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2025-2026

(( Environmental Pollution ))

Stage (3)

LEC- ((4))

Global warming (Greenhouse Effect) and Ozone  
hole

By

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# Global warming (Greenhouse Effect) and Ozone hole

## Global warming

The Greenhouse Effect is the capacity of certain gases in the atmosphere to trap heat emitted from the Earth's surface, thereby insulating and warming the Earth. Without the thermal blanketing of the natural greenhouse effect, heat leaving the planet with an inhospitable temperature close to  $-19^{\circ}\text{C}$  , instead of the present average surface temperature close to  $14^{\circ}\text{C}$  . The greenhouse effect has warmed the Earth for over 4 billion years.

Now scientists are growing increasingly concerned that human activities may be modifying this natural process, with potentially dangerous consequences. Scientists call this unnatural heating effect, **global warming** and blame it for an increase in the Earth's surface temperature of about  $0.6^{\circ}\text{C}$  (about 1 Fahrenheit degree) over the last nearly 100 years. Without remedial processes, many scientists fear that global temperatures will rise 1.4 to  $5.8^{\circ}\text{C}$ .

## How the greenhouse effects works

The greenhouse effect results from the interaction between sunlight and the layer of greenhouse gases in the Earth's atmosphere that extends up to 100 km above the Earth's surface.

Sunlight is composed of a range of radiant energies known as the solar spectrum, which includes visible light, infrared light, gamma rays, X-rays, and ultraviolet light. When the Sun's radiation reaches the Earth's



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atmosphere, some 25 percent of the energy is reflected back into space by clouds and other atmospheric particles. About 20 percent is absorbed in the atmosphere. For instance, gas molecules in the uppermost layers of the atmosphere absorb the Sun's gamma rays and X rays.

The Sun's ultraviolet radiation is absorbed by the ozone layer, located 19 to 48 km above the Earth's surface. About 50 percent of the Sun's energy, largely in the form of visible light, passes through the atmosphere to reach the Earth's surface. Soils, plants, and oceans on the Earth's surface absorb about 85 percent of this heat energy, while the rest is reflected back into the atmosphere, most effectively by reflective surfaces such as **ice**, and **sandy deserts**. In addition, some of the Sun's radiation that is absorbed by the Earth's surface becomes heat energy in the form of long-wave infrared radiation, and this energy is released back into the atmosphere.

Certain gases in the atmosphere, including water vapor, carbon dioxide, methane, and nitrous oxide, absorb this infrared radiant heat, preventing it from dispersing into space. As these atmospheric gases warm, they in turn emit infrared radiation in all directions. Some of this heat returns back to Earth to further warm the surface in what is known as the greenhouse effect.

### **Types of greenhouse gases and factors causes global warming**

1. Water vapor 2. Carbon dioxide 3. Methane 4. Nitrous oxide 5. Fluorinated compounds 6. Other factors such as volcanoes, evaporation and alterations in atmospheric and ocean circulation

### **Effects of global warming**



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The carbon dioxide, methane, soot, and other pollutants we release into the atmosphere act like a blanket, trapping the sun's heat and causing the planet to warm. Evidence shows that 2000 to 2009 was hotter than any other decade in at least the past 1,300 years. This warming is altering the earth's climate system, including its land, atmosphere and oceans. **Global warming could also affect the following:-**

### **1. More severe weather**

Higher temperatures are worsening many types of **disasters**, including storms, heat waves, floods, and droughts. A warmer climate changing weather patterns in such a way that wet areas become wetter and dry areas drier. According to the National Oceanic and Atmospheric Administration, in 2015 there were 10 weather and climate disaster events in the United States—including severe storms, floods, drought, and wildfires. Elsewhere around the world, lack of water is a leading cause of death and serious disease. At the opposite end, heavier rains cause streams, rivers, and lakes to overflow, which damages life and property, contaminates drinking water, creates hazardous-material spills.

### **2. Higher death rates**

Today's scientists point to climate change as "the biggest global health threat of the 21st century." It's a threat that impacts all of us—especially children and the elderly. In the developed countries, hundreds of heat-related deaths occur each year due to direct impacts and the indirect effects of heat, life-threatening illnesses, such as heatstroke, and cardiovascular and kidney diseases. Indeed, extreme heat kills more Americans each year, on average, than hurricanes and floods.



### **3.Higher wildlife extinction rates**

As land and sea undergo rapid changes, the animals that inhabit them are doomed to disappear if they don't adapt quickly enough. Some will make it, and some won't. According to the Climate Change's 2014 assessment, many land, freshwater, and ocean species are shifting their geographic ranges to cooler climates or higher altitudes, in an attempt to escape warming. They're changing seasonal behaviors and traditional migration patterns, too. And yet many still face "increased extinction risk due to climate change." Indeed, a 2015 study showed that vertebrate species—animals with backbones, like fish, birds, mammals, amphibians, and reptiles—are disappearing 114 times faster than they should be, a phenomenon that has been linked to climate change, pollution, and deforestation.

### **4.More acidic oceans**

The earth's marine ecosystems are under pressure as a result of climate change. Oceans are becoming more acidic, due in large part to their absorption of some of our excess emissions. As this acidification accelerates, it poses a serious threat to underwater life, particularly creatures with calcium carbonate shells or skeletons, including mollusks, crabs, and corals.

### **5. Higher sea levels**

These warmer temperatures resulting from green house effect could melt parts of polar ice and most mountain glaciers. Average temperatures in the Arctic are rising twice as fast as they are elsewhere on earth, and the world's ice sheets are melting fast. By 2100, it's estimated our oceans will be one to four feet higher, threatening coastal systems and low-lying



areas, including entire island nations and the world's largest cities, including New York, Los Angeles, and Miami as well as Mumbai, Sydney, and Rio de Janeiro.

## Ozone hole

### Introduction

Ozone is a triatomic form of oxygen (O<sub>3</sub>) found in Earth's upper and lower atmosphere. The basic equations determining ozone formation in the stratosphere are the "Chapman Reactions."



The ozone produced by the Chapman reactions will absorb UVB radiation and prevent this radiation from reaching the Earth's surface.



### The ozone layer

The ozone layer, situated in the stratosphere about 15 to 30 km above the earth's surface. The stability of the ozone layer in the stratosphere is of particular interest because of its role in absorbing ultraviolet radiation from the sun and preventing much of it from reaching the earth surface.

### What causes the ozone hole?

The ozone layer is being destroyed by nitrogen oxides resulting from supersonic flight. The chemical effect of the nitrogen oxides is very simple. The nitrogen oxides act as catalysis which destroy ozone but are regenerated to repeat the cycle. The cycle involves two reactions.





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Whose net reaction is



The cycle probably destroys about 70 percent of the ozone formed in the stratosphere. It is now realized that nuclear weapons tests in the atmosphere also introduced nitrogen oxides in to the stratosphere in sufficient quantities to have adverse effects.

In the mid-1970s anew threat to the stratosphere ozone layer suddenly appeared that the **chlorofluorocarbons** can also destroy the ozone layer. These compounds are so stable, they are **chemically inert** and do not react with other substances they come in contact with. As a result they float up through the atmosphere unchanged and eventually reach the stratosphere. There they absorb ultraviolet solar radiation and break down, liberating free atomic chlorine (Cl). The chlorine also can destroy ozone by the following reactions:



Cl is not consumed by this reaction. It can destroy thousands of ozone molecules.

Ozone depletion progressing globally except in the tropical zone. A combination of low temperatures and elevated chlorine and bromine concentrations are responsible for the destruction of ozone in the upper stratosphere thus forming a “hole”. In 1985, using satellites, balloons, and surface stations, a team of researchers had discovered a balding patch of ozone in the upper stratosphere. The size of the ozone hole reached to 24 million square meter over Antarctica.

### **Ultra-violet radiation (UVR)**

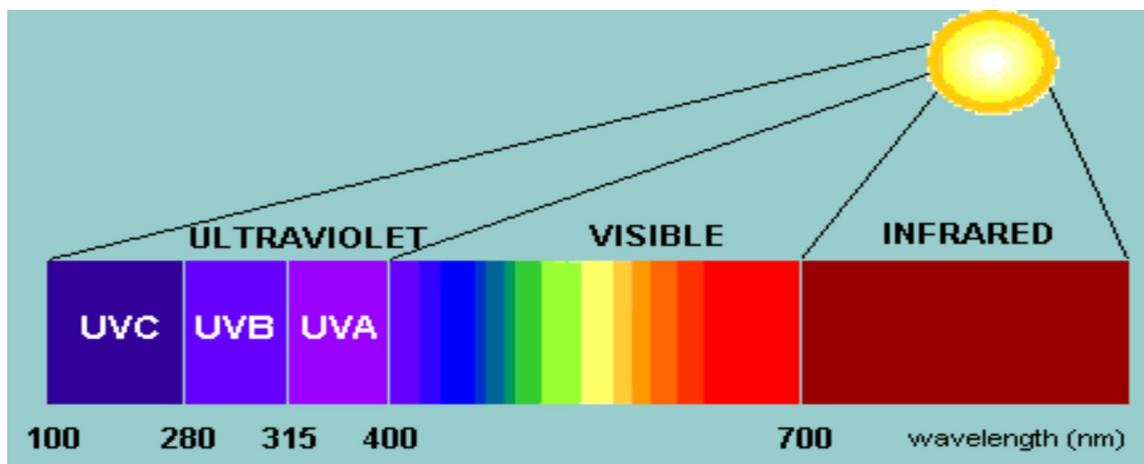


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High energy electromagnetic wave emitted from the sun. It is made up of wavelengths ranging from 100nm to 400nm. UV radiation includes UV-A, the least dangerous form of UV radiation, with a wavelength range between 315nm to 400nm, UV-B with a wavelength range between 280nm to 315nm, and UV-C which is the most dangerous between 100nm to 280nm.

UV-C is unable to reach Earth's surface due to stratospheric ozone's ability to absorb it.



### **Increased ultraviolet radiation leads to the following :-**

- 1- Skin cancer
- 2- Eye damage such as cataracts
- 3- Immune system damage
- 4- Reduction in phytoplankton
- 5- Damage to the DNA in various life-forms
- 6- Possibly other things too that we don't know about at the moment