

Composition and Structure of the Atmosphere

Introduction

The **atmosphere** is the envelope of gases that surrounds the Earth. It is held in place by the Earth's gravity and is essential for sustaining life. The atmosphere provides oxygen for breathing, carbon dioxide for photosynthesis, protects us from harmful solar radiation and helps regulate the Earth's temperature.

Composition of the Atmosphere

Major Gases

The atmosphere is made up of a mixture of gases.

The major components are:

- **Nitrogen (N₂) – 78%**
- **Oxygen (O₂) – 21%**
- **Argon (Ar) – 0.93%**
- **Carbon Dioxide (CO₂) – 0.04%**
- Other gases such as Neon, Helium, Krypton, Hydrogen and Ozone are present in very small quantities.

Nitrogen is essential for plant growth, while oxygen supports respiration and combustion.

Variable Components of the Atmosphere

Water Vapour

Water vapour is the most important variable component of the atmosphere. Its amount varies from **0% to 4%**.

Importance:

- Formation of clouds
- Rainfall and snowfall
- Regulates temperature
- Maintains humidity

Dust Particles

Dust particles include pollen, smoke, sea salt and ash.

Importance:

- Help in cloud formation

- Scatter sunlight
 - Produce beautiful sunrise and sunset colours
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Structure of the Atmosphere

Atmospheric Layers

The atmosphere is divided into **five main layers** based on temperature.

These are:

- Troposphere
 - Stratosphere
 - Mesosphere
 - Thermosphere
 - Exosphere
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Troposphere

Lowest Layer

The **Troposphere** is the lowest layer of the atmosphere.

Characteristics:

- Extends up to about **8 km** at the poles and **18 km** at the equator.
 - Contains about **75% of the atmospheric gases**.
 - Almost all weather phenomena occur here.
 - Temperature decreases with height at an average rate of **6.5°C per 1000 metres** (Normal Lapse Rate).
 - The upper boundary is called the **Tropopause**.
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Stratosphere

Ozone Layer

The **Stratosphere** lies above the troposphere.

Characteristics:

- Extends up to about **50 km**.
- Contains the **Ozone Layer**.
- Temperature increases with height due to the absorption of ultraviolet (UV) rays by ozone.
- Weather is generally calm.
- Jet aircraft often fly in this layer.

Ozone Layer

The ozone layer absorbs harmful **ultraviolet (UV) radiation** from the Sun and protects living organisms.

Mesosphere

Middle Layer

The **Mesosphere** extends from about **50 km to 80 km**.

Characteristics:

- Temperature decreases with height.
 - It is the **coldest layer** of the atmosphere.
 - Most meteors burn up in this layer.
 - The upper boundary is called the **Mesopause**.
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Thermosphere

Upper Atmospheric Layer

The **Thermosphere** extends from about **80 km to 700 km**.

Characteristics:

- Temperature increases rapidly with height.
 - Contains the **Ionosphere**.
 - Radio waves are reflected by the ionosphere.
 - Auroras (Northern and Southern Lights) occur in this region.
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Exosphere

Outermost Layer

The **Exosphere** is the outermost layer of the atmosphere.

Characteristics:

- Extends beyond **700 km**.
 - Air is extremely thin.
 - Mainly contains hydrogen and helium.
 - Artificial satellites revolve in this region.
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Importance of the Atmosphere

Functions

The atmosphere:

- Provides oxygen for living organisms.
 - Supplies carbon dioxide for photosynthesis.
 - Protects the Earth from harmful UV rays.
 - Burns up meteors before they reach the Earth's surface.
 - Maintains the Earth's temperature.
 - Supports weather and climate.
 - Makes life on Earth possible.
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Environmental Concerns

Air Pollution

Air pollution is caused by:

- Vehicle emissions
- Industrial smoke
- Burning fossil fuels
- Forest fires

Effects include:

- Respiratory diseases
- Global warming
- Acid rain
- Climate change

Ozone Layer Depletion

The ozone layer is being damaged by harmful chemicals such as **CFCs (Chlorofluorocarbons)**.

Its depletion increases the amount of harmful UV radiation reaching the Earth.

Key Points

- The atmosphere is a mixture of gases surrounding the Earth.
- Nitrogen (78%) and Oxygen (21%) are the major gases.
- Water vapour and dust are variable components.
- The atmosphere has five main layers.
- The Troposphere is the weather-making layer.
- The Stratosphere contains the ozone layer.
- The Mesosphere is the coldest layer where meteors burn.
- The Thermosphere contains the ionosphere.

- The Exosphere is the outermost atmospheric layer.
 - The atmosphere protects and supports life on Earth.
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Chapter Summary

The atmosphere is a protective blanket of gases surrounding the Earth. It is mainly composed of nitrogen and oxygen, along with small amounts of other gases, water vapour and dust particles. Based on temperature, it is divided into five layers: the Troposphere, Stratosphere, Mesosphere, Thermosphere and Exosphere. Each layer has unique characteristics and performs important functions. The atmosphere protects life from harmful solar radiation, regulates temperature, supports weather processes and makes life on Earth possible. However, pollution and ozone depletion pose serious threats to the atmosphere and require careful environmental protection.