ME?

1. What are some of the impacts we can expect from climate change?

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A. The impacts of climate change will vary from place to place, but we can expect more severe and frequent storms (such as hurricanes and ice storms), heat waves, floods, droughts and wildfires. Warmer temperatures will increase the range of disease-bearing mosquitoes, while also increasing the range and numbers of insects and other agricultural pests, such as weeds. Melting glaciers and expanding sea water (water expands as it warms) will further raise sea level, inundating low-lying islands and flooding coastal areas, while warmer ocean temperatures will kill many if not most of the world’s coral reefs. Such events, in turn, will influence our food supply, our access to clean water, our health, and the economic and social conditions of families and communities around the world.

As ecosystems become further stressed by climate change, species extinction will accelerate. Many of the species lost will be seemingly “insignificant” plants and insects, but we will also lose plants that could cure diseases, and large animals such as polar bears, which rely on winter ice as a platform to hunt for food. Warmer winters could mean reduced snow pack for some regions, reducing water supplies and the output of hydropower dams in the northwestern U.S., for example, and shortening if not eliminating ski seasons in some regions such as New England. The regional or national economic impacts of such changes could be significant.

Many such changes are already being seen around the world. For example, the number of weather-related disasters experienced worldwide every year has been increasing over the past few decades. In the United States, the number of such disasters experienced each decade has risen fivefold since the 1970s. During the course of this century, average global surface temperatures are projected to increase at a rate unprecedented over at least the past 10,000 years, and scientists believe that rising temperatures could further increase the intensity and frequency of extreme weather events.

2. Could climate change ever “wipe us out”?

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A. Past changes in climate have caused glaciers to advance and rivers to freeze. Even regional temperature fluctuations have contributed to the deaths of millions of people and the demise of civilizations, as in the cases of the Irish Potato Famine and the Vikings’ departure from Greenland. But humans can move and adapt far more easily than most other species, and are unlikely to be wiped out—even by abrupt changes.

At the same time, it’s important to realize that even relatively small changes in average global temperature can have significant impacts on weather patterns, agricultural productivity, water resources, and the spread of disease—and thus on millions of individual people. Climate change *will* have a lot of negative impacts, like the extinction of many plant and animal species, the spread of disease carrying insects, more frequent and intense heat waves, floods, droughts, and wildfires. Already, the World Health Organization blames climate change for an estimated 150,000 human deaths every year.

3. Should I be worried about climate change? Will it affect me personally?

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A. Rising global temperature means more than just extra time to wear shorts and sandals. An increase of just a few degrees in average temperature can cause dramatic changes in conditions that are important to the quality of life—and even the Earth’s ability to support life. We may not always see or feel it directly, but climate change affects us all. For one person it might mean paying more for food because flooding or drought has damaged crops. For another it might mean a higher risk of contracting a disease like malaria, which spreads more easily in warm, wet climates. Someone else might face losing her home or even life in a catastrophic weather disaster made worse by global warming.

Almost everyone is vulnerable to the effects of weather-related disasters, but people in poor countries face a far greater threat due to risk factors that include inadequate housing located on flood plains and steep hillsides, weak healthcare systems, and heavy economic dependence on agriculture. It is not uncommon for single weather events, such as tropical cyclones and floods, to kill thousands of people in regions such as South Asia, southern China, and Central America. If the warming continues for years and sea levels rise as predicted, then a great many people will become climate refugees—because their homes and countries will be under water. Rising sea levels will also affect people in U.S. coastal regions, from the Outer Banks of North Carolina and much of Florida, to Louisiana, to California. Already, rising seas are forcing

communities in Alaska to move inland, at very high cost to the state.

What Can I Do?

1. What can we do right now to slow climate change and make a real difference?

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A. While it's impossible for any one individual to prevent global warming, we each have a direct impact on the conditions that allow warming to occur. We can pledge to do our part to conserve energy and pollute less. Whether at home, on our commute to work or school, in the office, or at the store, there are things we can do to lessen our contribution to climate change.

Examples of things you can do include turning off lights and computers when they are not in use, using public transportation or carpooling, driving less, recycling, purchasing energy efficient appliances (in the U.S., look for the Energy Star label) or a more fuel-efficient car, buying food grown locally, insulating your water heater and home, and choosing "green" electricity from a company selling power generated from renewable sources such as the wind or sun, which is now possible in many areas.

For additional practical ways to lessen your impact on global warming see Worldwatch's guide to consumer items, *Good Stuff*, at www.worldwatch.org/pubs/goodstuff/. Also, see the Green Ribbon Pledge at www.greenribbonpledge.org/pledge/index.html, and the Center for a New American Dream's Turn the Tide Campaign at www.newdream.org/turnthetide/. These two sites will allow you to calculate your energy savings and track the positive impact you are having on the planet as you make better choices.

Another important way to act on climate change is by voting and supporting candidates who are serious about reducing greenhouse gas emissions. Also, encourage your current state and national legislators to support legislation that will slow climate change.

Getting Down to Businesses and Governments

1. What role can businesses play in curbing climate change?

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A. There are a number of ways that corporations as well as other large institutions like hospitals, universities, and government agencies can curb the amount of carbon dioxide and other greenhouse gases they emit into the atmosphere. At the production and manufacturing level, for example, companies can save energy and other resources by designing products with fewer materials and less packaging, and by making new products out of recycled materials.

Through their formal purchasing channels, institutions can commit to using energy-efficient office equipment or fixtures, and can use recycled materials such as paper, which require less energy to produce. Some businesses have already committed to reducing their greenhouse gas emissions by purchasing energy from renewable sources, and by choosing fleets of low emission vehicles. Businesses can also provide benefits that encourage employees to use public transportation, and facilitate telecommuting. (For more examples, see www.worldwatch.org/press/news/2003/07/22/.)

Individuals can play an important role in encouraging corporations to reduce their greenhouse gas emissions by patronizing businesses that have committed to polluting less, filing and voting on shareholder resolutions, or participating in letter-writing campaigns or boycotts.

2. What role can governments play in addressing climate change?

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A. Governments can enact laws and tax policies that encourage energy conservation; the development and use of more energy-efficient cars, buildings, and appliances; and the development and use of renewable energy such as solar and wind power and bio-fuels. Governments can also increase investments in public transportation and encourage development patterns that minimize sprawl. Today, the policies of most countries favor the most intensive forms of transportation (such as auto and air travel), and are biased toward conventional energy over renewables, and toward new energy supplies over efficiency measures. But, driven greatly by concerns about energy security and climate change, several countries have begun to promote the sustainable use of energy through green taxes, which shift the tax burden from labor to energy, and by enacting strong policies to advance the development and use of renewable energy and energy-efficient technologies.

3. Which countries contribute the most to global warming?

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A. Wealthier industrial countries contribute the most to global warming since they use most of the world's fossil fuels. Europe, Japan, and North America—with roughly 15 percent of the world's current population—are estimated to account for two-thirds of the carbon dioxide now in the atmosphere. With less than five percent of world population, the United States is the single-largest source of carbon from fossil fuels—emitting 24 percent of the world's total. U.S. automobiles (more than 128 million, or one quarter of the world's cars) emit roughly as much carbon as the entire Japanese economy, the world's fourth-largest carbon emitter in 2000. China, despite being home to one-fifth of the world's population and its heavy dependence on coal, ranks a distant second behind the U.S., emitting 12 percent of the global total. The average person in China produces less than one-eighth as much carbon dioxide as the average American.

4. What is the Kyoto Protocol and what can it do to curb climate change?

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A. The Kyoto Protocol is an international agreement, initially negotiated by government representatives meeting in Kyoto, Japan, in 1997, that sets targets to reduce the greenhouse gas emissions causing climate change. It requires a variety of actions by governments, including specific emission reduction requirements for industrial countries, as well as provisions to assist developing countries in limiting their emissions.

For the Protocol to “enter into force,” it must be ratified by at least 55 nations representing 55 percent of industrial-country 1990 carbon dioxide emissions. As of as of 15 April 2004, 122 countries (representing 44.2 percent of industrial country 1990 emissions) had ratified or acceded to the Kyoto Protocol, including those of the European Union, Canada, Japan, and a host of developing countries. But because the world’s largest emitter—the United States—withdraw from Kyoto, the 55 percent threshold that allows the treaty to enter into force will be crossed only if Russia ratifies the agreement.

According to many studies, enforcing the Kyoto Protocol would protect the environment, reduce air pollution, and create new jobs in industries such as energy conservation, solar energy, wind power, and hydrogen technology, all of which could become powerful growth sectors in the decades ahead.

The Kyoto Protocol, during its first phase (through 2012) is a modest, yet important first step. Perhaps its greatest contribution in the short term will be to put in place mechanisms that can be built on, such as emissions trading and the transfer of clean technologies (such as renewable energy) to the developing world. Even though it hasn’t yet entered into force, it is already spurring corporations and governments to action, from the U.S. to the E.U. to Japan, and many developing countries as well.

5. Why won’t the U.S. ratify the Kyoto Protocol?

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The Kyoto Protocol was signed by the U.S. government during the Clinton Administration in 1997. However, in March 2001, the Bush Administration withdrew its support for the agreement over concerns that the treaty would cause undue harm to the U.S. economy. The treaty requires that the U.S. cut its greenhouse gases to 7 percent below 1990 levels by 2012. The Administration claimed this put too heavy a burden on the U.S. economy, arguing that there was too much uncertainty around climate change to make the economic changes that would be necessary for such emissions reductions. The Administration also argued that the treaty does not require developing nations to curb their emissions.

The vast majority of governments, ranging from Great Britain to Japan, disagree with the Bush Administration, and believe that the Kyoto Protocol represents a moderate step that will not only be affordable, but will actually spur the market for cleaner and more energy-efficient technologies and thereby strengthen economies. Many nations are enthusiastic about the international emissions trading system that would be created by the Protocol, which ironically is an idea that originated in the United States and was adopted in response to the lobbying of the U.S. government. In addition, there is a growing sense that the costs of curbing emissions and reducing the threat of climate change will be far lower than the costs of inaction.

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