

Atmosphere

Without atmosphere, life on the Earth is impossible. Oxygen and nitrogen gases in it keep the living world alive. Clouds, fog, rain, snow, water vapour, etc. are various forms of water present in the atmosphere. Particles are important in atmosphere. They are responsible for processes of fog and dew.

Atmosphere is an envelope of air which surrounds the earth from all sides. The layer of the atmosphere from the earth's surface up to a height of 32 km contains 99% air. Thus the atmosphere near the surface is dense while it thins out higher up.

Atmosphere is colourless, tasteless and odourless. Air in motion is called wind or breeze. Atmosphere exhibits elasticity and compressibility. Atmosphere is transparent. But some kind of radiation is absorbed as it passes through it and matter is obstructed due to air friction of air. Hence meteors are burnt and end up in the atmosphere before reaching the earth's surface. Thus, atmosphere protects the earth from outer space objects.

Composition of the Atmosphere

There are solid, liquid and gaseous components in the atmosphere. There are microscopic particles, salt particles, snow particles, insects, water, various gases and humidity in the atmosphere.

Gas		Amount (%)
Nitrogen (N_2)		78.00
Oxygen (O_2)		21.00
Argon (Ar)		0.93
Carbon dioxide (CO_2)		0.03
Neon (Ne)	light gases	0.4
Helium (He)		
Ozone (O_3)		
Hydrogen (H_2)		
Methane (CH_4)		
Krypton (Kr)		
Xenon (Xe)		
		100.00

Carbon dioxide is the heaviest gas. Hence it is more in amount in atmosphere up to a height of 20 km from the surface. While oxygen is found up to a height of 110 km and nitrogen up to 130 km. Amount of carbon dioxide in the atmosphere is very less (0.03%). Vegetation takes in carbon dioxide from air during the process of photosynthesis and uses to prepare its food. Oxygen is important in breathing for man and animals. Layer of ozone gas is located at a height of from 15 to 50 km above the earth's surface. It absorbs the Sun's ultraviolet radiation. At a height of about 130 km from the earth's surface, atmosphere is mainly composed of light gases like hydrogen and helium.

Water is seen in solid, liquid and gaseous forms in the atmosphere. Water is present in air in the form of snow particles, water droplets and vapour. Among these, vapour is important. Evaporation from various reservoirs and transpiration from vegetation is the source of water vapour, which is added to

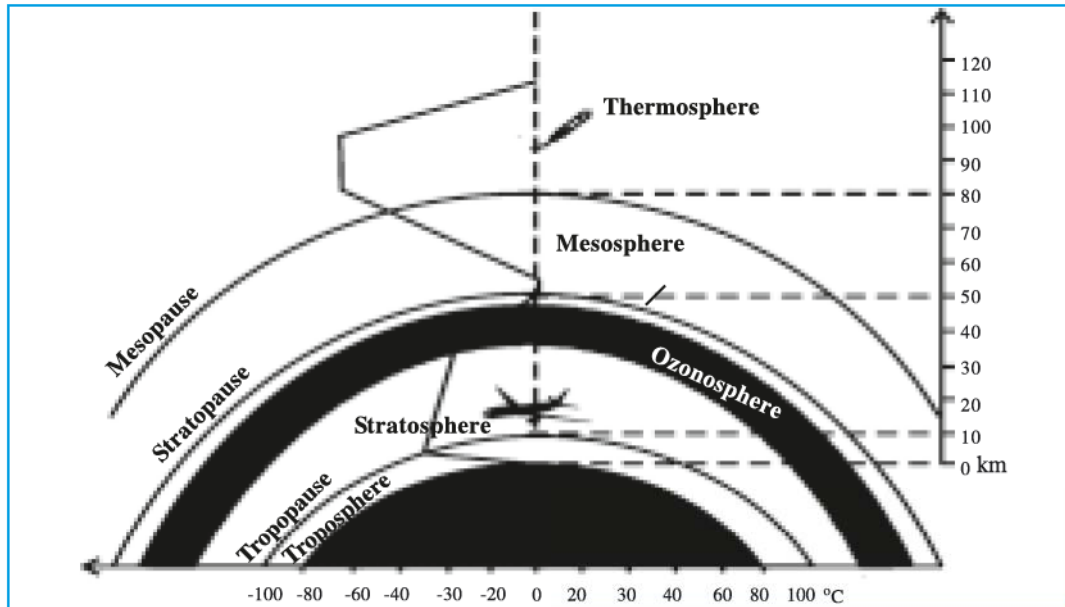
the atmosphere. Vapour is present in the atmosphere up to a height of about 10 to 12 km only. Amount of vapour in the atmosphere varies from 0 to 4%. Water vapour is an important component of atmosphere that absorbs Sun's heat. Clouds, fog, rain, etc. are various forms of vapour in the atmosphere.

There are innumerable particles in the layer of atmosphere close to the earth's surface. They enter the atmosphere from open land, smoke from factories, vegetation, volcanic eruptions, meteor shower, etc. Dust and salt particles being hygroscopic and moisture retaining, increase the atmosphere's density. Dust particles are responsible for picturesque sunrise and sunset, fog and clouds formation process, etc.

Structure of the Atmosphere

Depending on the variations in temperature with height, the atmosphere is divided into four layers :

- | | |
|------------------|------------------|
| (1) Troposphere | (3) Mesosphere |
| (2) Stratosphere | (4) Thermosphere |



8.1 Layers of the Atmosphere

(1) Troposphere : The very first layer of the atmosphere surrounding the earth's surface is the Troposphere. It extends up to a height of 16 km over tropics, 12 km over temperate regions and 8 km over polar regions. The height also varies with season. During the hot summer season, the troposphere extends to a greater height, while during cold winters it extends to a lesser height.

Life on the earth's surface is influenced by the Troposphere. Atmospheric disturbances, air movements, thunder and lightning, clouds, rain, storm, etc. are experienced in this layer. Troposphere plays a major role in determining the weather and climate of the earth. Almost 75 % of the atmosphere's gaseous component, water vapour and dust particles are present here. Temperature decreases with height, i.e. for every increase in height of 1 km temperature falls by about 6.5° Celsius.

The upper surface of the Troposphere where fall in temperature ceases is called the **Tropopause**. In this transitional zone air temperature becomes steady. Air movement calms down. This zone is highly beneficial for flights of aircraft.

(2) Stratosphere : This layer extends from where the Troposphere ends and up to a height of 50 km. Here Temperature remains almost stable, hence it is known as Stratosphere. Seasons are not experienced in this layer. It is free of clouds, rain, storm, snow, etc. Here the air is clean and thin, hence jet planes can fly speedily with less barrier.

In this layer, up to a height of 20 km air temperature almost remains stable. Further up temperature gradually rises. At an altitude of 50 km temperature stops rising. The height at which temperature stops rising is known as Stratopause.

A slight change is seen with height in the Stratosphere. Ozone is present at heights between 20 and 40 km. Hence this part of Stratosphere is known as the **Ozonosphere**. Ultraviolet rays of the Sun are absorbed here. Also meteors are burnt and end up in this layer. Ozone is a germicidal gas, keeps the air fresh and is healthy for humans.

(3) Mesosphere : Above the Stratosphere at a height of about 50 to 80 km, the layer is known as Mesosphere. In this layer, temperature decreases with height. Temperature stops decreasing at a height of about 80 km. This height is known as the Mesopause. Here the air temperature ranges from 90 ° to 100 degree Celsius.

(4) Thermosphere : The layer above the Mesosphere is the Thermosphere. Starting from a height of 80 km, this layer extends up to the limits of the atmosphere itself. Here the air is very hot and thin. In this layer temperature is about 900° degree Celsius at a height of 350 km. Due to the Sun's ultraviolet radiation, air in the Thermosphere is ionized. Hence this layer of the atmosphere is also known as the **Ionosphere**.

The radio waves are reflected back to the earth by the electrically charged air in this layer. Hence this layer is important for radio broadcasting. Due to the ionization process in this layer, sometimes in skies high up above the polar regions aurora is seen. Sometimes it is seen as flashes of light, sometimes as colourful fringe of pandal. Developed countries are trying to know more about the upper atmosphere through various experiments with the help of spacecraft. Thus the atmosphere is divided into four different layers.

Weather

Prevailing conditions of the atmosphere for a short duration is **Weather**. Weather can be of any time period such as morning, noon, evening, night or day. Weather depends on temperature, humidity, rain, air pressure, fog, amount of clouds, etc. Countries of the world record daily weather of their regions, prepare its report and weather maps and broadcast them on TV and radio. The headquarters of meteorological department in India is located in New Delhi. It publishes Weather Reports twice in a day and weather maps indicating the weather for the entire country.

Climate

The average conditions of weather over a longer period of time is **Climate**. Normally climate is determined on the basis of weather conditions of a region over a period of 35 years or more.

Elements of Climate

(1) Insolation and Temperature : The heat received from the Sun is known as Insolation. Amount of insolation varies with latitude. In tropical regions, Sun's rays fall vertically, so temperature remains high. In polar regions, Sun's rays fall oblique, so temperature remains low. On the basis of insolation and temperature, a region's climate may be hot or cold, moderate or extreme.

(2) Pressure and Winds : Latitude, distance from the sea, physical features, location, altitude, forest regions and such other factors result in formation of low and high pressure areas. Low pressure is experienced in equatorial regions due to heat, while in cold polar regions, high pressure is experienced due to the cold. Thus, under the influence of various factors, low and high pressures are formed. Air moves from areas of high pressure to that of low pressure. When there is high pressure over the sea, moist winds from here blow towards the low pressure areas over continents and bring rain. As winds coming from sea are cool, sea coast has a moderate climate. In areas where dry winds blow, there

is scanty rain and climate becomes extreme. Thus, pressure and winds play an important role in changing climate of a region.

(3) Humidity and Rain : Water present in the atmosphere in the form of vapour is Humidity. Amount of humidity depends on the rate of evaporation. In dry desert regions due to less rain and in polar regions due to less evaporation, humidity is low. Hence there is low rainfall. In equatorial regions, Sun's rays fall vertically throughout the year and so there is highest evaporation. World's heaviest rainfall is recorded here. Air moisture makes the weather steamy. Hence the humid climate of equatorial region is not healthy for humans. Thus humidity and rain determine whether climate is dry or humid.

Factors of Climate

Elements and factors of climate are different. Elements of climate contribute to making of a particular climate, while factors of climate influence its elements. Factors that influence climate are as follows :

(1) Latitude : Latitude is an important factor influencing climate. As the Sun's rays fall vertically in equatorial region, there is more heat. There is more evaporation and hence more rain also. Hence climate in this region becomes hot and humid. As we go from the equatorial region to the polar regions, Sun's rays become more oblique. In polar regions Sun's rays become most slanting. There is less evaporation and also less rain. Hence, very cold climate is experienced here throughout the year. In 30 and 45 degree latitudes belt of Mediterranean region, there is dry climate in summer while winters are warm and humid.

(2) Altitude : Temperature decreases as we go higher above the sea level. For every 1 km height, temperature of atmosphere falls on an average by 6.5° degree Celsius. Along with temperature, pressure also decreases with height. Some places although located in tropical regions enjoy a pleasant and stimulating climate. Quito city of Ecuador in South America, although located on the equator, its climate remains pleasant because of its height. That is why people travel to hill stations located at higher altitudes to escape the summer heat, such as Shimla, Manali, Darjeeling, Mount Abu, Saputara, Pachmadhi, Mahabaleshwar, Ooty, etc.

(3) Distance from sea : Land and water have different heat absorbing and heat transfer capacities. This effect can be clearly seen on the oceans and continents of the Earth. In areas close to the sea coast, the climate is moderate because of the effect of sea, while in continental areas located away from the sea, temperature remains higher and rainfall is less. Cities like Mumbai, Singapore, London, Shanghai, Rio de Janeiro, etc. located on sea coast enjoy moderate climate, while Delhi, Moscow, Winnipeg, Amritsar, Lahore, etc. located away from the sea coast experience extreme climate.

(4) Ocean currents : Warm and cold currents in oceans influence climate. Where warm and cold currents flow near sea coast, there climate remains warm and cold respectively. The east coast of Canada and the northern part of Western Europe lie almost on same latitudes. But due to different types of ocean currents that flow near these two regions, there is a difference in their climate. Cold Labrador current flows near the east coast of Canada. Hence there the climate is very cold. In winter it becomes icy frozen. While warm Gulf Stream of north Atlantic passes near the northern part of Western Europe. Hence there the climate remains warm throughout the year.

(5) Type of Soil : Soil is a minor factor of climate. Sandy soil rapidly becomes hot as well as cold. To some extent such soil is responsible for extreme climate of desert regions. Black lava soils or silty soil does not heat nor cool rapidly. To some extent its effect is seen on climate.

(6) Amount of forest : In regions with vast forest cover, amount of rain is more and temperature remains below average. In deserts or regions with open land surface, temperature remains higher and

rain is scanty. In east India, more rain is received due to vast forest areas. Hence here, climate is hot and humid. In dry and barren regions of Kachchh and west Rajasthan, temperature remains high, rain is very scanty. Thus, here climate is of extreme type.

(7) Winds : Wind direction and its velocity influence climate. Winds coming from cold regions are cold. When they blow over warm regions, they lower the temperature there. Winds coming from hot regions are hot. When they blow over cold regions, they increase the temperature there. Warm and moist winds blowing from the sea bring rain. Dry winds blowing from land areas do not give rain. This influences their climate.

(8) Direction and slope of mountain range : The time for which insolation persists and the direction of slope, determine the temperature and rain. Normally, on a mountain slope, insolation persists for a longer time on west facing slope compared to east facing slope. Accordingly, temperature remains higher on west facing slope. The south facing slopes of the Himalayas remain free from the effect of cold northerly winds. Hence temperature of southern slopes does not fall as much as that of northern slopes.

If a mountain range comes in way of moist winds coming from sea, the winds climb upslope and give more rain on the windward side. The same winds after crossing over the mountain range on reaching the leeward side have less moisture and hence give less rain.

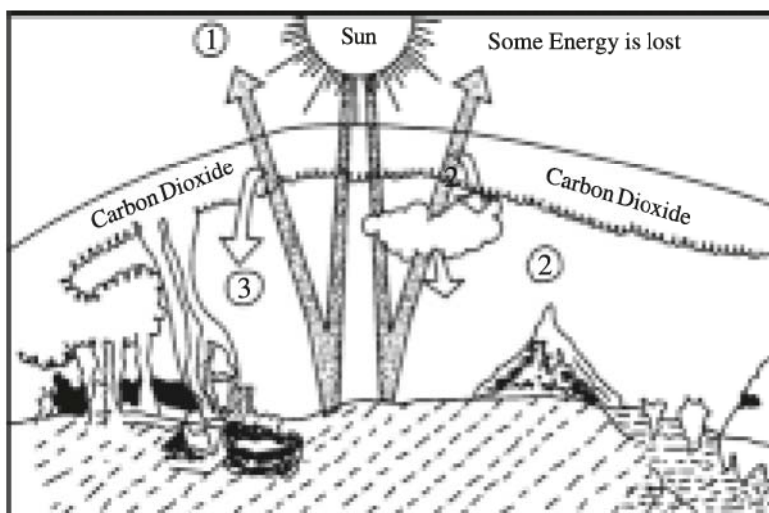
Global Warming

The atmosphere surrounds the Earth. Since past several years, a rise in temperature of atmosphere

has been recorded. This phenomenon of global rise in temperature is known as **global warming**. The Sun rays pass through the atmosphere and directly reach the Earth's surface. Thus the Earth's surface is heated up first. Thereafter the atmosphere heats up slowly.

When Sun rays reflected from the Earth's surface pass through the atmosphere, carbon dioxide present in the atmosphere absorbs the long wave length infrared radiation and is reflected back to the Earth. Thus the Earth and its atmosphere are heated. This effect is the '**Green house effect**'. Carbon dioxide

gas produces such effect and hence is known as Green house gas. Methane (CH_4), Nitrous oxide (N_2O), chlorofluorocarbon (CFC), etc. are other Green house gases.



8.2 Green house Effect

From figure 8.2, we find that

- (1) A part of heat is lost. Amount of carbon dioxide increases due to fossil fuels and deforestation.
- (2) Evaporation increases due to increase in heat, hence excess heat is absorbed. Increase in heat causes melting of ice resulting in a rise in sea-level.
- (3) Carbon dioxide is the maximum absorber of heat reflected from the Earth's surface.

Due to various human activities, green house gases are being added to the atmosphere day by day. Smoke produced from industries, gases emitted by means of transport, burning of fossil fuels, deforestation, burning fuelwood and organic waste, wars, etc. are such reasons by which carbon dioxide is being added to the atmosphere. Also, due to some human activities, amount of other green house gases such as methane, nitrous oxide, chloroflouro carbon increases leading to global warming.

Following steps can be taken to control global warming :

- To decrease the burning of fossil fuels.
- Use of natural gas as a substitute source of power.
- Use solar power, wind power, tidal power, etc.
- Encourage afforestation
- Care should be taken so that more green house gases are not emitted into the atmosphere.
- Students should be made aware at school, high school level, proper management should be done for this.

Climate Change

The structure of atmosphere over the Earth's surface is wonderful. However, this structure of atmosphere is never stable. According to the study of scientists, during the Pre-Cambrian Period, (about 60 crore years before) a major part of the Earth's surface was covered with ice. Within a period of lacs of years, four major ice ages were experienced on the Earth. Except the ice ages, most of the remaining time the climate was hot and humid. At that time the mean temperature of the Earth was about 22 degree Celsius. Hence, the poles were free of ice. Today the mean temperature of the Earth is estimated to be about 14 degree Celsius.

During the past ten thousand years, many changes have occurred in climate. Climate of the Earth was hot and humid about 8000 years before. Sahara, Arabian and Indo-Pakistan deserts were green areas and human civilizations had developed there. Around 3000 BC to 1700 BC, periods of dry and hot climate converted these areas into deserts. Today remains of ancient civilization are found from there.

During the period 1885 to 1940, the Earth's climate, particularly that of the northern hemisphere was hot. However, after 1940, climatologists believe that the Earth's mean temperature is decreasing. During the decade 1930 a severe famine occurred in the dust bowl region of south-western USA. During the period 1950 to 1966, the length of crop season in UK decreased by 9 to 10 days.

According to a study of climatologists, from 1850 till date, due to man's various activities such as smoke from industries, gases emitted from means of transport, deforestation, urbanization, wars, etc., amount of gases such as carbon dioxide, methane, chloroflouro carbon, nitrous oxide, etc. has increased. This is responsible for change in climate.

Evidences of major changes in past climates have been obtained from the Earth's surface. Rocks that bear imprints of past climate change have been found from the Earth's surface. Remains of animals that thrived in various climates and of past vegetation also point to changes that occurred in past climates. Also annular rings that develop in stems of trees according to climatic changes, river and glacial deposits, fossils of human settlement discovered from barren and desert areas, eustatic changes, changes in areas of perma frost, and its imprints left on land surface, etc. indicate notable changes that occurred in past climates.

Results of climate change

- Because of rise in global temperature, the areal extent of snow cover is decreasing, resulting in a rise of sea level.
- Some regions of the world are experiencing uncertainty in rainfall e.g. some regions are experiencing floods due to excessive rains while some regions experience drought due to scanty rains. Sometimes there is unseasonal rain also.
- Climate change has resulted in adverse effects on planting and harvesting of crops. Hence negative effects are seen on agricultural production. This indirectly affects the entire economy of the region.
- Due to the thinning of ozone layer, a rise in level of Sun's ultra violet radiation increases incidence of diseases such as cancer, skin diseases, cataract, etc.
- Some natural phenomena such as flood, famine, cyclone, landslide, snowfall, hail, etc. have become uncertain and excessive.

EXERCISE

1. Answer the following questions in detail :

- (1) What is an atmosphere ? Mention the different components of the atmosphere.
- (2) Explain structure of atmosphere with the help of a diagram.
- (3) What is climate ? Give information about elements of climate.
- (4) Mention the names of factors affecting climate and discuss any two factors.

2. Write to-the-point answer of the following questions :

- (1) Troposphere
- (2) Thermosphere
- (3) Explain the difference between weather and climate.
- (4) Discuss the outcome of climate change.
- (5) Write a short note on global warming.
- (6) Highlight the evidences for past changes in climate.

3. Answer the following questions in brief :

- (1) Tropopause is favourable for aircraft flights Explain.
- (2) Define weather and climate.
- (3) How does latitude affect climate ?
- (4) Explain insolation and temperature as elements of climate.
- (5) Highlight the steps to control global warming.

4. Answer the following questions in one-two sentences :

- (1) Which are the four main layers of the atmosphere ?
- (2) Ozone is found in which layer of the atmosphere ?
- (3) What is Tropopause ?
- (4) What is weather ?

- (5) What is climate ?
(6) Which are the elements of climate ?
(7) Which are green house gases ?

5. Select the correct option from the options given and write the answer :

- (1) Which gas is present in the highest amount in the atmosphere ?
(a) Oxygen (b) Carbon dioxide
(c) Nitrogen (d) Ozone
- (2) Which is the heaviest gas in the atmosphere ?
(a) Nitrogen (b) Oxygen
(c) Helium (d) Carbon dioxide
- (3) Aurora is seen in which layer ?
(a) Stratosphere (b) Thermosphere
(c) Mesosphere (d) Troposphere
- (4) In which city is the headquarters of the Indian Meteorological Department located ?
(a) Mumbai (b) Chennai
(c) Kolkata (d) Delhi
- (5) Which is a major gas among the green house gases ?
(a) Methane (b) Nitrous oxide
(c) Ozone (d) Carbon dioxide
- (6) What is the Earth's mean temperature at present ?
(a) 12° C (b) 18° C
(c) 22° C (d) 14° C

Activity

- Visit any industrial estate of Gujarat, and prepare a note on pollution from industries and resulting climate change.