



Our Earth is surrounded by a thick layer of air called the **atmosphere**. It is held to the Earth by the force of gravity. It protects us from the dangerous ultraviolet rays of the Sun, regulates the temperature conditions on the Earth and causes rain. We use air for breathing, burning and as a medium of communication. Thus, the atmosphere makes life possible on Earth.

Composition of the Atmosphere

The air consists of several gases. The average percentage of different gases in air, i.e., atmosphere is as under :

Nitrogen	78.1%
Oxygen	20.9%
Carbon dioxide	0.03%
Argon	0.93%
Other gases	0.04%
	<hr/>
	100.00%

Air also contains dust particles, smoke, soot, ash, pollen and sea salts suspended in it. It also contains water vapour also. However, the amount of various components vary from place to place.

Nitrogen constitutes a major portion of the total volume of the atmosphere. It avoids quick burning. When we inhale, we take some amount of nitrogen into our lungs and just exhale it. Plants, animals and human beings all need nitrogen in the form of proteins for their survival. But they cannot use the nitrogen directly from the air. Some bacteria living in the soil and roots of some plants take nitrogen from the air and change its form so that plants can use it. Animals and human beings eat plant parts to take their quantity of protein form of nitrogen.

Oxygen is the second most plentiful gas in the air. Humans and animals take oxygen from the air as they breathe. The oxygen is absorbed by their blood and burns their food in the cells very slowly to produce

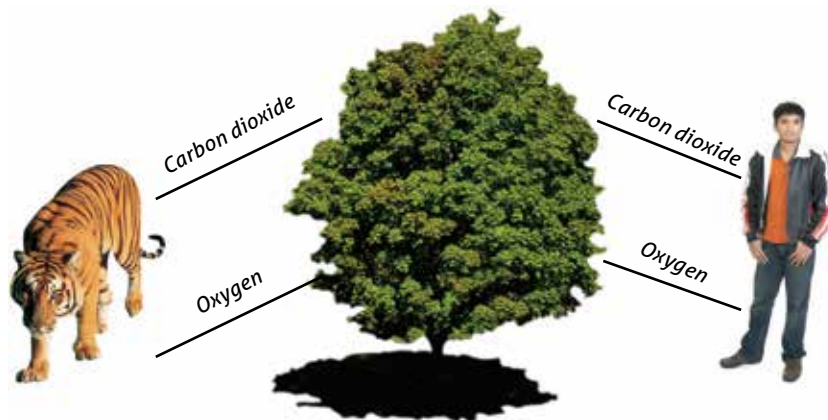
energy. Green plants produce oxygen during photosynthesis. Thus, the oxygen content in the air remains constant. If we cut trees then this balance is disturbed.

What is photosynthesis ?

The synthesis of carbon dioxide and water to make glucose in the presence of sunlight is called photosynthesis.

Carbon dioxide is another important gas for survival because green plants use carbon dioxide to make their food and release oxygen. Humans and animals are dependent on green plants for their food and oxygen for breathing. Humans and animals release carbon dioxide. The amount of carbon dioxide released by humans and animals is approximately equal to the amount used by the plants which make a balance of carbon dioxide in the atmosphere. With the advance of civilization and progress of industry, this balance is upset by burning of fuels, mostly coal and oil. By this burning, thousands of tons of carbon dioxide is added into the atmosphere everyday. As a result, Earth's weather and climate is affected badly.

The presence of carbon dioxide in air helps to keep Earth warm at night. Like a green house, the carbon dioxide in the atmosphere traps the heat radiated from the Earth at night. In this way the Earth remains warm at night otherwise the world have been too cold to live in. This phenomenon is called **greenhouse effect** and carbon dioxide is called a **greenhouse gas**. However, the factory smoke and car fumes increase the level of carbon dioxide in the atmosphere, the heat retained has increased the average temperature of the Earth. This phenomenon is called **global warming**. Global warming is a serious issue in today's world. This rise in global temperature caused the glaciers on mountains and ice-sheets in polar regions to melt. It may result in the rising of sea level, causing floods in the coastal areas. In the long run there will be drastic changes in the climate of a place leading to extinction of some plants and animals.



Balance of Carbon dioxide and oxygen in the atmosphere.

Fact File

The constant movement of air produces changes in the weather. The energy to keep air in constant motion is derived from the Sun. When the sun rays heat the ground, it, in turn, heat the air above it. The air is heated less directly by the Sun, more by the hot ground.

On heating, the air expands, becomes lighter and goes up. Cool air is denser and heavy, so it sinks down. When hot air rises, cold air from surrounding area rushes there to fill in the gap. In this way the motion or circulation of air takes place.

Structure of the Atmosphere

Our atmosphere is divided into five layers of air starting from the Earth's surface. They are Troposphere, Stratosphere, Mesosphere, Thermosphere and Exosphere. These layers have different density or pressure. The pressure of the air goes on decreasing with height.

- 1. Troposphere :** This layer is the densest layer of the atmosphere. It extends to a height of 8 km above the poles and 18 km above the Equator. Its average height is 13 km. Almost all the weather phenomena like rainfall, fog and hailstorm occur in this layer

because water vapour and dust particles are present. All life forms — plants, animals and human beings live in this layer. In this layer temperature and air pressure goes on decreasing with height. Temperature decreases with altitude (height) at the rate of 1°C for 165 m of ascent above sea level. This is why it is cooler at the top of a mountain than at the bottom. Because of low air pressure mountaineers and airline passengers use oxygen masks at high altitudes. The upper limit of the troposphere is the tropopause. Decrease in temperature ceases here.

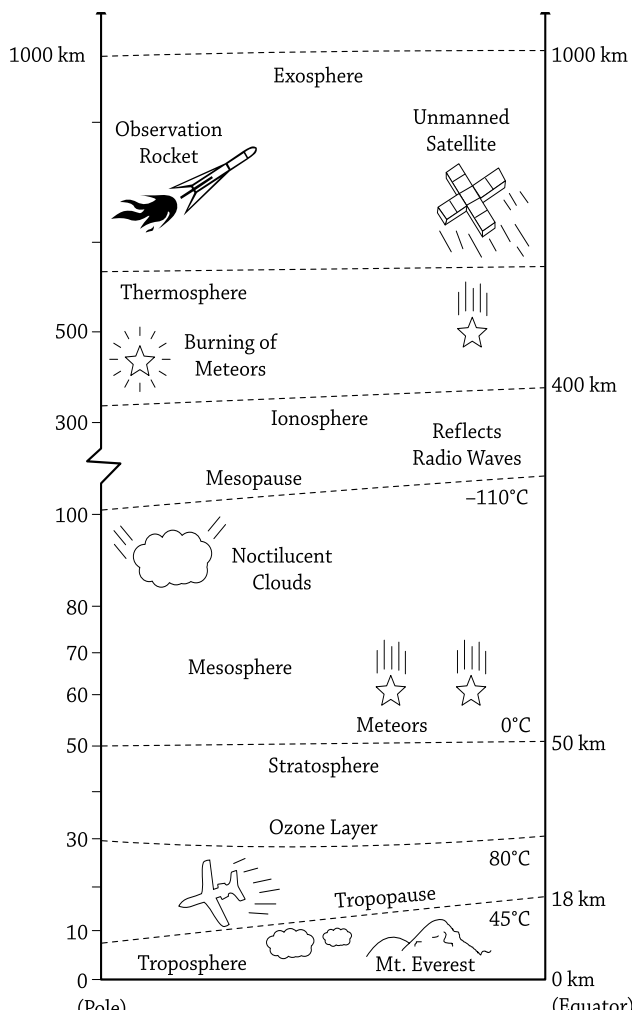
For life on Earth, Troposphere is the most important layer because it contains the air we breathe.

2. Stratosphere : It lies above the troposphere. It extends upto a height of 50 km. This layer is almost free from clouds, thunder and lightning and, therefore, it has ideal condition for the large jet planes to fly. It contains a layer of ozone gas which protects us from the harmful ultraviolet rays of the Sun. It is a layer of clean and cold air. The temperature remains constant in the lower

part of the stratosphere upto 20 km. Thereafter, it gradually increases upto a height of 50 km. Its temperature reaches upto 40°C .


3. Mesosphere : The mesosphere lies just above the stratosphere. It extends upto a height of 80 km. Meteors burn up in this layer on entering from the space due to friction and the presence of some oxygen. Here the temperature decreases again with height falling as low as -100°C . Luminous clouds called noctilucent clouds are found in the mesosphere which are formed due to the presence of cosmic dust. The end part of mesosphere is called mesopause.

4. Thermosphere : The thermosphere begins from mesopause. In the lower layer of thermosphere molecules of gases are electrically charged which are called ions. These molecules have formed their own layer called ionosphere. It extends between 80-400 km. Radio waves transmitted from the Earth are reflected back to Earth by this layer. This helps in long distance wireless communication. In the upper part of this layer, temperature begins to rise rapidly upto 1480°C . This is so because gaseous molecules here absorb the x-rays and shortwave ultraviolet rays of the Sun. Thermosphere protects us from meteors and no longer useful satellites. The high temperature of this layer burns up nearly all the debris coming towards the Earth.



Layers of Atmosphere

Exosphere : This is the outermost layer of Earth's atmosphere. This



layer has very thin air. The atmosphere here merges into space. It does not have any defined border. Light gases like helium and hydrogen float into the space from the outer fringes of the atmosphere. It starts from a height of about 500 km upto 1000 km. Low level satellites orbit within this layer. The temperature increases rapidly in this layer because of direct solar radiation. It has temperatures ranging from 300° C to 1650° C. Gravitational pull is minimum in this layer.

Weather and Climate

Weather of a place is hour to hour, day to day condition of the atmosphere of that place. We feel irritable in a hot or humid weather. We feel cheerful in a cool breezy weather. Weather can change at any hour of the day from hot to cool or vice-versa though not always. That is why we have daily weather reports and forecasts in the morning and evening. The average weather condition of a place for a longer period of time represents the climate of a place. The factors of weather and climate are temperature , air pressure, winds and moisture.

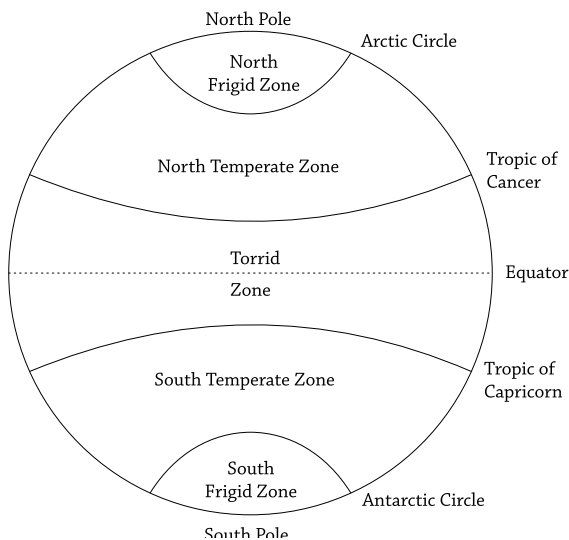
Temperature

The degree of hotness and coldness of the air at a place is known as temperature. It is measured in degree Celsius or Fahrenheit. It may differ slightly inside and outside of a room. The temperature of the atmosphere at a place changes between day and night. Some news channels display at the moment temperatures of certain major cities on the TV screen.

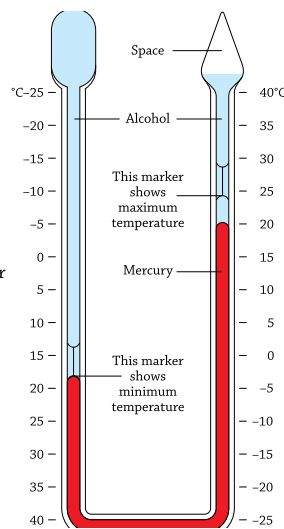
The Sun emits most of its energy as heat rays called **solar radiation**. The Earth receives only a little fraction of this energy. The Earth's atmosphere allows only a small part of this incoming solar radiation reach the ground. This small part of solar radiation is known as **insolation**. The Earth radiates this heat back to space in equal measures. This outgoing heat is known as **terrestrial radiation**. The atmosphere is heated more by terrestrial radiation than by insolation. This helps to keep Earth warm at night. During night there is no receipt of insolation from the Sun on half of the Earth. Though Earth is kept warm by water vapour and carbon dioxide in air during night, there is lower temperature at night.

The rays of the Sun falls directly at the equator heating it more than the slanting rays on the poles. Therefore, the amount of insolation decreases from the equator towards the poles. Therefore, the temperature decreases in the same manner. That is why the poles are covered with snow. However, temperature is a complex process which is influenced by several other factors.

Temperature in cities is much higher than that of villages. The concrete and metals in buildings and the asphalt of roads get heated up during the day. This heat is released during the night. Also, the crowded high rise buildings of the cities trap the warm air and thus raise the temperature of the cities.



Heat Zones on Earth



Maximum and Minimum Thermometer

Temperature of air is measured with the help of thermometer. A special thermometer has been designed, which measures the maximum temperature during day and minimum temperature at night. The difference between maximum and minimum temperature is known as **range** of temperature. The range of temperature near sea coasts is much lower than at places away from the sea. This is because land heats up and cools more quickly than water bodies. It is why it is very cold in winter in Delhi, Punjab, Uttar Pradesh and Bihar than places near the sea like Mumbai, Kolkata and Chennai.

Temperature of a place depends upon its distance from the equator, its height from sea level, its slope, its distance from the sea, direction of winds, humidity of air, ocean currents and vegetation cover. Slopes exposed to Sun receive more radiation.

Air Pressure or Atmospheric Pressure

Like any other material air has weight and exercises pressure on the Earth's surface. The air above us presses us with a great force on our bodies. However, we don't even feel it. This is because the air presses us from all directions and our body exerts a counter pressure and we are also accustomed to it.

The pressure exerted by the weight of air on the Earth's surface is called **air pressure**. It is measured by an instrument called barometer. An **aneroid barometer** is the convenient portable instrument used to measure atmospheric pressure.

The air pressure falls rapidly with increasing height up the layers of atmosphere. It is highest at sea level

Horizontally the atmospheric pressure varies from place to place. It varies due to changing temperature and humidity, change in altitude and from season to season even at the same latitude. In areas where temperature is high, the air gets heated and rises. This creates a low pressure area. **Low pressure is associated with cloudy skies and wet weather.** In areas having lower temperature, the air is cold. It is, therefore, heavy. Heavy air sinks and creates a high pressure area. **High pressure is associated with clear and sunny skies.**

Wind

When air on Earth's surface is heated, hot air expands and rises. Because of atmospheric pressure the surrounding colder air comes to



Aneroid barometer

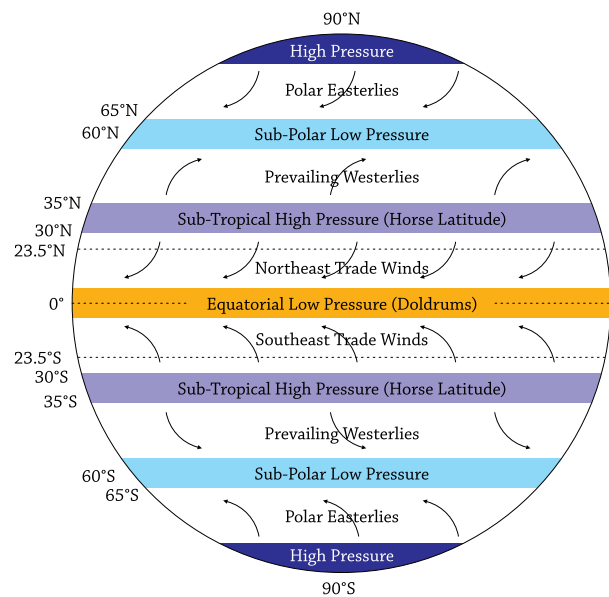
fill its place. In other words, the air always moves from high pressure areas to low pressure areas. The horizontal movement of air from high pressure area to low pressure areas is called **wind**. A gentle wind is seen blowing away smoke or fine dust. A slow wind blows dry leaves down the pavement. It is not easy to hold an umbrella on a windy day. It is difficult even to walk against strong wind. A very strong wind called storm can uproot a tree.

Since differences in air temperature routinely prevail over oceans (water bodies) and land masses, which are well marked off from each other, there is a certain pattern in high and low pressure over Earth. Consequently similar pattern is found in the wind system.

World Pressure Belts

Variations in the atmospheric pressure over the globe shows almost a permanent pattern of high and low pressure called **pressure belts**. Major pressure belts on the Earth follow the pattern of heat zones on Earth. It is modified by the piling up of and blowing away of air due to rotation of the Earth. Pressure belts formed due to temperature are found at the equator and poles. Major pressure belts of the world are as under :

1. **Equatorial Low Pressure Belt (One) :** The sun shines vertically over the equator giving excessive heat within 5 degrees N and S of the equator. The air gets heated, expands and becomes light. It rises up to create a low pressure belt on the Earth known as **doldrums**.
2. **Sub-Tropical High Pressure Belts (Two) :** The light air rising from the doldrums moves upwards towards the poles. It cools down and settles down near the Tropic of Cancer (30° N— 35° N) and near the Tropic of Capricorn (30° S — 35° S) and creates high pressure. These belts are also known as **Horse Latitudes**.
3. **Sub Polar Temperate Low Pressure Belts (Two) :** When cold polar winds meet the warm subtropical winds, the warm air rises and low pressure belts are formed near the Arctic circle (60° N — 65° N) and the Antarctic circle (60° S — 65° S).
4. **Polar High Pressure Belts (Two) :** The air is dense and heavy at the N and S polar regions that are always cold. So, it creates high pressure areas.



Major Pressure Belts and Wind System

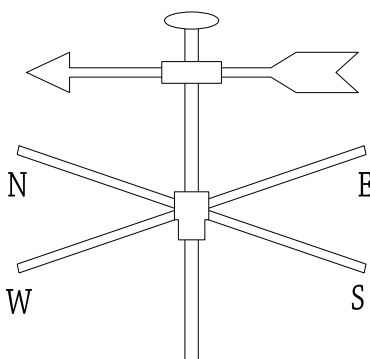
There are two alternate low and high pressure belts in each hemisphere (N and S). Almost permanent low and high pressure belts on the Earth cause winds that blow in a certain direction permanently.

Types of Winds



FACT FILE

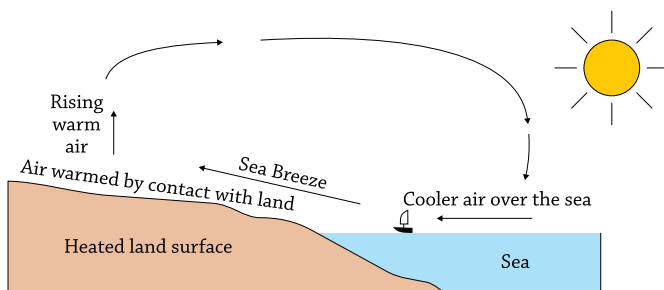
A wind is named after the direction from which it blows, e.g. the wind blowing from the west is called westerly. And the wind blowing from the east is called easterly. An instrument known as wind vane shows the direction of the wind.



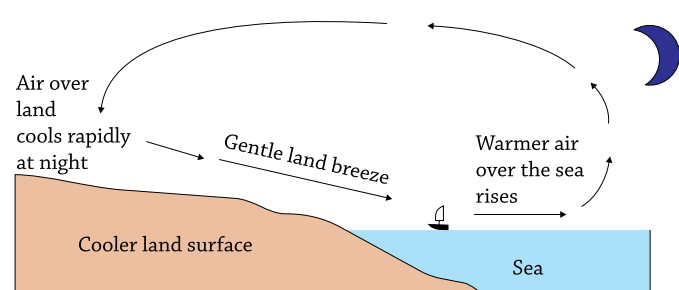
Wind Vane

Winds can be broadly divided into four types :

- 1. Permanent Winds :** These winds blow constantly throughout the year in a particular direction. These are also called planetary or prevailing winds. The trade winds, westerlies and easterlies are the permanent winds. The winds which continuously blow from the sub-tropical high pressure areas to the equatorial low pressure areas are called **trade winds** also known as easterlies. The winds which blow in the temperate zone from the sub-tropical high pressure areas to the sub-polar low pressure areas are called **westerlies**. They blow in the opposite direction of the trade winds. Polar winds blowing in from the polar high pressure areas to the sub-polar low pressure areas are called **easterlies**.
- 2. Periodic or Seasonal Winds :** These winds blow for a certain period in a particular direction. These winds change their directions in different seasons. For example, **sea breeze** blows from the sea toward the land mass for a few hours during the day. **Land breeze** blows from the landmass toward the sea for a few hours in the night. **Mountain and valley breeze** blow up the slope during the day and down the mountain slope at night. The **monsoon winds** blow from the sea to the landmass in summer and then from the land mass to the sea in winter.
- 3. Local Winds :** These blow only during a particular period of the day or year in a particular/small area. For example, hot and dry local wind called 'loo' that blows over the North Indian plains during the summer season in the months of May and June. Periodic winds, sea breeze and land breeze blowing in the narrow coastal belt are sometimes called as local winds.
- 4. Variable Winds :** These winds change their directions often. For example, cyclones and anticyclones. **Cyclones** are formed by air circulation around a low pressure area. **Anticyclones** are formed by air circulation around a high pressure area.



Sea Breeze



Land Breeze

Orissa Cyclone 1999

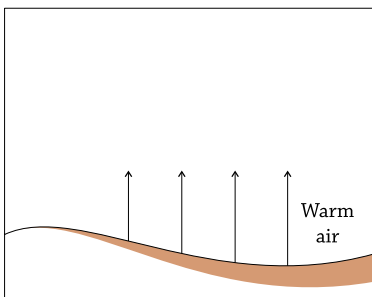
A cyclone is formed by the rapid inward circulation of an airmass around a low pressure centre, usually with strong winds blowing at 50 to 250 km per hour. A supercyclone originated as a depression

(low pressure) in the Gulf of Thailand on 25 October 1999. It gradually moved in a north-westward direction. It struck almost 200 km long east Indian coast of Orissa from the Bay of Bengal on 29 October 1999. The winds of upto 260 km per hour lasted for over 36 hours which uprooted the trees and poles and damaged the houses and other structures. Under the influence of the cyclone it rained heavily for three days continuously which led to the flooding of major rivers. 7 to 10 m high tidal waves caused massive damage to the standing crops and forests upto 20 km inland. The big cities Bhubaneshwar and Cuttack and 28 coastal towns and 18000 villages in 6 districts were damaged. Thousands of people were killed and about 13 millions were affected. Over 200 lakh hectares of the land was turned infertile due to salinisation caused by the tidal surge.

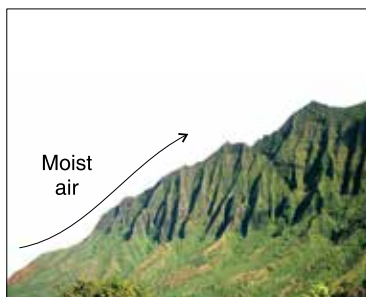
Just 12 days before (on 17-18 October 1999), a cyclone had struck five districts of the state. In spite of the prior warnings of another cyclone by the meteorological department, the people were not convinced and did not left the coastal area.

Moisture

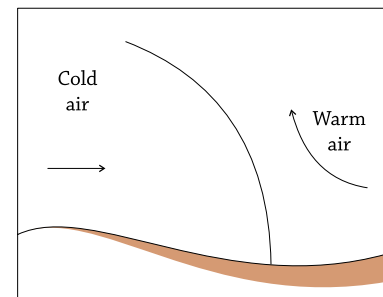
When water evaporates from big and small water bodies, it turns into water vapour. The water vapour in the air is called **moisture**. Moisture in the air at any time at a place is known as **humidity**. As the air gets warmer, its capacity to hold water vapour increases and it becomes more humid. When the air is full of water vapour, it is known as a **humid day**. On a humid day, sweat from our body does not evaporate easily making us feel very uncomfortable. Wet clothes also, when spread, take longer to dry.



Convectional Rainfall



Relief (Orographic) Rainfall



Cyclonic Rainfall

Types of Mechanism of Rainfall

When the water vapour rises up in the higher level of cool atmosphere, it starts cooling. The water vapour condenses around dust particles forming droplets of water. Clouds are just masses of water droplets. These droplets combine with other droplets. When they result into drops too heavy to float in air, they come down as **precipitation**.



Rain Gauge

Precipitation that comes down to the Earth in liquid form is called **rain**. On the basis of mechanism, there are three types of rainfall.

Convective Rainfall : In the equatorial regions air become hot. As the ascending hot and humid air rises, it sets up convectional air current. Moisture laden air currents cool in the upper region and condensation takes place. There is a heavy rainfall in the afternoons almost daily known as **4 O'clock rains**.

Orographic Rainfall : Orography relates to relief specially mountains. When the humid wind strikes a steep slope of a mountain, it rises, expands and cools down. This causes condensation and precipitation. It is common in Western Ghats in India

Cyclonic Rainfall : In a cyclone, winds move from all sides towards low pressure in the centre. The warm moist air, being lighter, rises leading to condensation and rainfall.

Rain Gauge : Rainfall is measured with an instrument called Rain Gauge. It consists of a graduated

bottle having a funnel at its top. Rainfall is collected and measured. Other forms of precipitation are drizzle, snow, sleet and hail.

Rainfall brings fresh water to the Earth's surface. Most of the ground water comes from rain water. Rainfall is essential for the survival of plants and animals. Plants help preserve water. When trees on hill sides are cut, rainwater flows down the bare mountains rapidly and causes floods take place. Less rainfall causes water scarcity and drought.



Key Words

- » Solar Radiation : the heat radiated by the Sun to the Earth's surface.
- » Insolation : amount of solar radiation received by the Earth's surface.
- » Moderate : surface neither very hot nor very cold.
- » Terrestrial Radiation : outgoing heat energy from the surface of the Earth.
- » Doldrums : low pressure belt across the Equator.
- » Horse latitudes : subtropical high pressure belts in both hemispheres.
- » Wind : horizontal movement of the air.
- » Air current : vertical movement of the air.
- » Moisture/Humidity : amount of water vapour in air.

SUMMARY

- ▶ Our Earth is surrounded by a thick layer of air called the atmosphere.
- ▶ Atmosphere consists of nitrogen (78.1%), oxygen (20.9%), carbon dioxide (0.03%), argon (0.93%) and other gases (0.04%)
- ▶ The presence of carbon dioxide in the air helps to keep Earth warm at night.
- ▶ Major pressure belts on the Earth follow the pattern of heat zones on Earth.
- ▶ The water vapour in the air at any time is known as humidity.
- ▶ When the water vapours rise, and cool, they condense and the precipitation comes down as rain.

Exercise Time

A. Tick (✓) the only correct choice amongst the following :

- The most important layer of the atmosphere is
 - Thermosphere
 - Mesosphere
 - Troposphere
 - Stratosphere
- Which of the following gases protects us from harmful sunrays ?
 - Carbon dioxide
 - Oxygen
 - Nitrogen
 - Ozone
- The sub-tropical high pressure belts are also known as
 - Polar belt
 - Horse latitudes
 - Doldrums
 - Temperate
- Drizzle and sleet are the forms of
 - Condensation
 - Evaporation
 - Precipitation
 - Expansion
- When the precipitation comes down to the Earth in the liquid form, it is called
 - Cloud
 - Rain
 - Snow
 - Hails

B. Fill in the blanks :

- Stratosphere is free of _____ conditions.
- _____ is used to measure pressure of air.
- _____ layer of atmosphere protects us from ultraviolet radiation of the Sun.
- Rainfall, snowfall, sleet and hail are together known as _____.
- _____ rainfall is common in equatorial regions.

C. Match the Following :

- | | |
|----------------|--------------------|
| 1. Trade Winds | a. Periodic Winds |
| 2. Loo | b. Variable Winds |
| 3. Monsoon | c. Local Winds |
| 4. Cyclone | d. Permanent Winds |

D. Write true (T) or False (F) against the following statements in given brackets :

- Temperature decreases from the equator to the poles.
- Weight of the air on the Earth is known as air pressure.
- Wind blows from high pressure area to low pressure areas.
- Condensation is the change of water to vapour on heating.
- Climate is the average weather conditions.

E. Define the following terms :

- Weather
- Climate
- Insolation
- Doldrums
- Horse Latitudes
- Green House Effect
- Trade Winds
- Periodic Winds
- Cyclone
- Precipitation

F. Identify the following :

- The most abundant gas in air
- The blanket of air around the Earth
- The layer of atmosphere containing ozone
- The densest layer of atmosphere
- The radiation that heats the atmosphere from below more than insolation



G. Answer in one word or one phrase :

1. Which two gases make the bulk of the atmosphere ?
2. Which gas creates green house effect in atmosphere ?
3. What is the name of the temporary state of temperature, air pressure, wind etc. ?
4. What is the name of the heat energy which the Sun radiates to the Earth's surface ?
5. What is barometer used for ?

H. Answer these questions briefly :

1. What is the atmosphere ? What is it useful for ?
2. What is weather ?
3. Why does the amount of insolation decrease from equator towards poles ?
4. Describe the process of heating of the atmosphere.
5. What is known as stratosphere ? State its importance.

I. Differentiate between :

1. Weather and Climate
2. Insolation and Terrestrial Radiation
3. Doldrums and Horse Latitudes
4. Troposphere and Stratosphere

J. Answer these questions in detail :

1. Describe briefly the structure of the atmosphere.
2. What is meant by weather and climate ? Explain with example.
3. How is the variation in the atmospheric pressure caused ?
4. How are clouds formed ? How does rainfall occur ?
5. Describe the three types of rainfall with sketches.

PROJECT WORK

1. During the rainy season measure daily amount of rainfall and make weekly reports.
2. Observe weather in your area and report about Maximum and Minimum Temperature during a week.
3. Look for the weather conditions given in your newspaper for a month. Make weekly report.
4. Draw a globe showing different winds.