Composition and Structure of the Atmosphere

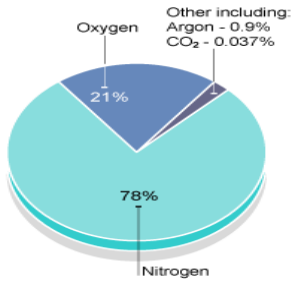
The Earth is divided into three main domains—lithosphere, atmosphere and hydrosphere. The sphere of the Earth where all these three domains interact with each other is known as the **biosphere**.
The atmosphere exists in the gaseous state. Oxygen present in the atmosphere is one of the life-sustaining elements present on the Earth.

Atmosphere – Composition and Functions

The blanket of air which surrounds the Earth is known as the atmosphere. It exists in several layers.

Composition of the Atmosphere

- The atmosphere is made of many gases and solid particles.
- Nitrogen and oxygen are the two major gases which are present in the atmosphere.
- Nitrogen makes up 78% of the total volume of the atmosphere. It is essential for the survival of plants. Plants cannot directly take in nitrogen from the atmosphere. The bacteria present in the soil and roots of plants convert it to a form which can be used by plants.
- Oxygen is the second most available gas in the air. It is also known as the life-giving gas as it is inhaled by human beings and animals and is essential for their survival.
- Gases such as argon, carbon dioxide and water vapour constitute the remaining one percent of the total volume of the atmosphere.
- Carbon dioxide which is present in the atmosphere in small quantities is used by plants to make food. It absorbs the heat and keeps the Earth warm during the nights. The quantity of carbon dioxide remains constant in the atmosphere. However, its amount may increase because of the burning of fuels such as coal and oil. The increase in level of carbon dioxide adversely affects the weather and the climate of the Earth.
- Water vapour is added to the atmosphere by the process of evaporation and transpiration from plants. All forms of precipitation are caused by water vapour present in the atmosphere.
- Many particles such as dust, pollen, ash produced from meteorites and smoke are also present in the atmosphere.



The figure showing the composition of atmosphere

Functions of the Atmosphere

- The atmosphere is one of the most essential elements required for the survival of life on the Earth.
- Water vapour in the atmosphere causes precipitation on the Earth.
- While oxygen present in the atmosphere is the life-giving gas on the Earth, carbon dioxide absorbs heat and keeps the Earth warm during the nights.
- It acts as a blanket which shields the Earth from the harmful radiation of the Sun.

Structure of the Atmosphere

The atmosphere is divided into five layers beginning from the surface of the Earth. These are

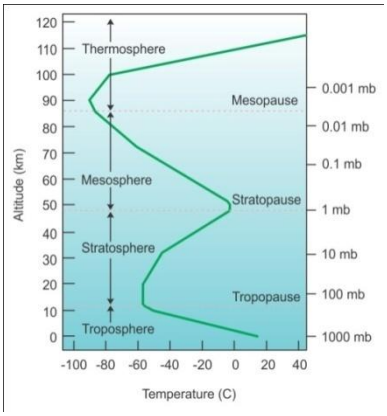
Troposphere

- It is the most important layer of the atmosphere. It extends up to 13 km from the surface of the Earth. The oxygen which we breathe exists in this layer of the Earth.
- The temperature decreases in this layer with the increase in height.

- All the weather phenomena such as rainfall, hail and fog occur here as the clouds are formed in this layer.
- The upper limit of the troposphere is known as the **tropopause**. Temperature may be as low as −58°C at this level.

Stratosphere

- This layer of the atmosphere lies above the troposphere and it extends up to the height of 50 km.
- Aeroplanes fly in this layer, as this layer is free from clouds and other weather phenomena. This layer is also free from water vapour and dust particles.
- The stratosphere contains a layer of ozone gas which protects us from the harmful ultraviolet rays of the Sun.
- In the higher levels of the stratosphere, the temperature increases with height because of the absorption of ultraviolet rays by ozone in the layer.
- The upper part of the stratosphere is known as the stratopause.



Structure of the Earth

Mesosphere

- This is the third layer of the atmosphere and it lies above the stratosphere up to the height of 80 km.
- It is in this layer that the meteorites burn when they enter the atmosphere from space.
- The upper layer of the mesosphere is known as the mesopause.

Thermosphere or Ionosphere

- This layer extends from 80 to 400 km.
- The temperature increases drastically in this layer and can go up to 1,480°C. It is because the molecules in this layer absorb the Sun's ultraviolet rays.
- The thermosphere helps in the transmission of radio waves as the latter is reflected to the Earth by this layer.

Exosphere

- It is the uppermost layer of the Earth. It has a very thin layer of air.
- Light gases such as helium and hydrogen float into space from this layer because of the lack of gravity.
- This layer extends from 480 to 960 km above the Earth.
- Temperature increases with height in this layer. The temperature may well go beyond 5,500°C

Weather and Climate

Weather and climate are two most commonly used words. Weather refers to the state of the atmosphere of a given area for a short period of time. Climate is the state of weather over a large area for a fairly long period of time.

Ozone

Ozone is a form of oxygen which is present in the atmosphere. It is significantly present in the stratosphere. This layer protects the Earth from harmful ultraviolet rays of the Sun. The ozone hole refers to the depletion of the ozone area. A large ozone hole has been depicted over Antarctica. Ozone is depleting from the atmosphere largely because of human activities. Chemicals such as chromium and

bromide are harmful for the ozone layer. Many countries have banned these chemicals. Similarly, chlorofluorocarbons (CFCs) which damage the ozone layer have also been banned. The release of sulphur dioxide as a result of volcanic eruption also depletes the ozone layer.

Global Warming

The rise in the global mean temperature of the Earth is known as global warming. In the 20th century, the global mean temperature has increased by approximately 0.6°C. Rising global temperature leads to changes in the rainfall patterns in the world. While some areas may experience recurrent droughts, some regions may experience regular flooding.

Causes of Global Warming

a) Greenhouse Effect: One of the major causes of global warming is the excessive accumulation of the greenhouse gas, carbon dioxide. Carbon dioxide traps the heat of the Sun and does not allow the part of the heat to go back into space. This has led to an increase in the temperature of the Earth, resulting in global warming.
b) Deforestation: Large-scale cutting of trees has also played an important role in increasing the level of carbon dioxide in the atmosphere. Trees absorb carbon dioxide and maintain the fertility of the soil. Therefore, the large-scale destruction of forest cover results in global warming.
c) Indiscriminate Burning of Fossil Fuels: When fossil fuels such as coal and petroleum are burned, they release a large amount of carbon dioxide in the atmosphere resulting in global warming.

Effects of Global Warming

Main effects of global warming:

Melting of Snow and the Rise in the Sea Level: Global warming has raised the temperature of the Earth. This has resulted in the melting of glaciers and the consequent rise in the sea level. Rise in the sea level results in

- Coastal erosion
- Coastal flooding
- Threat to coastal structures
- Increase in salinity of the estuaries and aquifers

Change in the Pattern of Precipitation: Warming of the atmosphere increases the rate of evaporation and the moisture-carrying capacity of winds. It has been predicted by scientists that the warming of the troposphere and the cooling down of the stratosphere will influence the pattern of precipitation over vast regions in coming years. This could result in the increased level of rainfall at higher latitudes during the summers and winters. During winters, however, the rainfall may decrease at areas of lower latitudes.

Imbalance in Radiation: Life is possible on the Earth because of the balance maintained between the incoming and outgoing radiation of the Sun. Any change in this balance will impact many life forms. It is also feared that global warming may gradually lead to the death of trees replacing them by scrub vegetation, which generally grows in regions experiencing high temperature and scanty rainfall.

Agriculture: It is estimated that global warming may influence the pattern of cultivation. While some crops may witness increased production, other crops may see a decline in their productivity.

Diseases: A phenomenal change in the temperature and level of rainfall may cause the outbreak of many diseases like malaria.

It is thus important to save our environment and reduce the emission of carbon in the atmosphere. We can do this by:

- Using cleaner sources of energy like solar and wind energy
- To use car pooling or public transport
- To save electricity
- By planting trees