

Chapter 7

Climate Change, Environmental Phenomena, and the SDGs

By the end of this unit, students will be able to:

- Understand key concepts related to climate change, the greenhouse effect, ozone depletion, and acid rain.
- Explain the greenhouse effect and its connection to climate change.
- Describe the impact of ozone layer depletion, acid rain, and deforestation on the environment.
- Use interactive simulations to visualize environmental phenomena like greenhouse gases and acid rain.
- Analyze real-world climate data to predict future trends and propose sustainable actions.
- Build a foundational understanding of environmental vocabulary through glossaries and study guides.
- Recognize the importance of SDG 13 (Climate Action) and SDG 15 (Life on Land) in addressing global environmental challenges.

7.1 Weather and Climate

Weather and climate are two familiar words in our daily life. Imagine you live in a coastal town. One summer day, you wake up to clear blue skies and a temperature of 32°C. You decide to go to the beach. By midday, you notice the weather changing; dark clouds begin to gather, and the wind picks up. Suddenly, it starts pouring rain, and you have to run for shelter.

This sudden rain is an example of weather—it can change in just a few hours. However, if you look at the records for your town over the years, you'll see that summers are usually hot and often have thunderstorms, indicating the climate of your area.

7.1.1 Weather

Weather is what we experience on a day-to-day basis, like sunny, rainy, or windy conditions. It can change quickly; for example, one morning it might be sunny and warm, but by the afternoon, dark clouds could roll in, and it starts to rain. Weather reports are a part of the daily television news. We also see daily weather reports on the radio, in daily newspapers and even on smartphones. These weather reports contain the following issues:

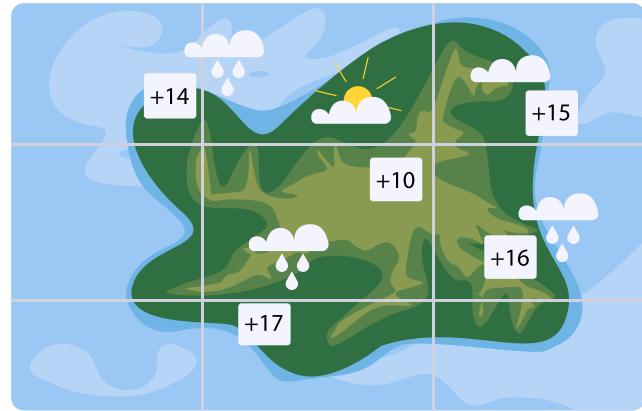


Image: Weather and Climate

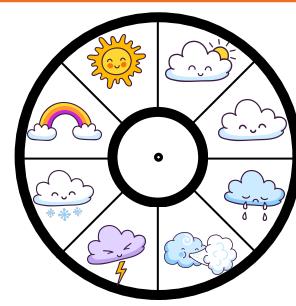


Image: Weather Wheel

- | | |
|---|--|
| <input checked="" type="checkbox"/> Insolation
<input checked="" type="checkbox"/> Rain
<input checked="" type="checkbox"/> Air temperature | <input checked="" type="checkbox"/> Humidity of air
<input checked="" type="checkbox"/> Direction of wind flow
<input checked="" type="checkbox"/> Air pressure etc. |
|---|--|

These are called elements of weather. Depending on the different weather qualities, we can understand what the weather would be like. Scan the QR code to learn more about Weather and climate.



Image: QR Code

7.1.2 Climate

On the other hand, climate is the average weather conditions in a place over a long period, usually 30 years or more. For instance, in a tropical region, the climate is generally hot and humid throughout the year, while in polar regions, it tends to be cold and icy. Temperature and rainfall are the two main elements of knowing about climate. In this case, it is important to keep in mind that all the elements of the weather are also the elements of the climate (insolation, rain, temperature, humidity, etc).



Image: Climate Change

The three things that climatologists consider to explain the climate of an area are:

1. What is the average temperature of that place?
2. What is the average rainfall of that place?
3. What are the changes in temperature and rainfall in different seasons there?

7.2 Climate Change

Climate change is one of the most critical environmental issues facing our planet today. It refers to significant changes in global temperatures and weather patterns over time. Climate change can occur naturally through volcanic eruptions, variations in solar radiation, and other processes. However, over the past century, human-induced climate change has rapidly accelerated due to increased emissions of greenhouse gases like carbon dioxide (CO_2) and methane (CH_4). These gases trap heat in the Earth's atmosphere, leading to rising global temperatures, or what is commonly referred to as "global warming." Deforestation further accelerates this process by reducing the number of trees that absorb carbon dioxide. These activities, combined with the overuse of fossil fuels in industries and transportation, have significantly contributed to global warming.

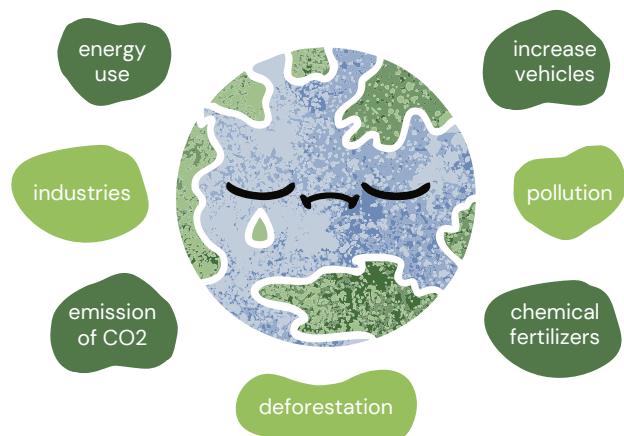


Image: Causes of climate change



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As a result, the Earth faces rising global temperatures, leading to more frequent and intense extreme weather events such as hurricanes, floods, and droughts. The changing climate also threatens biodiversity, as many species struggle to adapt to new conditions, risking extinction. Additionally, melting glaciers and polar ice cause sea levels to rise, posing serious risks to coastal communities and ecosystems worldwide.

Climate change is one of the most significant challenges to achieving global sustainability. Addressing this issue is central to the United Nations' Sustainable Development Goals (SDGs), particularly:

- SDG 13: Climate Action – Urges nations to take urgent action to combat climate change and its impacts.
- SDG 15: Life on Land – Focuses on protecting, restoring, and promoting sustainable use of terrestrial ecosystems, halting biodiversity loss and deforestation.



Image: SDG13



Image: SDG13

7.2.1 The Greenhouse Effect and SDG 13

The greenhouse effect is a process that causes the Earth's atmosphere to become warmer compared to what it would have been without this effect. Imagine you're in a cozy house with big glass windows, just like a greenhouse. During the day, sunlight comes through the windows, making the inside of the house warm and bright. But when the sun goes down, the warmth stays trapped inside because the windows keep most of the heat from escaping. As a result, the temperature inside the greenhouse is higher than the temperature outside. That's how a greenhouse works! In the same way, some gases in the atmosphere increase the temperature of the air by absorbing the re-radiated heat from the sun's heated surface.



Image: Use of greenhouse in cold countries

This process is collectively known as the greenhouse effect. Greenhouse gases are caused by gases such as water vapor, methane, carbon dioxide, nitrous oxide, etc. These gases are called greenhouse gases. The greenhouse effect plays a crucial role in regulating the Earth's temperature. Without it, the planet would be too cold to support life. However, human activities, such as burning fossil fuels—are increasing the concentration of greenhouse gases in the atmosphere, enhancing the greenhouse effect and leading to global warming. Methane is released into the atmosphere because of the decomposition of various plants, animals and living things. This methane gas is 30 times stronger than CO₂.

As cattle rearing increases, the amount of methane gas also increases. Cattle such as cows, goats, sheep, etc. release large amounts of methane gas into the air due to their digestion of food.

When nitrogenous fertilizers are used in agricultural lands, nitrous oxide is produced and spread in the air. This gas is at least 10 times more harmful than carbon dioxide and can cause about 300 times more damage.

Deforestation and felling trees are reducing the number of trees to absorb carbon dioxide from the air. As a result, man-made carbon dioxide is increasing in the air. Some appliances and products (such as, refrigerator, air conditioner, foam, aerosol etc.) emit a type of gas which is called fluorinated gas. The greenhouse effect of this gas is about 23,000 times greater than carbon dioxide. When the amount of these gases increases, the

greenhouse effect in the Earth's atmosphere also increases. As the temperature of the atmosphere rises due to the greenhouse effect, the ice at the two poles of the earth (north and south poles) is melting and raising the sea level. Even many types of disease-causing germs are becoming active. It can increase the outbreak of various diseases.

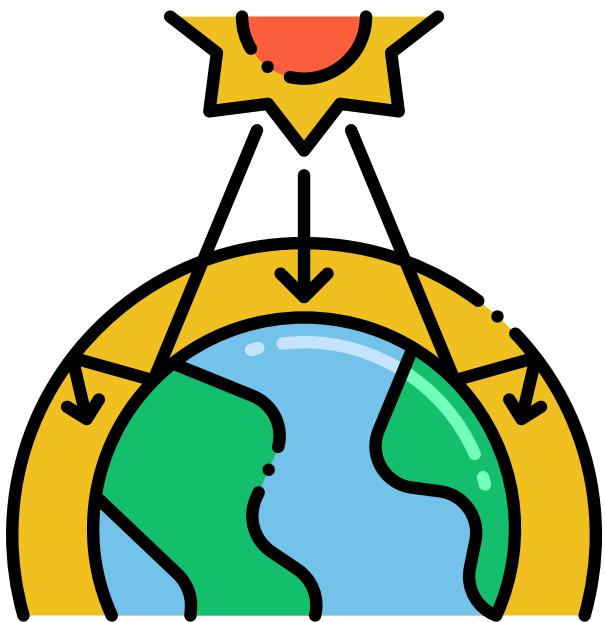


Image: Greenhouse effect

Connection to SDG 13:

The United Nations wants countries to include climate change solutions in their policies and plans. By learning about the greenhouse effect and reducing greenhouse gas emissions, you are supporting SDG 13(Climate Action – Encourages countries to take urgent steps to combat climate change and reduce its harmful impacts), which focuses on slowing down global warming.



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Connection to SDG 15: Life on Land

Protecting forests and biodiversity also helps fight climate change. Forests act like giant air purifiers by absorbing carbon dioxide. When we cut down trees (deforestation), we lose this valuable resource and contribute to global warming. Protecting forests and restoring ecosystems directly supports SDG 15, which aims to stop deforestation and biodiversity loss.

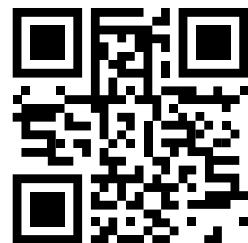


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7.2.2 Acid rain and its effect

If acid or acidic elements are mixed with rainwater, it can be called acid rain. In this case, sulfuric acid or nitric acid mixed with rainwater falls to the ground. Even acidic substances in solid or liquid state can be mixed with snow, fog, hailstones and dust particles. Now the question is how did this acid get into rainwater, fog, snow etc.? Sulphur dioxide and nitrogen oxide are emitted from various man-made and natural sources. Reacting with water vapour,

oxygen and other chemicals present in the air, these gases form sulfuric and nitric acids. Then they mix with water and other substances and fall to the earth's surface. A small portion of Sulphur dioxide and nitrogen oxide is created from natural sources (such as, volcanoes) but most portions come from different man-made sources. The sources are —

- Fossil fuels (such as, oil, gas or coal) used in power generation. 2/3 part Sulphur dioxide and 1/4 part nitrogen oxide of the air are emitted from the power generator.
- Various vehicles and heavy equipment.
- Manufacturers of various products, oil refineries and other factories.

The air can carry polluting gases emitted from these sources and other particles to a great distance and may cause acid rain there. As a result, the polluting countries as well as other distant countries may experience acid rain, which can cause damage to the area. Some of the damages caused by acid rain are:

- It makes life difficult for fish and other aquatic creatures.
- Damages different parts of the plant.
- Destroys the quality (required for plants and other microorganisms living in the soil) of soil.
- Damaged equipment is made of various metals, other installations, and even buildings. Acidic rainwater reacts with metals and concrete and decays them.



Image: Effects of acid rain

7.2.1 Ozone Layer Depletion and SDG 15

The ultraviolet rays emitted from the sun is seriously harmful to the living world including the humans. But this harmful rays cannot reach the earth's surface because there is a covering of a type of gas called ozone surrounding the earth in the atmosphere. This covering of the ozone gas is located at the lower part of the atmosphere to the second layer (stratosphere). This part is known as ozone layer. This layer absorbs the ultraviolet rays coming from the sun and helps the earth's various living things to survive. But this layer is depleting (decreasing) due to the presence of some polluting elements. As a result, harmful ultraviolet rays enter the earth and cause

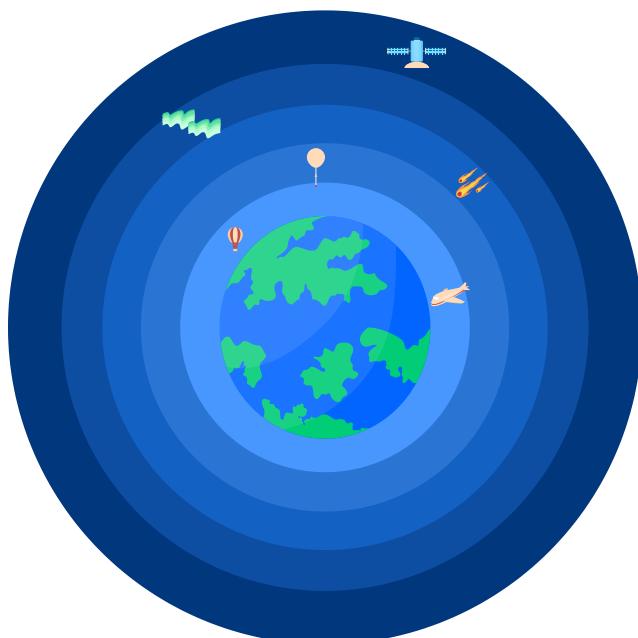


Image: Different layers of the atmosphere



Image: Ozone Hole

damage to the living world. Polluting elements responsible for ozone layer depletion are chlorofluorocarbon, carbon tetrachloride, hydrochlorofluorocarbon and so on. Ozone layer depletion can have the following harmful effects:

Impact on human health: As a result of depletion of the ozone layer, humans come in direct contact with harmful ultraviolet rays. As a result, they suffer from various physical problems such as skin diseases, cancer, reddening of the skin due to sun exposure, cataracts in the eyes, premature aging, poor immune system, etc.

Impact on animals: Direct contact with ultraviolet rays can cause cancer of the eyes and skin of animals.

Impact on plants: Strong ultraviolet rays can slow down plant growth, disrupt food production of plants (it is called photosynthesis) and even disrupt flowering. As a result, the plants of the forest have to bear this harmful effect.

Impact on aquatic and marine life: Tiny plants and animals (known as plankton) face severe damage in the presence of ultraviolet rays. This plankton is a source of food for fish and other aquatic organisms. If these are destroyed, aquatic life will also be damaged.

Connection to SDG 15: Life on Land

The depletion of the ozone layer poses a serious threat to ecosystems and biodiversity, as increased ultraviolet (UV) radiation can damage plant life, aquatic ecosystems, and wildlife. SDG 15: Life on Land focuses on protecting natural habitats and halting the loss of biodiversity, which aligns with efforts to repair the ozone layer. Global initiatives like the Montreal Protocol, which limit the use of harmful chemicals like chlorofluorocarbons (CFCs), are vital in reducing UV radiation's harmful effects. By safeguarding the ozone layer, we contribute to the protection of endangered species and the preservation of ecosystems, ensuring a healthier planet for future generations.

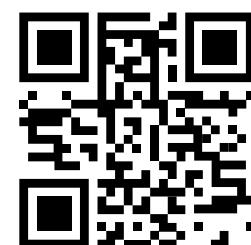


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7.2.3 Man made impacts on climate

Various human activities are having a harmful effect on the climate of the whole world. This damage is mainly caused by greenhouse gas emissions, depletion of the ozone layer, tiny particles (called aerosols) floating in the air, and deforestation by cutting trees. As a result, the temperature and the amount of rainfall are changing in different parts of the world. The following are some of the incidents that may happen because of climate change:

- The polar ice caps are melting, and the sea level is rising.



Image: Man-made impacts on climate

- The number of heavy rains and strong storms is increasing. This is causing floods in some places and decreasing water quality. Again, the chances of getting water in some places are decreasing.
 - The Mediterranean region, the southern and central regions of Europe are experiencing regular hot weather, droughts and forest fires.
 - Other developing and underdeveloped countries, including Bangladesh, are facing various natural disasters (such as storm, heavy rain, flood, tidal surge, droughts, etc.) because of climate change.
 - Many plants and animals are at risk of extinction because they cannot adjust themselves with climate change.
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Exercise