

# GLOBAL CLIMATE CHANGE

*The Earth's climate is changing, and people's activities are the main cause.*



Our world is always changing. Look out your window long enough, and you might see the weather change. Look even longer, and you'll see the seasons change. The Earth's climate is changing, too, but in ways that you can't easily see.

The Earth is getting warmer because people are adding heat-trapping gases to the atmosphere, mainly by burning fossil fuels. These gases are called greenhouse gases. Warmer temperatures are causing other changes around the world, such as melting glaciers and stronger storms. These changes are happening because the Earth's air, water, and land are all linked to the climate. The Earth's climate has changed before, but this time is different. People are causing these changes, which are bigger and happening faster than any climate changes that modern society has ever seen before.

## CLIMATE CONCEPTS

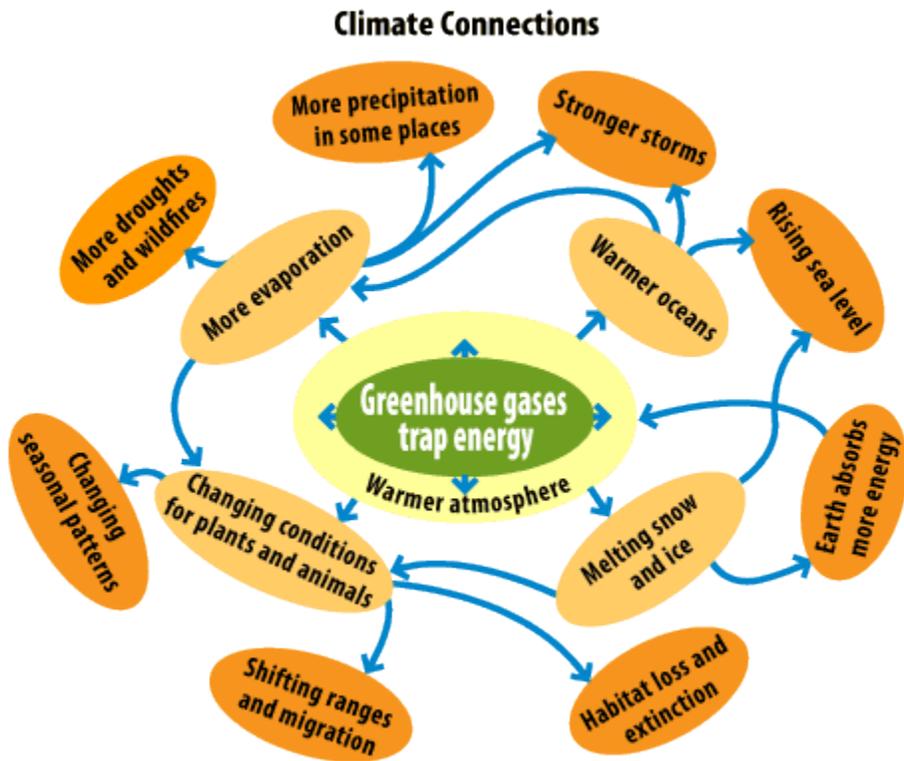


*Climate is what we expect, weather is what we get. – Mark Twain*

Climate refers to the average weather conditions in a certain place over many years. For example, the climate in Minnesota is cold and snowy in the winter, and the climate in Honolulu, Hawaii, is warm and humid all year long. The climate in one area, like the Midwest or Hawaii, is called a regional climate. The average climate around the world is called global climate.

When scientists talk about global climate change, they're talking about the global climate and a pattern of change that's happening over many years. One of the most important trends that scientists look at is the average temperature of the Earth, which has been increasing for many years. This is called global warming.

Rising global temperatures lead to other changes around the world, such as stronger hurricanes, melting glaciers, and the loss of wildlife habitats. That's because the Earth's air, water, and land are all related to one another and to the climate. This means a change in one place can lead to other changes somewhere else. For example, when air temperatures rise, the oceans absorb more heat from the atmosphere and become warmer. Warmer oceans, in turn, can cause stronger storms.



*This diagram shows how global warming can lead to a variety of other changes.*

1. Imagine that last summer was much hotter than usual where you live. Is this a sign of climate change? Yes or no?
2. Imagine that almost every summer for the past decade has been hotter than usual. Is this a sign of climate change? Yes or no?

## TODAY’S CLIMATE CHANGE

More than 100 years ago, people around the world started burning large amounts of coal, oil, and natural gas to power their homes, factories, and vehicles. Today, most of the world relies on these fossil fuels for their energy needs. Burning fossil fuels releases carbon dioxide, a heat-trapping gas, into the atmosphere, which is the main reason why the climate is changing.

Heat-trapping gases are also called greenhouse gases. They exist naturally in the atmosphere, where they help keep the Earth warm enough for plants and animals to live. But people are adding extra greenhouse gases to the atmosphere. These extra gases are causing the Earth to get warmer, setting off all sorts of other changes around the world—on land, in the oceans, and in the atmosphere. And these changes affect people, plants, and animals in many ways.

- **GREEN HOUSE EFFECT:** If it were not for greenhouse gases trapping heat in the atmosphere, the Earth would be a very cold place. Greenhouse gases keep the Earth warm through a process called the greenhouse effect.

The Earth gets energy from the sun in the form of sunlight. The Earth's surface absorbs some of this energy and heats up. That's why the surface of a road can feel hot even after the sun has gone down—because it has absorbed a lot of energy from the sun. The Earth cools down by giving off a different form of energy, called infrared radiation. But before all this radiation can escape to outer space, greenhouse gases in the atmosphere absorb some of it, which makes the atmosphere warmer. As the atmosphere gets warmer, it makes the Earth's surface warmer, too.



➤ **GREEN HOUSE GASES:** Greenhouse gases trap heat in the atmosphere, which makes the Earth warmer. People are adding several types of greenhouse gases to the atmosphere, and each gas's effect on climate change depends on three main factors:

- **How much?**

People produce larger amounts of some greenhouse gases than others. Carbon dioxide is the greenhouse gas you hear people talk about the most. That's because we produce more carbon dioxide than any other greenhouse gas, and it's responsible for most of the warming.

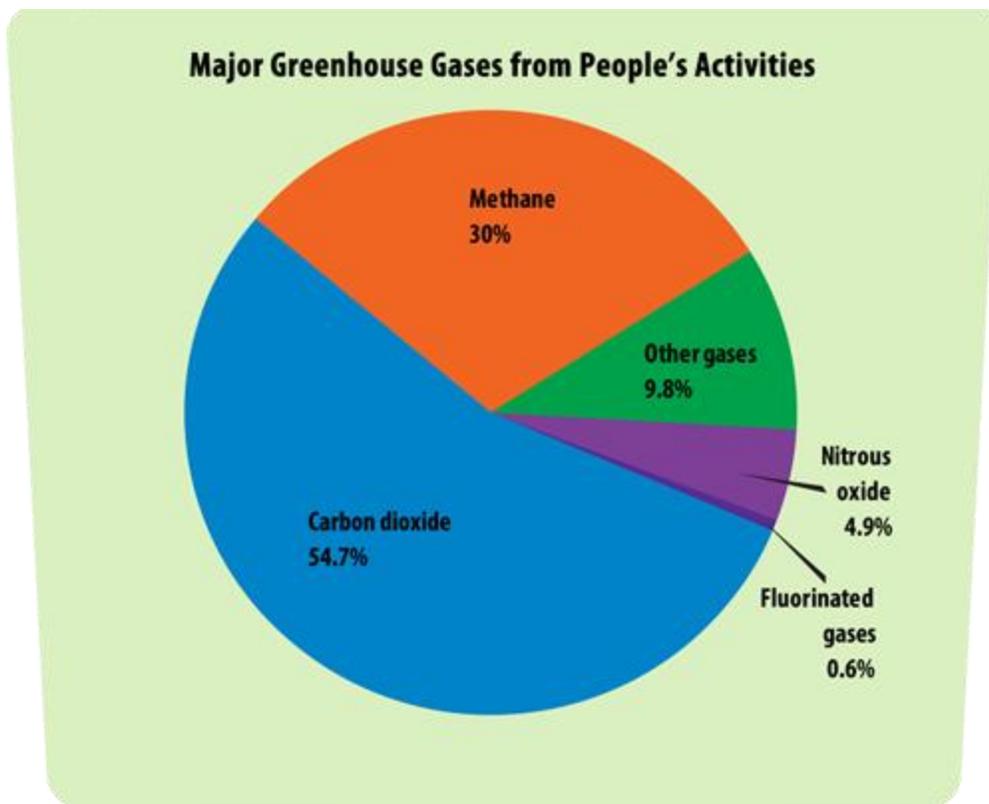
- **How long?**

Some greenhouse gases stay in the atmosphere for only a short time, but others can stay in the atmosphere and affect the climate for thousands of years.

- **How powerful?**

Not all greenhouse gases are created equal! Some trap more heat than others. For example, one pound of methane traps about 21 times as much heat as one pound of carbon dioxide.

Carbon dioxide is the most important greenhouse gas emitted by humans, but several other gases contribute to climate change, too.



## Carbon dioxide



### Where does it come from?

- Burning fossil fuels to produce electricity and heat buildings.
- Burning gasoline and other fossil fuels to run vehicles.
- Cutting down and burning trees or other vegetation.
- Some industrial and manufacturing processes, like producing cement and certain chemicals.

### How long does it stay in the atmosphere?

Anywhere from 50 to thousands of years.

## Methane



### Where does it come from?

- Raising livestock. Certain animals—especially cows and sheep—produce methane as they digest food. Manure also releases methane when it decays.
- Landfills. As trash in a landfill breaks down over time, it releases methane.
- Producing and transporting natural gas. Natural gas is made mostly of methane, which is released if there are even small leaks in gas pipes.
- Mining coal. Methane is often found underground with coal and can be released during mining.

### How long does it stay in the atmosphere?

About 12 years.

### How much heat does it trap?

Over 20 times more heat than the same amount of carbon dioxide

## Nitrous oxide



### Where does it come from?

- Farming practices that add extra nitrogen to the soil, such as applying lots of fertilizer. Certain bacteria that live in the soil turn this extra nitrogen into nitrous oxide.
- Burning fossil fuels.
- Some industrial and manufacturing processes.

### How long does it stay in the atmosphere?

About 114 years.

### How much heat does it trap?

About 298 times more heat than the same amount of carbon dioxide.

## Other gases



Other greenhouse gases that stay in the atmosphere for a long time include chlorofluorocarbons, which are more commonly known as CFCs. CFCs also damage the Earth's ozone layer, so the countries of the world have joined together and agreed to stop using these chemicals. As a result, emissions of CFCs are already decreasing, and they will continue to decrease over time.

## Fluorinated gases



### Where do they come from?

- Leaking coolants. Fluorinated gases used as coolants can be released by leaky refrigerators, freezers, and air conditioners in cars and homes.
- Some industrial and manufacturing processes, like producing computer chips.

### How long do they stay in the atmosphere?

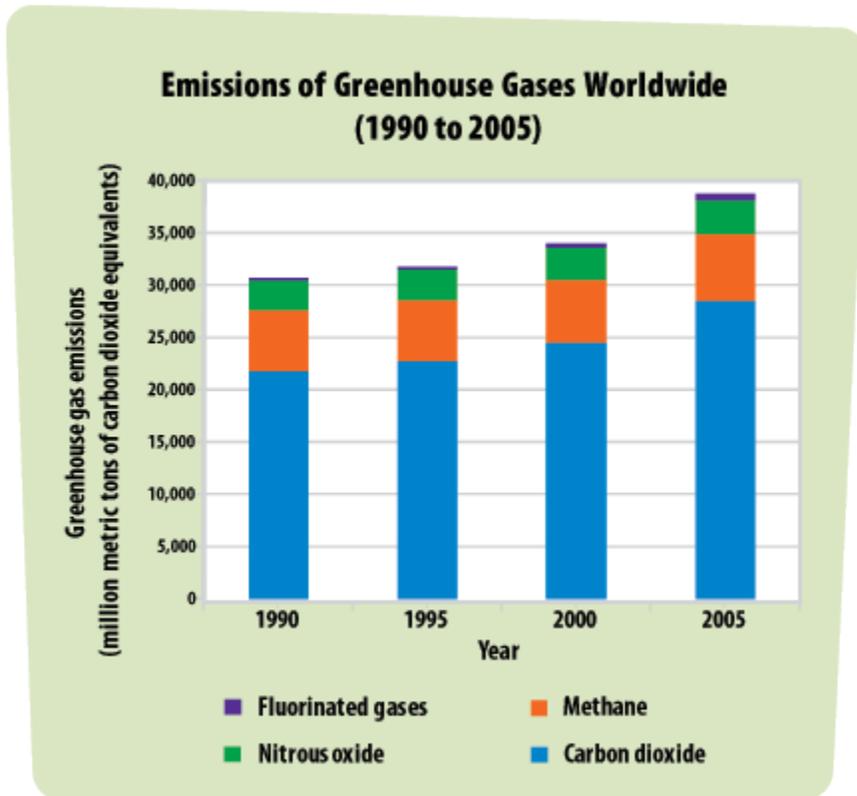
Each gas is different. Some of these gases can last for thousands of years.

### How much heat do they trap?

Depending on the gas, anywhere from a few hundred to 23,000 times more heat than the same amount of carbon dioxide.

Although these gases represent only a small fraction of the greenhouse gases in the atmosphere, emissions are expected to increase faster than the emissions of other greenhouse gases.

These greenhouse gases don't just stay in one place after they're added to the atmosphere. As air moves around the world, greenhouse gases become globally mixed, which means the concentration of a greenhouse gas like carbon dioxide is roughly the same no matter where you measure it. Even though some countries produce more greenhouse gases than others, emissions from *every* country contribute to the problem. That's one reason why climate change requires global action. The graph below shows how the world's total greenhouse gas emissions are continuing to increase every year.



- **All about Carbon dioxide:** Carbon is an element that's found all over the world and in every living thing. Oxygen is another element that's in the air we breathe. When carbon and oxygen bond together, they form a colorless, odorless gas called carbon dioxide, which is a heat-trapping greenhouse gas. Whenever we burn fossil fuels such as coal, oil, and natural gas—whether it's to drive our cars, use electricity, or make products—we are producing carbon dioxide.

The atmosphere isn't the only part of the Earth that has carbon. The oceans store large amounts of carbon, and so do plants, soil, and deposits of coal, oil, and natural gas deep underground. Carbon naturally moves from one part of the Earth to another through the carbon cycle. But right now, by burning fossil fuels, people are adding carbon to the atmosphere (in the form of carbon dioxide) faster than natural processes can remove it. That's why the amount of carbon dioxide in the atmosphere is increasing, which is causing global climate change.

**People are adding carbon dioxide to the atmosphere faster than it can be removed.**