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Global Warming: An Introduction

Earth gets most of its heat from the sun. The sun's energy travels through space and enters Earth's atmosphere. Some of this energy is reflected back into space by the atmosphere and clouds, and some of it is absorbed and stored as heat by Earth's surface. When the surface and atmosphere become warm, they radiate heat back into space. This helps keep Earth from becoming too hot or too cold.

What is global warming?

Global warming is the increase in average temperature of Earth's surface. Earth has warmed by about 1° F over the past 100 years. Our planet could be getting warmer on its own, but many scientists think it has happened because of human activities. A warmer Earth means frequent heat waves, rising sea levels, floods, droughts, wildfires, and epidemics.

Causes of Global Warming

Human Activities

The atmosphere contains gases that trap the sun's energy and keep Earth warm. These gases are called greenhouse gases. If the level of greenhouse gases in the atmosphere increases, more heat will be trapped, making Earth warmer. Burning of coal, oil, and natural gas emits large amounts of greenhouse gases into the atmosphere. Deforestation and various agricultural and industrial practices also contribute to an increase in greenhouse gases. This has led to an increase in the atmospheric temperature of Earth.



Volcanic Eruptions

Volcanoes also release large amounts of water and carbon dioxide. Over long periods of time (thousands or millions of years), multiple eruptions of volcanoes can raise carbon dioxide levels enough to cause significant global warming.

Solar Variations

The sun is the main source of energy for Earth's climate system. Small changes in the sun's energy over an extended period can lead to climate changes. Some scientists suspect that a portion of the global warming in the first half of the 20th century was due to an increase in the output of solar energy.

Effects of Global Warming

Scarcity of Water

Change in rainfall patterns is an important effect of global warming. Decreasing rainfall in many places has reduced groundwater. The water in coastal areas has become polluted by rising sea levels. These factors have contributed to severe shortages of drinking and irrigation water. It is estimated that by 2080 more than three billion people could suffer from water shortage. Northern Africa, the Middle East, and the Indian subcontinent will be the worst affected.

Failing Crops

Long stretches of dry seasons caused by reduced rainfall have resulted in crop failures. Cereal crop yields are expected to drop significantly in Africa, the Middle East, and India.

Changing Weather Patterns

Global warming has led to inevitable climate changes. Changing weather patterns have upset physical and biological systems in many parts of the world. Humans, animals, and plants alike have been affected by these changed weather patterns.

Melting Sea Ice

Arctic sea ice continues to decline because of global warming. The current rate of decline is about 8% per decade. This means that by 2060 there will be no Arctic sea ice.



Effect on Animals

The population of many species of polar animals has been reduced over the years. According to a survey, the polar bear population in Canada's western Hudson Bay has dropped by 22% since the late 1980s. Global warming has also shortened the polar bears' hunting season. This has reduced their body mass and led to reduced fertility. Female polar bears now give birth to fewer cubs. Studies have shown striking changes in other marine animals, too. The North Sea codfish has gotten smaller in size, and their reproductive abilities have become weak, too.

Human Deaths

According to the World Health Organization (WHO), five million people fall ill and 150,000 die every year because of climate-related changes. WHO estimates that this figure could double by 2030.

Did you know?

Current computer models have projected the Earth's average surface temperature could rise as much as 4° F to 11° F by the end of the 21st century.



Earth Is Getting Hotter

Earth is getting hotter by about 0.36° F every 10 years. Some scientists believe this is because the sun is burning more brightly. Other scientists have shown that the increased emission of greenhouse gases and other chemicals such as methane, nitrous oxide, and halocarbons is responsible for making Earth hotter. The last 25 years were the warmest for the United States. In Europe, during the summer of 2003, thousands of people died due to extreme temperatures. Nearly 15,000 people died in France alone. Scientists believe that Earth will continue to get hotter and endanger human and animal lives.



Diseases

Increasing temperatures have led to the outbreak of diseases such as malaria and dengue fever in areas that were previously unexposed to these diseases. Warmer temperatures extend the habitable zone for disease-carrying animals such as insects, rodents, and snails. Mosquitoes are particularly sensitive to temperature. They do not breed below 60.8 degrees Fahrenheit. However, climate shifts allow them to survive in formerly inhospitable areas at higher latitudes and altitudes. For example, in South America, the dengue fever virus previously could only be found at elevations of about 3,000 feet or lower, but now it can be found above 6,000 feet.



Rising Sea Level

Warmer temperatures have led to the melting of glaciers and ice shelves, causing ocean water to expand. Most mountain glaciers have been melting over the past 150 years, and most will be gone by the year 2100. Global sea levels have risen by about 4 to 10 inches over the past 100 years, and an increase of another 6 to 33 inches is expected in the next hundred years. In the last 30 years, more than a million square miles of sea ice has disappeared.

Did you know?

The temperature of Earth is expected to increase by 4° F to 11° F by 2100 if we do not reduce greenhouse gas emissions.



Extreme Weather

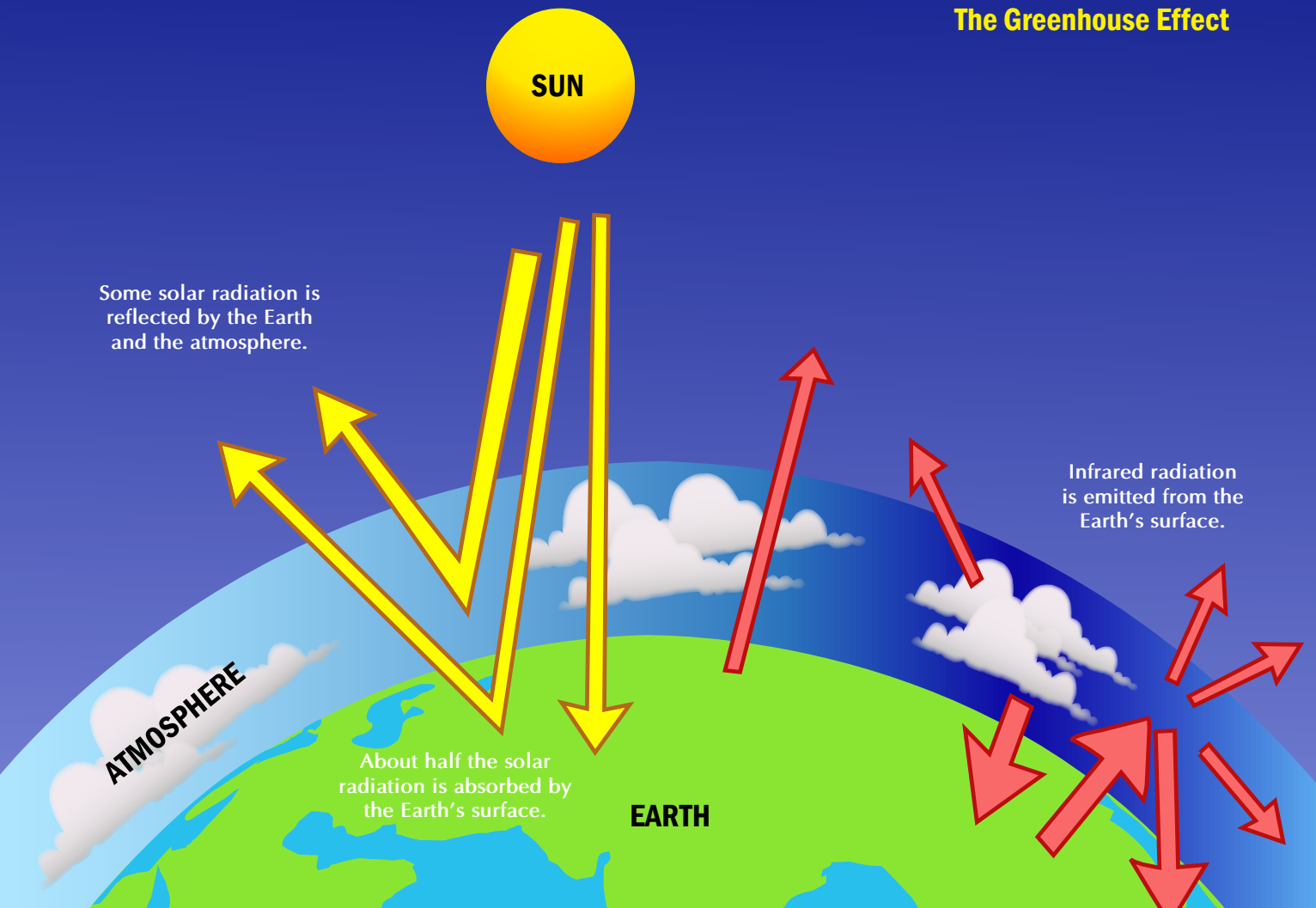
Precipitation has increased worldwide. Heavy downpours and snowstorms in mid to high latitudes have led to severe floods, soil erosion, landslides, and damage to life and property. Increased temperatures have also intensified the drying out of soils in summer. Droughts have become widespread, and the risk of wildfires has become very high. In 2007, there were more than 85,000 wildfires in the United States, and more than 9.3 million acres were burned.

Bleaching Reefs

Coral reefs are one of the most diverse and productive kinds of ecosystems in the world. Our planet's coral reefs are experiencing bleaching caused by the loss of algae on which corals survive. Corals bleach when the surface algae that covers them dies out, causing the corals to appear white. The warming of seawater is one of the reasons for coral bleaching.



The Greenhouse Effect



The Greenhouse Effect

Earth is surrounded by a layer of gases known as the *atmosphere*. Some of these gases, such as carbon dioxide, methane, and ozone, behave like glass in a greenhouse. These gases let the sun's energy pass through but prevent some of the heat from leaving Earth's atmosphere. Without these gases, Earth's temperature would be too cold for most life to exist. These gases are called *greenhouse gases*, and the phenomenon is called *the greenhouse effect*.

Greenhouse Effect Sustains Life

The greenhouse effect helps to sustain life on Earth. Sufficient warmth and light are essential for any living organism. The greenhouse effect has warmed our planet for millions of years. Without the greenhouse effect, Earth would have been a much cooler place, with an average temperature of 0.4°F instead of its present 59°F . Humans, animals, and plants could hardly survive in such severe conditions. The greenhouse effect helps in creating a constant average temperature on Earth's surface.



Enhanced Greenhouse Effect

The *enhanced greenhouse effect* is the increase in the natural greenhouse effect caused by manmade activities. It occurs at a much faster rate than the natural greenhouse effect. The enhanced greenhouse effect traps extra heat in the atmosphere, and that ultimately increases Earth's surface temperature. The enhanced greenhouse effect is an outcome of human activities such as the burning of fossil fuels such as oil, coal, and natural gas and the clearing of forests. Extensive agriculture, especially rice cultivation, produces methane. And the application of fertilizers and burning of biomass produce nitrous oxide, which is a potent greenhouse gas.

Did you know?

The greenhouse effect is stronger on some planets and weaker on others. On Venus, for example, the greenhouse effect is so strong that the surface temperature can reach 900°F .

Impacts of Enhanced Greenhouse Effect

The enhanced greenhouse effect is largely responsible for global warming. Some of the changes caused by the enhanced greenhouse effect:

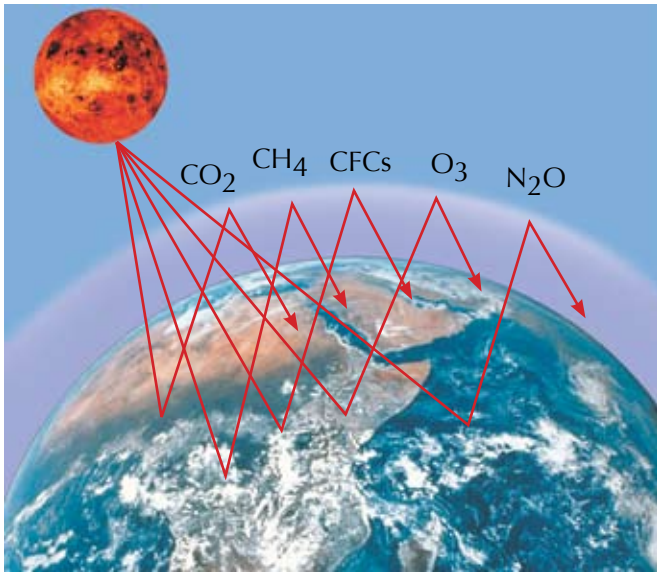
- Climate change
- Melting of glaciers and rising of sea levels
- Submerging of many islands and coastal areas
- More rainfall and floods in certain areas
- Severe droughts leading to hunger and death
- Extinction of many species of plants and animals

The Glass Greenhouse

A greenhouse is an enclosed building made of glass in which plants are grown. Greenhouses can be found in places where temperatures are too cold for plants to grow naturally. The glass in a greenhouse lets in light energy from the sun, which warms the air inside the greenhouse. The warm air inside cannot escape through glass. This keeps the greenhouse warm and protects the plants from the cold outside. Earth's atmosphere also behaves like the walls in a greenhouse. It lets in sunlight but traps heat and prevents it from returning to space.



Greenhouse Gases



Discovering Greenhouse Gases

French mathematician Jean Baptiste Fourier was the first scientist to suggest that the greenhouse effect existed. In 1827, Fourier noted that greenhouse gases kept Earth warm. About 30 years later, British physicist John Tyndall discovered that certain atmospheric gases could absorb and radiate heat. Tyndall showed that water vapor, carbon dioxide, and ozone were the best absorbers of solar radiation. In the 1890s, Swedish scientist Svante Arrhenius and an American, P. C. Chamberlain, independently studied carbon dioxide as a warming gas. They suggested that the burning of fossil fuels could cause Earth's temperature to change.

Water Vapor

Water vapor is water in gaseous form. It is the most abundant greenhouse gas in the atmosphere. Water vapor accounts for about 60% to 70% of the natural greenhouse effect. With the increase in atmospheric temperature, more water is evaporated from lakes, rivers, and oceans. Warm air in the atmosphere can hold more water vapor. Higher amounts of water vapor absorb more heat radiated from Earth and contribute to global warming.

Greenhouse gases are atmospheric gases that trap solar radiation. Greenhouse gases create a natural warm cover for Earth. Some greenhouse gases are primarily natural gases and have always been there in the atmosphere. Others, like chlorofluorocarbons, are manmade and are rarely found in nature. The six major greenhouse gases are water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), ozone (O₃), and chlorofluorocarbons.

Carbon Dioxide

Carbon dioxide is an important greenhouse gas. It is the most prominent contributor to the enhanced greenhouse effect and is responsible for 50% to 60% of the global warming from greenhouse gases produced by human activities. Carbon dioxide enters the atmosphere naturally through the carbon cycle. Human activities have produced more carbon dioxide in recent years. Carbon dioxide is released into the atmosphere by the burning of fossil fuels such as petroleum, natural gas, and coal. The amount of carbon dioxide in the atmosphere has increased by about 35% since the Industrial Revolution in the 1700s. The United States alone produces about 25% of the global carbon dioxide emissions.

