



# Climate Change

## Earth's Atmosphere

Our Earth is surrounded by a blanket of gases called the **atmosphere**. Without this blanket, our Earth would be so cold that almost nothing could live. It would be a frozen planet. Our atmosphere keeps us alive and warm.

The atmosphere is made up of many different gases. Most of the atmosphere (99 percent) is oxygen and nitrogen. Less than half of one percent is a mixture of **greenhouse gases**. Greenhouse gases include water vapor, **carbon dioxide (CO<sub>2</sub>)**, **methane**, **Flourinated or F-gases**, **ozone**, and nitrous oxide. Water vapor is the most common greenhouse gas, but it can have varying levels of concentration depending on the climate.

Carbon dioxide is the gas we produce when we breathe and when we burn wood and fossil fuels. Methane is the main gas in natural gas. It is also produced when once-living matter decays and from animal waste. The other greenhouse gases are produced by burning fuels and from other natural and human activity.

## Sunlight and the Atmosphere

Rays of sunlight (**radiant energy**) shine down on the Earth every day. Some of these rays bounce off clouds and are reflected back into space. Some rays are absorbed by molecules in the atmosphere. About half of the sunlight passes through the atmosphere and reaches the Earth.

When the sunlight hits the Earth, most of it turns into thermal energy (heat). The Earth absorbs some of this thermal energy. The rest flows back out toward the atmosphere. This keeps the Earth from getting too warm.

When this thermal energy reaches the atmosphere, it stops. It can't pass through the atmosphere like sunlight. Most of the heat becomes trapped and flows back to the Earth. We usually think it's sunlight that warms the Earth, but actually it's this contained thermal energy that gives us most of our warmth.

## The Greenhouse Effect

We call this trapping of thermal energy the **greenhouse effect**. A greenhouse is a building made of clear glass or plastic. In cold weather, we can grow plants in a greenhouse. The glass allows the sunlight into the greenhouse. The sunlight turns into heat when it hits objects inside. The heat becomes trapped. The radiant energy can pass through the glass; the thermal energy cannot.

## The Greenhouse Effect

Radiant energy (light rays) shines on the Earth. Some radiant energy reaches the atmosphere and is reflected back into space. Some radiant energy is absorbed by the atmosphere and is transformed into thermal energy (heat) (dark arrows).

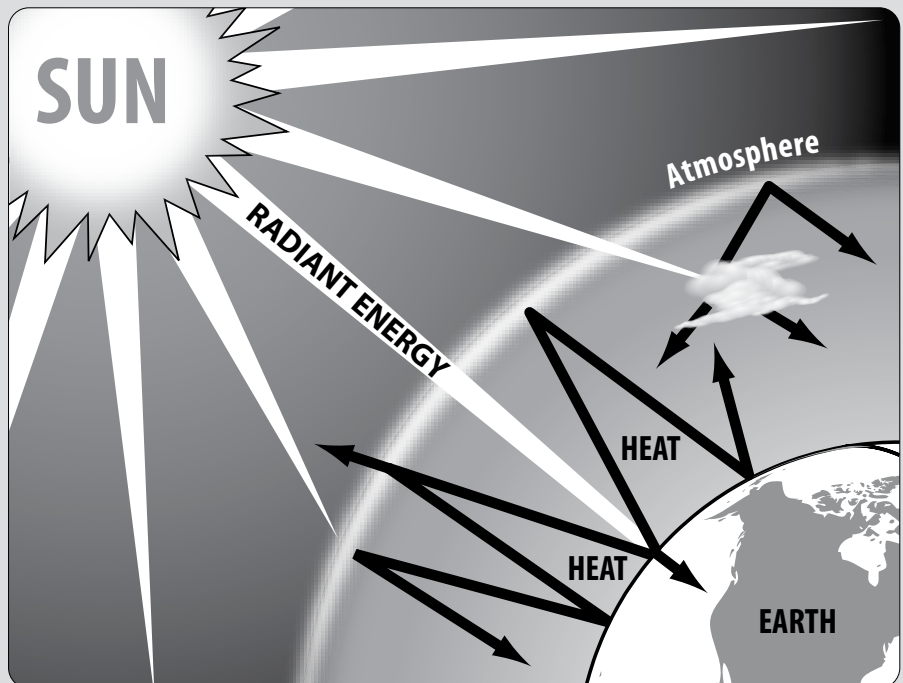
Half of the radiant energy that is directed at Earth passes through the atmosphere and reaches the Earth, where it is transformed into heat.

The Earth absorbs some of this heat.

Most of the heat flows back into the air. The atmosphere traps the heat.

Very little of the heat escapes back into space.

The trapped heat flows back to Earth.



## Greenhouse Gases

What is in the atmosphere that lets light through but traps heat? It's the greenhouse gases, mostly carbon dioxide and methane. These gases are very good at absorbing thermal energy and sending it back to Earth.

In the last 50 years, the amount of some greenhouse gases in the atmosphere has increased dramatically. We produce carbon dioxide when we breathe, when we burn wood and fossil fuels such as coal, oil, natural gas, and propane, and when we develop land. Since the Industrial Revolution, CO<sub>2</sub> levels have risen by almost 50 percent.

Levels of methane have also risen. Some methane escapes from coal mines and oil wells. Some is produced when plants and garbage decay. Some animals also produce methane gas. Worldwide, grazing, plant-feeding animals, like cattle and goats, are one of the largest methane sources.

## Global Climate Change

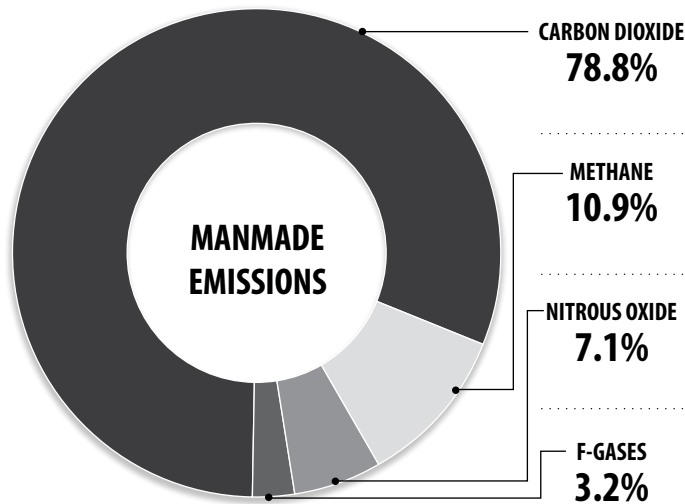
Scientists all over the world are studying the effects of increased levels of greenhouse gases in the Earth's atmosphere. The overwhelming majority of scientists agree the greenhouse gases are trapping more heat in the atmosphere as levels increase. They have collected data to show that the average temperature of the Earth is beginning to rise. This phenomenon is called **global warming**.

Scientists at the National Aeronautics and Space Administration (NASA), have found that the average temperature of the Earth has risen by more than 1°C (1.8°F) since 1880. They assert this increase in global temperature is the major cause of a 21-24 centimeter rise in the sea level over the same period of time.

Climate change experts predict that if the temperature of the Earth rises just a few degrees Fahrenheit, it will cause major changes in the world's climate. They predict there will be more floods in some places and more droughts in others. They believe the level of the oceans will rise as the ice at the North and South Poles melts. They think there might be stronger storms and hurricanes. Some of these effects are already visible today.

Climate experts are urging countries all over the world to act now to lower the amount of carbon dioxide that is emitted into the atmosphere. Scientists and politicians agree that we should reduce the amount of fossil fuels that we burn. The solutions being implemented include reducing CO<sub>2</sub> emissions from transportation and electricity by switching to less carbon-intensive fuels. Experts around the world are trying to find ways to lower greenhouse gas emissions without causing major impacts on the economy.

### U.S. GREENHOUSE GAS EMISSIONS, 2020



Data: U.S. Environmental Protection Agency

\*F-gases include HCFCs, PFCs, and SF<sub>6</sub>, which are used in many different industrial applications, including refrigerants, propellants, and tracer chemicals.

### SOURCES

