Table of Contents

Composition of the Atmosphere

The Earth’s atmosphere is a mixture of gases essential for life. The primary gases are nitrogen (78%) and oxygen (21%). Other gases include carbon dioxide, argon, helium, neon, krypton, xenon, ozone, and hydrogen in smaller amounts. Water vapour and dust particles are also present, with water vapour ranging from 0.1% to 4.0%, playing a key role in cloud formation and precipitation. The composition varies with altitude.

Exam Question

Q: What are the main gases present in the Earth’s atmosphere and their importance?

A: Nitrogen and oxygen are the main gases. Nitrogen is important for plants, and oxygen is essential for respiration. Other gases like carbon dioxide help in photosynthesis and

maintaining temperature.

Structure of the Atmosphere

The atmosphere is divided into layers based on temperature and density changes with altitude. The main layers are:

- **Troposphere:** Extends up to 12 km, contains most weather phenomena, air we breathe, and water vapour. Temperature decreases with altitude.
- **Stratosphere:** Extends up to 50 km, contains the ozone layer which protects from ultraviolet radiation. Temperature increases with altitude.
- **Mesosphere:** Extends up to 80 km, temperature decreases with altitude, meteors burn here.
- **Thermosphere:** Extends from 80 to 700 km, temperature rises rapidly due to absorption of solar X-rays and UV rays. Contains the ionosphere and auroras.
- **Exosphere:** The outermost layer with very thin air, light gases escape into space.

Exam Question

Q: Describe the layers of the atmosphere and their significance.

A: The troposphere supports life and weather; the stratosphere protects from UV rays; the mesosphere burns meteors; the thermosphere aids radio communication and shows auroras; the exosphere fades into space.

Weather and Climate

Weather refers to the short-term atmospheric conditions like temperature, humidity, and precipitation. **Climate** is the average weather over a long period, usually 30 years or more.

Elements affecting weather and climate include temperature, humidity, precipitation, wind, and atmospheric pressure.

Exam Question

Q: What is the difference between weather and climate?

A: Weather is the day-to-day condition of the atmosphere, while climate is the average weather pattern over a long period.

Elements of Weather and Climate

- **Temperature:** Varies with insolation and latitude; highest near the equator.
- **Humidity:** Amount of water vapour in the air; higher humidity feels uncomfortable.
- **Precipitation:** Water falling as rain, snow, sleet, etc., influenced by winds, mountains, and seasons.
- **Atmospheric Pressure:** Pressure exerted by air; decreases with altitude; influences wind and weather.
- **Wind:** Movement of air from high to low pressure; includes local winds like sea breeze and land breeze.

Exam Question

Q: Explain the role of temperature and wind in weather changes.

A: Temperature differences cause air to rise or sink, creating pressure differences. Wind moves from high to low pressure, causing weather changes.

Seasons in India

India has a tropical monsoon climate with four main seasons recognized by the Indian Meteorological Department:

- **Winter:** December to early April, coldest in north-west India.
- **Summer or Pre-monsoon:** April to June/July, hottest months vary by region.
- **Monsoon or Rainy:** June to September, dominated by south-west monsoon bringing most rainfall.
- **Post-monsoon:** October to December, dry and clear in north-west India.

The Himalayan states also experience autumn and spring. Traditionally, India has six seasons based on the lunar calendar.

Exam Question

Q: What are the main seasons in India and their characteristics?

A: Winter is cold, summer is hot, monsoon brings rain, and post-monsoon is dry. Himalayan states have additional autumn and spring seasons.

Monsoon

Monsoon refers to the seasonal reversal of wind direction. The south-west monsoon (summer monsoon) blows from sea to land from June to September, bringing heavy rainfall due to low pressure over heated land and high pressure over cooler oceans.

The north-east monsoon (winter monsoon) blows from land to sea from October to February, generally dry but causes rainfall on the south-eastern coast of India.

Monsoon is vital for agriculture, water supply, and daily life but can cause floods or droughts if irregular.

Exam Question

Q: How does the south-west monsoon affect India?

A: It brings most of the annual rainfall, supporting agriculture and water resources.

Climate Change and Carbon Footprint

Climate change is the long-term alteration of weather patterns caused mainly by human activities like burning fossil fuels and deforestation, increasing greenhouse gases and global temperatures.

Consequences include floods, droughts, melting glaciers, rising sea levels, and loss of biodiversity, affecting health, agriculture, and livelihoods.

Reducing carbon footprint involves saving energy, using renewable sources, protecting forests, and adopting sustainable lifestyles.

Exam Question

Q: What is climate change and how can we reduce our carbon footprint?

A: Climate change is the long-term change in weather due to human activities increasing greenhouse gases. We can reduce carbon footprint by conserving energy, using renewable energy, planting trees, and reducing waste.

Punjab Floods 2025 Case Study

In 2025, Punjab experienced severe floods due to heavy monsoon rains and swollen rivers Satluj, Beas, and Ravi. The floods caused loss of life, displacement, damage to agriculture, infrastructure, and health issues.

Causes:

- Natural: Heavy monsoon rains intensified by western disturbances, high river flows.
- Human-made: Weak embankments, construction near rivers, silt accumulation, delayed warnings.

Effects:

- Loss of lives and displacement.
- Damage to crops, farms, roads, and buildings.
- Health problems due to standing water.

Exam Question

Q: What were the causes and effects of the Punjab floods in 2025?

A: Causes included heavy rains and weak embankments. Effects were loss of life, damage to property, crops, and health issues.

Solved Examples

Example 1: Explain why the troposphere is important for life on Earth.

Answer: The troposphere contains the air we breathe, water vapour, and weather phenomena like rain and clouds, which are essential for life.

Example 2: Describe how the south-west monsoon forms.

Answer: During summer, land heats faster than the ocean, creating low pressure over land and high pressure over the ocean. Winds blow from ocean to land, bringing moist air and rainfall.

Practice Set

Easy

- What are the main gases in the atmosphere?
- Define weather and climate.

Moderate

- Explain the role of the ozone layer.
- What causes wind?

Challenging

- Discuss the impact of monsoon on Indian agriculture.
- Describe the causes and effects of the Punjab floods in 2025.

Answer Key

- **Main gases:** Nitrogen and oxygen.
- **Weather and climate:** Weather is short-term atmospheric conditions; climate is long-term average.
- **Ozone layer:** Protects from harmful ultraviolet radiation.

- **Wind:** Movement of air from high to low pressure.
- **Monsoon impact:** Provides essential rainfall for crops and water supply.
- **Punjab floods causes and effects:** Heavy rains and weak embankments caused floods; effects included loss of life and damage.

Quick Reference

- **Atmosphere:** Layer of gases surrounding Earth.
- **Troposphere:** Lowest layer where weather occurs.
- **Monsoon:** Seasonal wind reversal bringing rain.
- **Climate change:** Long-term weather changes due to human activity.
- **Carbon footprint:** Greenhouse gases released by human activities.

Glossary

- **Atmosphere:** The layer of gases surrounding the Earth.
- **Carbon footprint:** Total greenhouse gases emitted by human activities.
- **Climate:** Average weather conditions over a long period.
- **Humidity:** Amount of water vapour in the air.
- **Monsoon:** Seasonal reversal of wind direction.
- **Ozone layer:** Layer in the stratosphere that protects from UV rays.
- **Precipitation:** Water falling from clouds as rain, snow, etc.
- **Troposphere:** Lowest atmospheric layer where weather occurs.
- **Wind:** Movement of air from high to low pressure.