

Atmosphere

[UPSC Notes]

Structure of Atmosphere is usually defined into five layers based on the temperature and density. To fully understand structure of atmosphere for the upcoming UPSC exam, aspirant must understand the composition of atmosphere along with layers of the atmosphere.

The atmosphere is a mixture of different types of gases such as nitrogen, oxygen, carbon dioxide, hydrogen, helium, etc. It also includes water vapor and dust particles. The atmosphere is mainly made up of the two gases, Nitrogen and Oxygen.. Other gases like organ, carbon dioxide, hydrogen, helium, etc. form the remaining part of the atmosphere.

The atmosphere, in addition, contains huge numbers of solid and liquid particles, collectively called aerosols. The proportion of gases changes in the higher layers of the atmosphere. Carbon Dioxide and water vapor are found only up to 90 km from the surface of the earth and oxygen will be almost in negligible quantity at the height of 120 km. The atmosphere keeps the temperature over the earth's surface within certain limits and in absence of the atmosphere, extremes of temperature would exist between day and night. The atmosphere also protects us from the harmful ultraviolet rays and in a way regulates the entry of solar radiation into the earth's atmosphere

Composition of the Atmosphere

The atmosphere is made up of a mixture of many gases that vary across the structure of the atmosphere. The gases in the atmosphere are composed of neutral, uncharged particles. The proportion of gas changes in the higher layers of the atmosphere, such as oxygen is negligible at the height of approx 120km. The Carbon Dioxide and water vapor are found only up to the height of 90 km from the surface of the earth.

Nitrogen and Oxygen constitute about 99% of the clean dry air. The remaining gases are mostly inert and constitute about 1% of the atmosphere. Besides these gases, large quantities of water vapor and dust particles are also present in the atmosphere.

Gases of the Atmosphere

The table below represents the gases of the atmosphere in volume by their percentage.

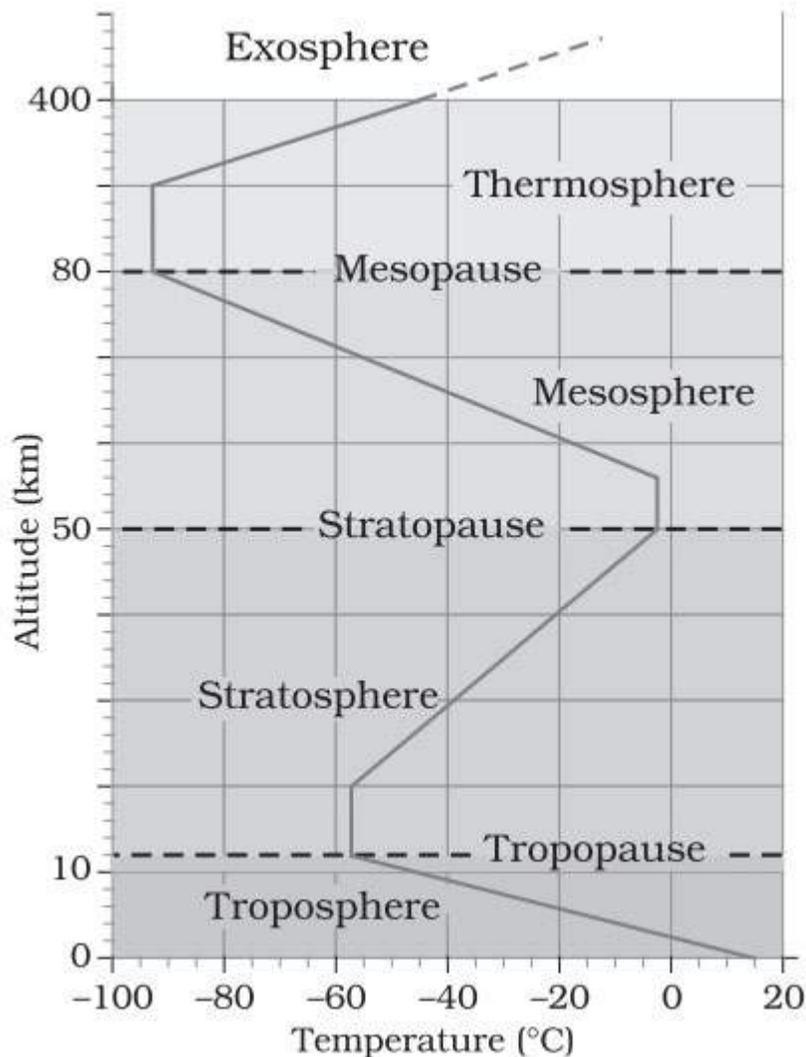
Constituent	% by Volume

Nitrogen	78.08
Oxygen	20.95
Argon	0.93
Carbon dioxide	0.036
Neon	0.002
Helium	0.0005
Krypton	0.001
Xenon	0.00009
Hydrogen	0.00005

Layers of the Atmosphere

The structure of the atmosphere consists of different layers with varying temperatures and densities. The density of air is highest near the surface of the earth and decreases with increasing altitude. The Layers of the Atmosphere include:

- Troposphere
- Stratosphere
- Mesosphere
- Ionosphere
- Exosphere



Structure of the Atmosphere UPSC

The Structure of the Atmosphere UPSC along with the Layers of the Atmosphere are an essential part of the Geography part of the [UPSC Syllabus](https://byjusexamprep.com). The topic is asked both in

the [UPSC Prelims](#) and in the [UPSC Mains](#) GS-Paper 2. The topic can be covered through the [NCERT Books for UPSC](#) and sufficing with the [UPSC Books](#).

Several questions have been asked in the [UPSC Previous Year Question Papers](#) in both Prelims and Mains. One example of MCQ is:

Find the wrong pair?

- I. The home of humankind-Troposphere
 - II. Ozone layer-Stratosphere
 - III. Meteor shower region-Stratosphere
 - IV. Long-distance broadcasting of radio programs-Mesosphere
- A - I&II
 - B- II&III
 - C- III&IV
 - D- II&IV

Correct Answer - Option C

Structure of the Atmosphere

The atmosphere is divided into different layers according to its composition, density, pressure, and temperature variations. According to its composition, the atmosphere is divided into two layers- homosphere and heterosphere. Mostly, the segregation of the Layers of the Atmosphere is done on the basis of varying temperatures and density. The atmosphere is basically made up of 5 layers, which are mentioned below.

- The homosphere is the lower segment of the atmosphere and consists of three regions namely troposphere, stratosphere, and mesosphere, and extends from the earth's surface up to an altitude of 80km.
- Whereas, the heterosphere is where the gases are separated out by molecular diffusion with increasing altitude such that lighter species become more abundant relative to heavier species. It begins over 80km and extends up to 10,000 km and includes the Thermosphere and the Exosphere.

Troposphere- 1st Layer of the Atmosphere

- It is the lowermost layer of the atmosphere which contains dust particles and water vapors.
- The troposphere extends up to the height of 10km from the earth's surface.
- The height of the Troposphere is about 18 km on the equator and 8 km on the poles. The thickness of this layer is greatest at the equator because heat is transported to great heights by strong convectional currents.

- Meteorologically, Troposphere is the most significant zone in the entire atmosphere because all weather conditions, such as temperature inversion, turbulence, and eddies take place in this layer.
- The air never remains static in this layer, and therefore, the troposphere is also known as the 'changing sphere'.
- The troposphere is also called the convective region since all convection stops here.
- The air temperature at the tropopause is about -80 degrees Celsius over the equator and about -45 degrees Celsius over the poles. The temperature here is nearly constant, and hence, it is called the tropopause.
- The zone separating the troposphere from the stratosphere is known as the tropopause.
- The troposphere is influenced by seasons and jet streams.

Stratosphere- 2nd Layer of the Atmosphere

- The stratosphere is the second layer of the atmosphere, just above the troposphere.
- It extends up to 50km from the surface of the earth.
- This layer is considered ideal for flying aircraft because the air blows horizontally here.
- This layer is almost free from clouds
- The temperature remains almost the same in the lower part of the stratosphere up to the height of 20km. After 20km, the temperature increases slowly with the increase in height. This rise is due to the presence of ozone.
- The cirrus clouds are present at lower levels of the stratosphere.

Ozonosphere

- The Ozonosphere lies between 30 km and 60 km altitude from the earth's surface. The temperature rises at a rate of 5°C per kilometer through the ozonosphere.
- The ozonosphere is also known as the chemosphere because a lot of chemical activity takes place in this layer. This layer reflects the harmful ultraviolet radiation due to the presence of the ozone molecules.

Mesosphere- 3rd Layer of the Atmosphere

- The Mesosphere is the third layer of the atmosphere, which is above the stratosphere and extends up to the height of 80km from the Earth's surface.
- The temperature reaches up to -100 degrees Celsius at the height of 80 km due to the fact that temperature starts to decrease with an increase in altitude.
- The meteorites burn up in this layer and the falling star phenomenon occurs in this layer only.
- The upper limit of the mesosphere is known as mesopause.

Thermosphere- 4th Layer of the Atmosphere

- The thermosphere is located above the Mesopause, at a height of between 80km-400km.

- In the thermosphere, the temperature rises very rapidly with an increase in height, but a person would not feel warm because of the thermosphere's extremely low pressure.
- The ionosphere is a part of this layer. It contains electrically charged particles.
- The radio waves transmitted from the earth are reflected back to the earth by this thermosphere, which makes radio transmission possible.
- The International Space Station and satellites orbit in this layer. The sighting of Aurora's is also observed in the lower parts of this layer.

Exosphere- 5th Layer of the Atmosphere

- The Exosphere is the uppermost layer of the atmosphere above 400km and coincides with space.
- The density of gases is very sparse here due to the lack of gravitational force. Light gases such as helium and hydrogen float into space from here.
- As Exosphere is exposed to direct sunlight, the temperature gradually increases through the layer.

