

5

Composition and Structure of Atmosphere

Lesson Plan

Contents

- ▶ An overview of the atmosphere, its purpose and components
- ▶ To understand the significance of the atmosphere and how we affect it

Objectives

- ▶ To understand the important role of the atmosphere around us
- ▶ To learn its composition, structure and purpose
- ▶ To know its importance for us
- ▶ To understand how we have created global warming and the impact it has on our lives

■ Teacher's Aids

- ▶ Globe
- ▶ Pictures, atlas and wall maps
- ▶ Blackboard
- ▶ Internet

■ Tips for Teacher

- ▶ Explain what we mean by atmosphere and its purpose
- ▶ Explain the different components and structure of the atmosphere, along with their importance
- ▶ Explain global warming, how it is caused, the damage it creates, and how it should be reduced or contained

■ Background and Reading

- ▶ Read the lesson aloud and explain, sharing the aids, etc., pausing to examine and explain the data in the boxes.
- ▶ Particularly focus on the significance of atmosphere on Earth—the only planet known to sustain life—and what we can do to keep it clean and healthy.

Atmosphere

- ▶ Atmosphere—the vast blanket of air surrounding the Earth—upper limit up to 1000 km above the surface—total weight: about 500 million metric tonnes
- ▶ Held close to Earth by force of gravity—about 50% of total mass of air found within 5 km from the surface—density decreases as you go higher, making breathing more difficult
- ▶ Protects us from harmful effects of Sun’s rays [heat and radiation]—life on Earth depends on it for survival—oxygen and nitrogen gases—helps retain Earth’s warmth—also helps circulation of water vapour
- ▶ Without it, we will be baked by Sun’s heat in daytime and frozen at night—air makes Earth a unique planet: temperature makes it suitable for growth of life

Composition of the Atmosphere

- ▶ Mixture of many gases, tiny dust particles, smoke and water vapour—composition not fixed—varies from place to place and season to season.
- ▶ In lower layers, composition of dry air is fixed.
- ▶ Main gases—nitrogen and oxygen [99%]. Other gases: Carbon dioxide, helium, ozone, argon and hydrogen. Also has varying quantities of dust particles and water vapour.
- ▶ Nitrogen—most abundant gas about 78% of clean, dry air—colourless inert gas, dilutes oxygen and slows down process of oxidation—plants need it for survival—cannot get it directly so obtain it from the soil.
- ▶ Oxygen—second most important gas [21%]—found only in lower layers of atmosphere—needed for breathing—share of oxygen in atmosphere remains constant as plants produce it during photosynthesis.
- ▶ Carbon dioxide—needed by plants for survival—humans and animals release it—almost equal to amount required by plants—this balance disturbed by burning fossil fuels like coal and petroleum.
- ▶ Water vapour—quantity in atmosphere depends on temperature—added by evaporation from water bodies and transpiration from vegetation and respiration from animals—water vapour responsible for all forms of condensation and precipitation.
- ▶ Dust particles, salt particles, pollen, ash from volcanic eruptions, smoke, etc.—found in lower layers only—act as nuclei for water vapour to form raindrops around them—scatter sun’s radiation during sunrise and sunset.

Structure of the Atmosphere

- ▶ Scientific and systematic knowledge of atmosphere made available by radars and satellites—temperature and density of air vary from place to place and season to season.
- ▶ Layered structure of atmosphere—each with its own characteristics—upper layer presses lower layer—therefore upper less dense than lower one—estimated that about 90% of the total mass of atmosphere lies within a height of 20 km from Earth’s surface.
- ▶ Based on temperature and atmospheric pressure—five layers starting from Earth’s surface: troposphere, stratosphere, mesosphere, thermosphere and exosphere.

- ▶ Troposphere–most important layer–lowest and densest–height varies from 8 km at Poles to 18 km at Equator– $\frac{3}{4}$ of total mass of atmosphere found in this layer–air we breathe available only in this layer.
- ▶ Temperature of air decreases with height–almost all types of weather phenomena [rainfall, fog, clouds, hailstorms, etc.] occur in this layer–water vapour and dust particles only found in this layer–this layer is heated from below–its upper limit is called tropopause.
- ▶ Stratosphere–above tropopause, extends to about 50 km above sea level–temperature at lower part almost constant.
- ▶ Air generally thin, cold and dry–strong winds called jet stream–blows horizontally from west to east.
- ▶ Almost free from various weather phenomena–lower layer completely free of water vapour and dust particles–hence ideal for jet aircraft–upper limit called tropopause.
- ▶ Important features: Presence of ozone in lower part–can absorb incoming ultraviolet rays of solar radiation–ozone layer essential for sustaining life–scientists have observed that there is a decline in the total global ozone–cause global warming.
- ▶ Mesosphere–above stratosphere to height of 90 km above sea level–temperature decreases at upper limit to -110° C.
- ▶ Meteors burn up on entering this layer from space–upper layer called mesopause–after this, the temperature increases.
- ▶ Thermosphere–above mesosphere up to 400 km above sea level–temperature increases rapidly with height.
- ▶ Ionosphere a part of this layer which contains electrically charged particles called ions–ions reflect radio waves back to Earth’s surface enabling wireless communication.
- ▶ Exosphere–uppermost layer of atmosphere–400 km to 1500 km above sea level–air very thin as main gases present are hydrogen and helium.
- ▶ Temperature increases with height may reach up to 5000° C–this sphere merges with interplanetary space.

Importance of Atmosphere

- ▶ Extremely important for growth and development of life on Earth:
 - Protects us from the Sun’s harmful ultraviolet rays
 - Controls extremes of daytime and night time temperatures through the greenhouse effect
 - Protects us from meteors from outer space
 - Weight of air and pressure it exerts keeps it pressed down in contact with land and water
 - Responsible for change in the weather
 - Gases like oxygen and carbon dioxide make life on Earth possible
 - Ionosphere makes wireless and long distance communication possible
 - Sound waves can only travel through air
 - Sun’s energy makes the atmosphere dynamic.

Global Warming – A Case Study

- ▶ Increase in carbon dioxide, methane, etc., causes energy imbalance in atmosphere – increase heat on Earth – carbon dioxide creates a greenhouse effect, trapping heat radiating from Earth – hence called greenhouse gas.
- ▶ Fossil fuel based industries increase carbon dioxide in atmosphere – it acts like glass in a greenhouse in the lower layers, allowing entry of sun's rays but blocking radiation from the greenhouse back into the atmosphere.
- ▶ When levels of greenhouse gases increase on Earth, especially of carbon dioxide [car fumes or factory smoke] – heat retained increases average temperature of air – called global warming – study shows increase in global mean temperature leading to climate change.
- ▶ Expected outcomes: (i) Normal precipitation in Africa and Gulf Coast and USA below normal; (ii) Tropical Belt precipitation above normal; (iii) No rainfall in some areas; (iv) Causes snow and ice in coldest parts to melt; (v) Flooding in some parts and drought in others; (vi) Over the last 100 years, ice reserves have melted causing sea level to rise by 10-20 cm; causing floods at coastal areas; (vii) Many areas will be submerged under sea water.

Assessment Corner

Oral Assignment

- A. Ask for answers at random from the students. Confirm the right answers. Let them write down the correct answers if they like in their books.

Written Assignment

- B–F. The teacher has two options – (i) Either do these exercises orally first and then ask the students to write them down. OR (ii) Ask the students to write the answers on their own. Then the teacher can announce the correct answers to the students and can ask their partners to cross-check them.

In either case, the answers can be written as homework and the teacher can check them in the class.

Think Tank

- G. **HOTS questions:** Discuss the questions in the class and let the students write the answers to G and H as homework. Teacher should assess individual work.