1 Weather and Climate

Fig 1.1

Observe the present atmospheric condition at your place. Are the atmospheric conditions that we experience such as sun light, rain, mist, wind, cloud, and the conditions such as hot and cold stable? The atmospheric conditions of any place depend on the factors such as temperature, pressure, wind and humidity. They in turn, are influenced by the amount of sunlight available there. Hence these are called **elements of weather**.

Atmospheric conditions such as temperature, pressure, wind, humidity and precipitation for a shorter period of time are termed as **Weather**.

The average weather condition experienced for a longer period over a larger area is termed as the **Climate**. The climate of a place is determined by considering the weather conditions of about 35 to 40 years. The climatic conditions of any place is detrimental to the diverse flora and fauna as well as human life of the place. The influence of climatic elements is evident not only in the food habits, dressing, settlement and occupation but also in the physical and mental conditions and in the colour and race of mankind as well. Agricultural practices world over mainly correspond to the climatic conditions. Weather has always been an influential factor right from the early marine voyages which revolutionised the world history, to the modern transport and communication systems.

Conduct a discussion in the class on the significance of weather studies in day-to-day human activities.

Hints: Agriculture, travel/ transport, fishing, tourism

Indian Meteorological Department (IMD)

Indian Meteorological Department is the agency functioning under the Ministry of Earth Sciences, Government of India. This is the principal agency responsible for the weather observations, weather forecast etc. in the country. Delhi is the headquarters of IMD. Hundreds of observation stations are functioning at various places in India as well as in Antarctica.

Let's have a detailed overview on the elements of weather and climate, being influential on every human activity on the earth.

Atmospheric Temperature

As you know, the sun is the sole source of energy for the earth. Energy is produced in the sun by nuclear fusion. Haven't you studied about nuclear fusion in the science class?

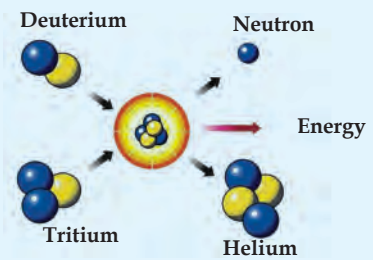
Massive amount of energy continuously produced in the sun through nuclear fusion is emitted in the form of short waves. Only a small amount of energy radiated from the sun reaches the earth's surface (approximately one part of 200 million). The amount of sun's rays reaching the earth's surface is called **Insolation**.

A part of insolation coming towards the earth gets reflected or absorbed by the atmospheric particles such as clouds and dust particles. As the incoming solar radiation is in the form of short waves, it does not heat the atmosphere considerably.

The earth's surface gets heated by insolation. Then the heat is transferred to the atmosphere through various processes from the earth's surface. Conduction, convection, advection and radiation are the major processes of heat transfer.

Nuclear Fusion

Nuclear fusion is the reaction in which two or more atomic nuclei collide and merge together to form a larger atom. This process is common in the case of elements with lower atomic number. Massive amount of energy is generated through this process.



In all the stars including the sun, energy is continuously generated through nuclear fusion. It is estimated that 600 million tonnes of Hydrogen is being converted to Helium every second in the sun through this process.

Processes of heat transfer in the atmosphere

Conduction : Heat is transferred to the lower part of the atmosphere which is directly in contact with the surface of the earth.

Convection: As the heated air expands and rises up, heat is transferred to higher reaches of the atmosphere.

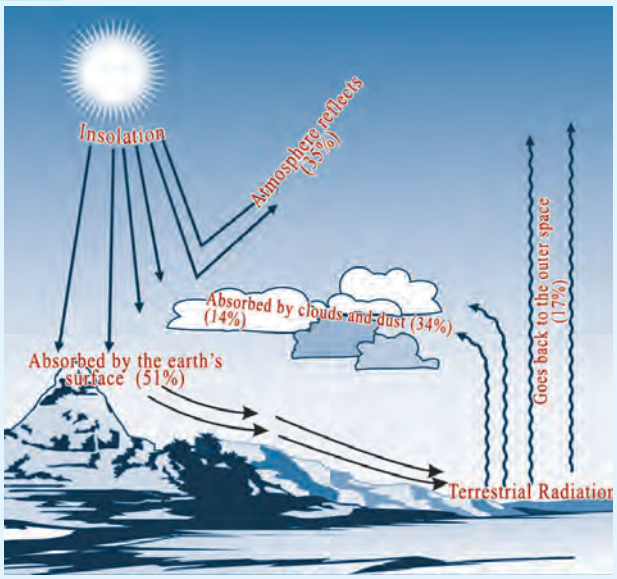
Advection: Heat is transferred horizontally through wind.

Radiation: Emission of energy in the form of long waves after the earth's surface gets heated up.

Short waves and Long waves

Energy is radiated in the form of short waves from hotter objects. Due to high frequency, the short waves traverse through the atmosphere without obstruction. Objects with relatively less heat radiate energy in the form of long waves. Due to low frequency, long waves will be absorbed or reflected by the atmospheric particles.

Heat Budget



Consider the total amount of solar energy reaching the top of the atmosphere of the earth as 100 units. Out of this, 35 units will be reflected back and 14 units will be absorbed by the atmospheric particles. The total amount of energy reaching the surface of the earth is estimated as 51 units. Out of this, 34 units will be transferred to the atmosphere through the processes of heat transfer such as conduction and convection. By re-radiating 17 units of energy directly from the earth's surface and 48 units from the atmosphere, the entire energy received by the earth and its atmosphere gets sent back.

The re-radiation of energy in the form of long waves from the earth's surface is called **Terrestrial radiation.** The absorption of terrestrial radiation by the atmospheric gases such as carbon dioxide heats up the atmosphere. This phenomenon is termed as **Green House Effect.**

What are Green Houses? Inquire.

Almost entire energy reaching the earth as insolation is radiated back every day Thus the surface temperature of the earth remains balanced without becoming extremely hot or cold. This process of heat balancing is called the **Heat Budget of the Earth.**

Discuss the importance of heat budget in sustaining the earth as a life supporting planet.

Do we get the same amount of energy from the sun throughout the day?

The surface temperature of the earth gradually increases by the flow of insolation since the sun rise and attains the maximum by the noon. As the atmosphere is heated through various processes of heat transfer, it takes more time for the atmosphere to get heated up than the time taken for the earth's surface. Thus the temperature recorded at 2pm is considered as the maximum temperature of the day by the meteorologists. The surface temperature of the earth gradually decreases in the afternoon due to the decrease in intensity of insolation as well as the simultaneous terrestrial radiation. The earth's surface as well as the atmosphere get cooled by more energy loss through terrestrial radiation during night. Thus the temperature recorded just before the sun rise is considered as the minimum temperature of the day.

Maximum – Minimum Thermometer

Atmospheric temperature is measured using an instrument called Thermometer.

Maximum – Minimum thermometer is a special type of instrument made by connecting two ordinary thermometers using a U-shaped glass tube. The Maximum temperature and the Minimum temperature of a day can be read out from the recordings of a Maximum-Minimum thermometer.

Fig 1.2

Degree Celsius and Degree Fahrenheit are the common units for recording temperature. In Fahrenheit the melting point of water is 32° and the boiling point is 212°. This is equivalent to 0° Celsius and 100° Celsius respectively.

$$°F = °C \times \frac{9}{5} + 32$$

$$°C = (°F - 32)\ \frac{5}{9}$$

By making use of the maximum temperature and the minimum temperature, diurnal range of temperature and daily mean temperature can be calculated.

Diurnal range of temperature is the difference between the maximum temperature and the minimum temperature of a day.

Diurnal Range = Maximum temperature – Minimum temperature

The average temperature of a day is called as **Daily mean temperature.**

$$\text{Daily mean temperature} = \frac{\text{Maximum temperature} + \text{Minimum temperature}}{2}$$

Heat and Temperature

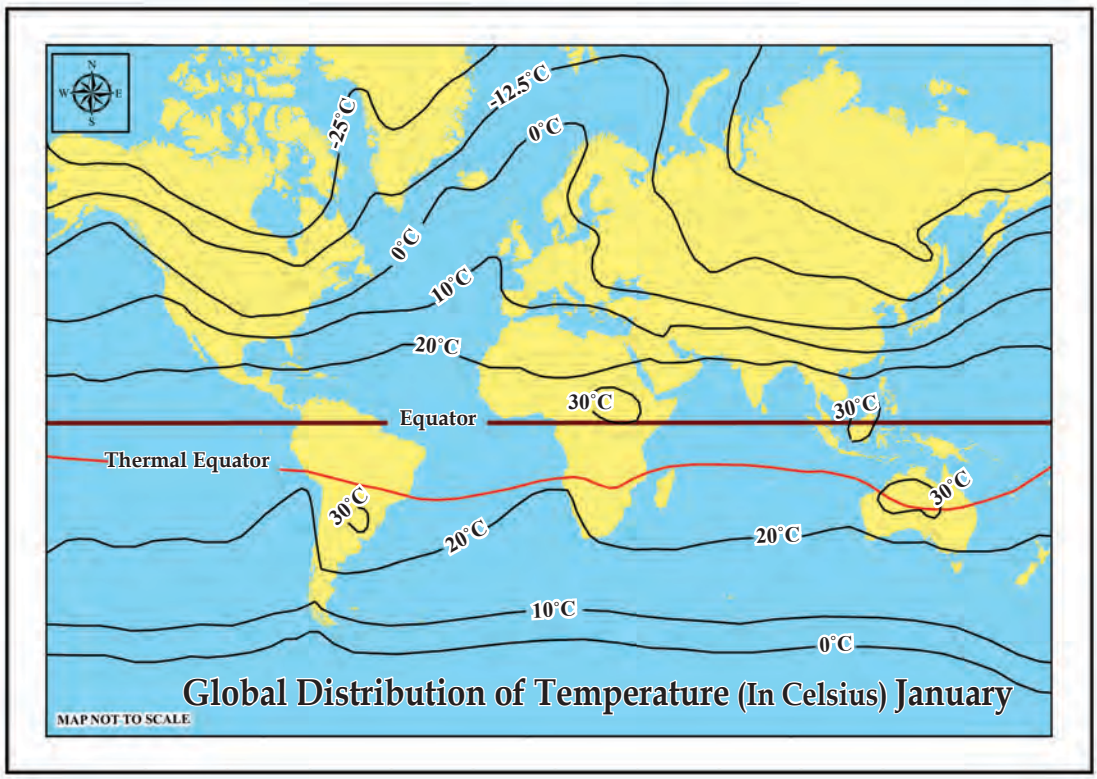
The total energy of an object due to molecular movement is termed as Heat. It is measured in Joule.

Degree of hotness of an object is its temperature. Temperature is recorded in units such as Degree Celsius, Degree Fahrenheit and Kelvin.

Calculate the diurnal range of temperature and the daily mean temperature if the maximum and minimum temperatures of a place are 36° C and 28° C respectively.

Data regarding the temperature are being utilized for climatic studies and further analysis. Plotting the temperature recorded at specific places, smooth curved lines are drawn connecting the places having equal temperature. These imaginary lines are called **Isotherms**. Isotherm maps are very useful for analysing temperature distribution.

See the map showing the world distribution of temperature using isotherms (Fig 1.3).



Global Distribution of Temperature- Isotherm Map
Fig 1.3

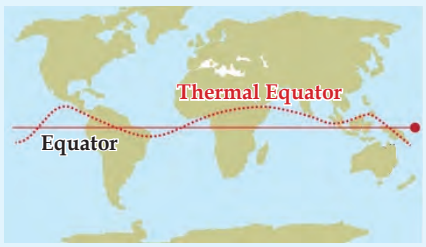
Is the distribution pattern of isotherms shown in the map uniform? You might have noticed that the temperature gradually decreases while moving away from the equator.

The isotherms show a noticeable bend along land-sea confluences. What may be the reason?

Compared to the Northern Hemisphere, Isotherms are more or less parallel to the latitudes in the Southern Hemisphere. Why?

There is spatial and temporal variation in the temperature experienced on earth. Let's examine the factors influencing the distribution of temperature.

Thermal Equator



Imaginary line connecting places with highest mean annual temperature along every longitude is termed as Thermal Equator.

Latitude

Very high temperature is experienced along the equatorial regions where the incidence of sun's rays is almost vertical.

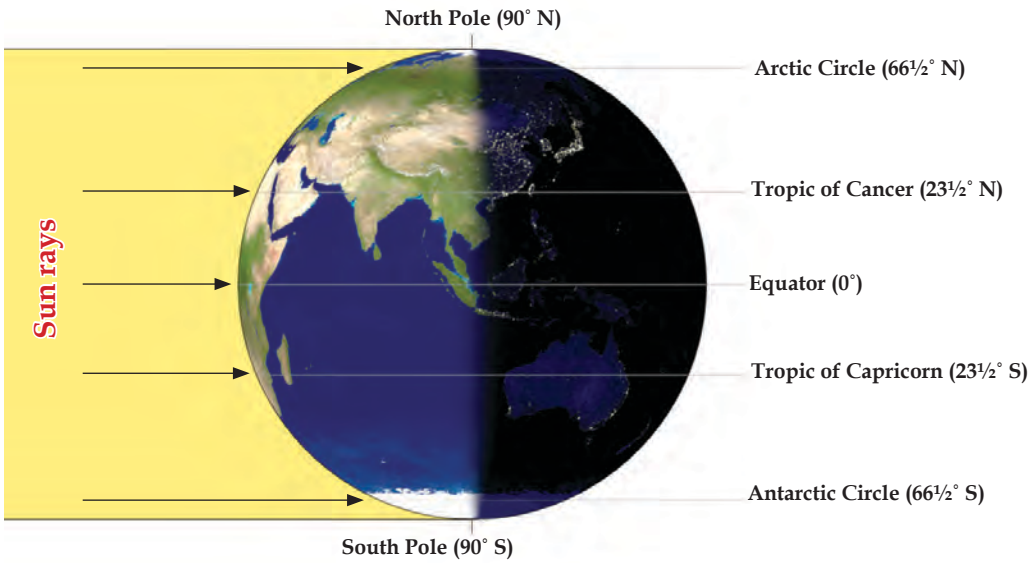
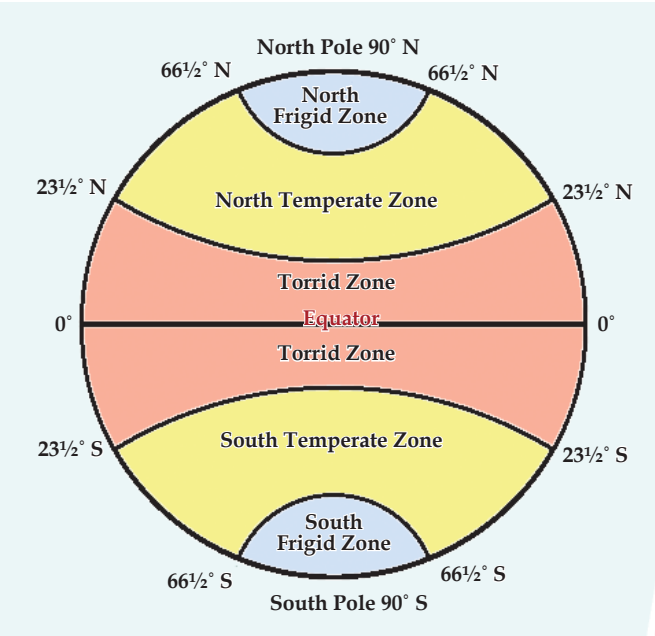


Fig 1.4

Owing to the spherical shape of the earth, the incidence of sun's rays are more inclined away from the equator towards the poles. Thus the temperature gradually decreases towards both the poles. On the basis of this, different temperature zones may be formed.



Temperature Zones
Fig 1.5

Observe the diagram (Fig 1.5). Familiarise the temperature zones and identify the latitudes between which these zones are located.

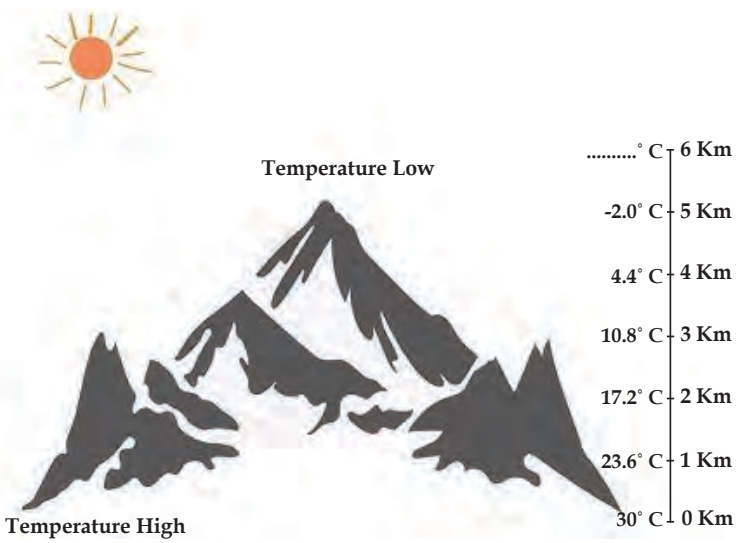


Fig 1.6

Altitude

Atmospheric temperature gradually decreases with increase in altitude. The phenomenon of gradual decrease in temperature at the rate of 6.4° Celsius per kilometre of altitude is termed as **Normal Lapse Rate.**

Observe the diagram (Fig 1.6). Familiarise the decrease in temperature with altitude. Estimate the temperature at 6 km altitude and label it.

Why do we generally experience low temperature at places situated at higher elevations such as Ooty, Munnar and Kodaikanal?

Differential Heating of Land and Sea

Compared to sea, land gets heated and cooled at a faster rate. Thus the land areas experience higher summer temperature and lower winter temperature, when compared to sea.

Distance from the Sea

The winds blowing from land to sea and vice versa help to moderate the temperature experienced along coastal areas. Away from the sea, the maritime influence gradually decreases to cause very high day temperature and low night temperature.

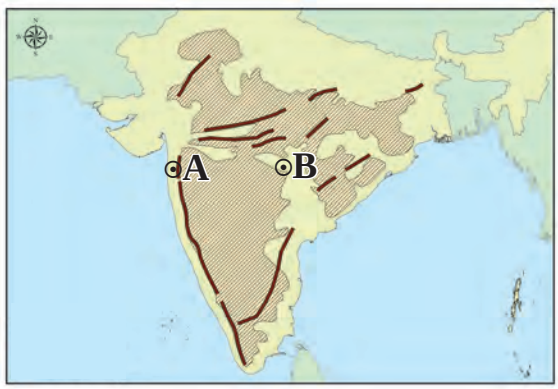


Fig 1.7

Look at the diagram (Fig 1.7). Analyse , which place, A or B, experiences the highest diurnal range of temperature. Give reason for your answer.

Diurnal range of temperature is generally low in Kerala. Why?

Ocean Currents

The temperature along the coastal regions is raised or lowered by the warm currents and cold currents respectively as they pass by. For example, the warm current called North Atlantic Current gives relief for the Western European countries

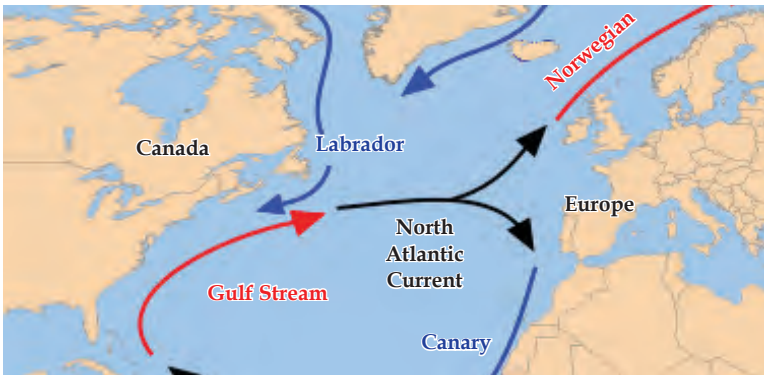


Fig 1.8

from severe cold. On the other hand, the places situated along the North Eastern Canada, which are also in the same latitude, experience severe cold for months due to the influence of Labrador cold current.

Relief

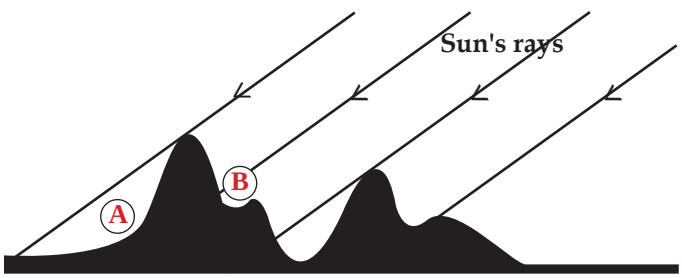


Fig 1.9

Observe fig 1.9, which of the two mountain slopes marked as A and B gets more sunlight? Now you must have understood that the availability of sunlight differs from one place to another in accordance with the relief. Due to this difference, the mountain slopes facing the sun experience higher temperature and opposite slopes experience lower temperature.

Now you might have understood that there is spatial and temporal variability in the distribution of temperature and also know the reasons for the same.

Let's see how these spatio-temporal variations in temperature influence other atmospheric phenomena.

Barometer

Fig 1.10

Fig 1.11

Barometer is the instrument used to measure atmospheric pressure. Barometers are of different types such as Mercury Barometer (Fig 1.10) and Aneroid Barometer (Fig 1.11). In Mercury Barometer, the average pressure on the earth's surface is recorded as 76 cm. Atmospheric pressure is usually recorded in units millibars (mb) or hectopascal (hpa). The average atmospheric pressure experienced on the earth's surface is estimated as 1013.2mb or hpa.

Atmospheric Pressure and Winds

Like any other matter, air also has weight. The weight exerted by the atmospheric air over the earth's surface is termed as **Atmospheric Pressure.**

Following are the factors affecting atmospheric pressure.

- Temperature
- Altitude
- Humidity

Let's examine how these factors influence atmospheric pressure.

Atmospheric air expands on getting heated, and rises up. Thus low pressure regions are formed. This rising air gradually cools, contracts and subsides to form high pressure regions. As the density of atmospheric gases decreases with increase in altitude, atmospheric pressure gradually decreases. The vertical variation of atmospheric pressure is at the rate of about 1mb per 10 metres.

Why do we feel discomfort like clogging of ears while travelling to higher elevations?

As the humidity increases, the water molecules displace the heavier gases in the atmosphere like nitrogen and oxygen. The atmospheric pressure becomes low, as humid air is lighter than dry air.

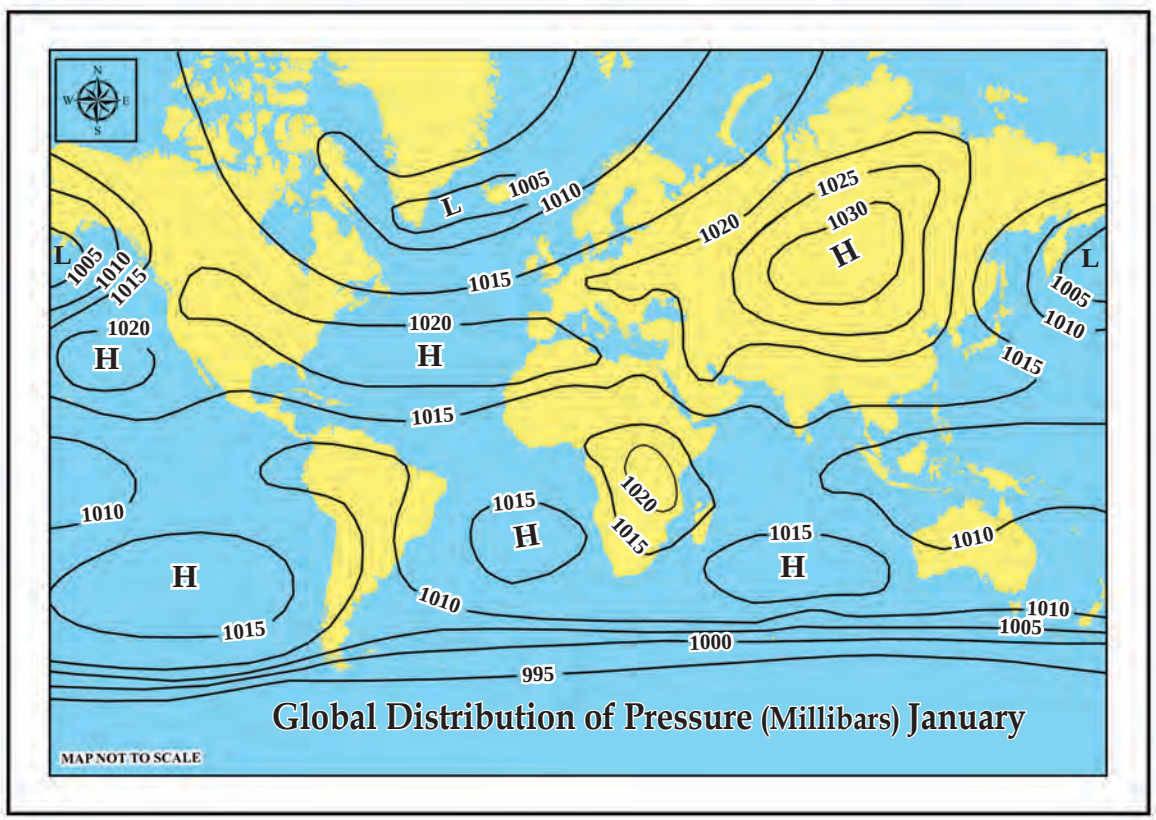
Do you know?

We do not feel the severe pressure exerted by the atmospheric air on us. This is because our body exerts an equivalent body pressure (opposing pressure) to balance this.

Coastal regions experience comparatively lower atmospheric pressure than interior locations. Why?

The air movements right from light breezes to violent gales are the results of variations in atmospheric pressure. Thus, thorough analysis regarding the spatial distribution of atmospheric pressure is essential for meteorological purposes. Smooth curved lines are drawn on maps to connect places having equal atmospheric pressure. These imaginary lines are called **Isobars.**

Map showing the world distribution of atmospheric pressure using isobars is given below (Fig 1.12). The symbol 'H' represents High Pressure Centres and 'L' Low Pressure Centres.



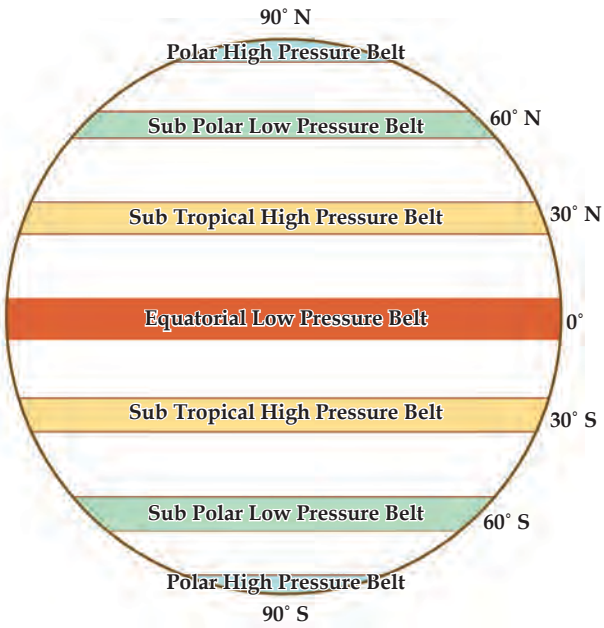
Global Distribution of Pressure - Isobar Map
Fig 1.12

Download the pressure distribution maps of different seasons with the help of ICT and familiarise the difference in pressure distribution.

As we know, temperature is inversely proportional to pressure. Thus the lowest atmospheric pressure might be experienced in the equatorial region and the highest might be in the polar regions. The pressure should therefore increase from the equator towards the poles. But actually this is not the case. Distinct pressure conditions prevail at certain specific zones due to the influence of the rotation of the earth. Different pressure belts are formed along certain specific latitudinal zones. These are called **Global Pressure Belts.**

Global Pressure Belts

Observe the given diagram (Fig 1.13) and identify the major Global Pressure Belts.



Global Pressure Belts
Fig 1.13

The expansion and rising up of air due to high temperature prevailing in the equatorial region is the cause for the formation of **Equatorial Low Pressure Belt.** This zone of vertical air currents is devoid of winds. Being the windless zone, this pressure belt is called **Doldrum.**

As we know the atmospheric conditions along the poles are just opposite to that in equatorial region. **Polar High Pressure Belts** are formed as a result of the contraction and subsidence of cold air.

The rising warm air along the equatorial region moves polewards as upper air winds which gradually cool and subside at about 30° North and 30° South latitudes. This results in the formation of **Sub Tropical High Pressure Belts.**

At about 60° North and 60° South latitudes, normally high pressure zones should be formed due to lower temperature conditions. But owing to the continuous throwing up of air along these regions caused by the influence of the rotation of the earth **Sub Polar Low Pressure Belts** are formed.

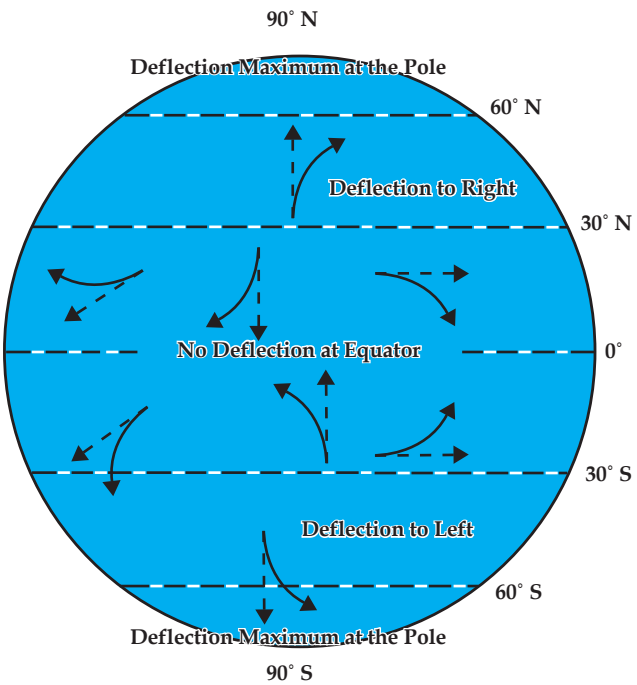
As the temperature conditions vary with the apparent movement of the sun, the global pressure belts are subjected to relative shifts. Global pressure belts may shift to about 5° to 10° northwards during summer season and shift southward

during winter season. This shifting of global pressure belts has decisive influence on global climate.

The pressure differences in the atmosphere are largely noticeable through air movements. There are two types of air movements in the atmosphere – Air Currents and Winds. **Air Currents** are the vertical movements of air and **Winds** are the horizontal movements of air from high pressure areas to low pressure areas. Winds are of different types, varying from light breezes to devastating gales.

Winds are named according to the direction from which they blow. For example, the winds blowing from the south west are termed as south west winds and the winds blowing from the sea towards the land are termed as sea breezes.

What is the name given to the monsoon winds blowing towards the north east direction in India?



Coriolis Force
Fig 1.14

One of the major factors influencing the direction of winds is the **Coriolis Force.** You have learnt about Coriolis Force in your earlier classes. What is Coriolis Force?

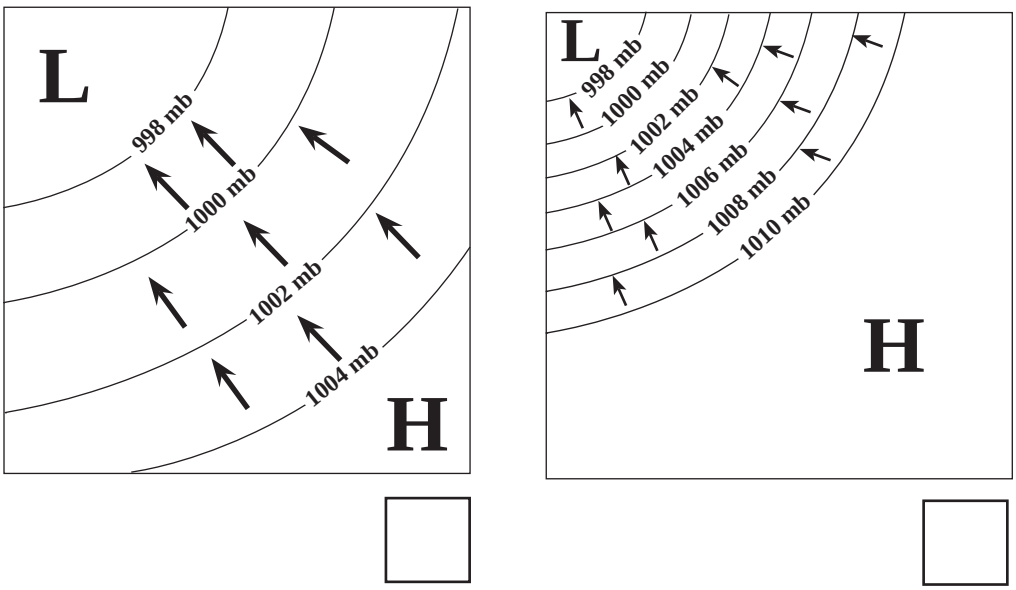
Owing to the Coriolis effect, the winds will deflect towards the right of its direction in the Northern Hemisphere and towards the left of its direction in the Southern Hemisphere.

The speed and intensity of winds are influenced mainly by two factors.

- Pressure gradient force
- Frictional force

Pressure gradient is the change in pressure over a horizontal distance. If there is considerable change in pressure between nearby places, it indicates high pressure gradient. If there is no considerable difference of pressure over horizontal distance, pressure gradient is said to be low. At places where there is high pressure gradient, winds will be strong.

Analyse the patterns of isobars given below (fig 1.15) and find out where the winds are strong. (Put a tick mark)



Pressure Gradient
Fig 1.15

The friction caused by hills, mountains, forests and man-made structures will obstruct the free flow of winds.

Winds are comparatively stronger over oceans than over continents. Why?

Anemometer and Wind Vane

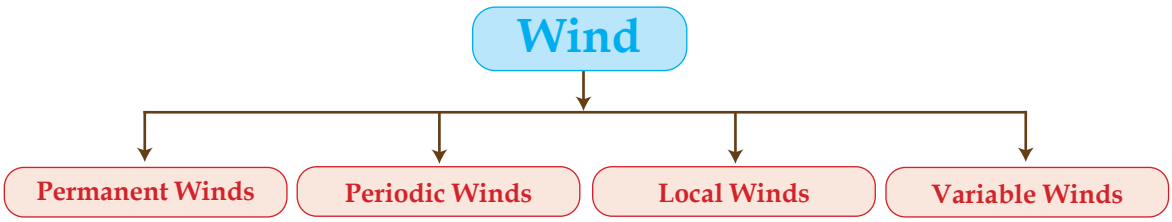
Anemometer is the instrument used to measure the speed of wind. The distance travelled by wind per hour can be estimated using this instrument.

Wind Vane is the instrument which indicates the direction of wind.

Fig 1.16

Now you might have understood how the winds are formed and also have familiarised the factors influencing the speed and direction of wind.

Let's go through the different types of winds.



Permanent Winds

The winds blowing constantly over a particular direction throughout the year are called **Permanent winds**. These winds are also known as prevailing winds and planetary winds. These winds blow between global pressure belts. Trade winds, Westerlies and Polar winds are the major permanent winds.

Observe the diagram (Fig 1.17) and identify the pressure belts between which each of these permanent winds blow. Make use of the diagram showing the global pressure belts (Fig 1.13) also.

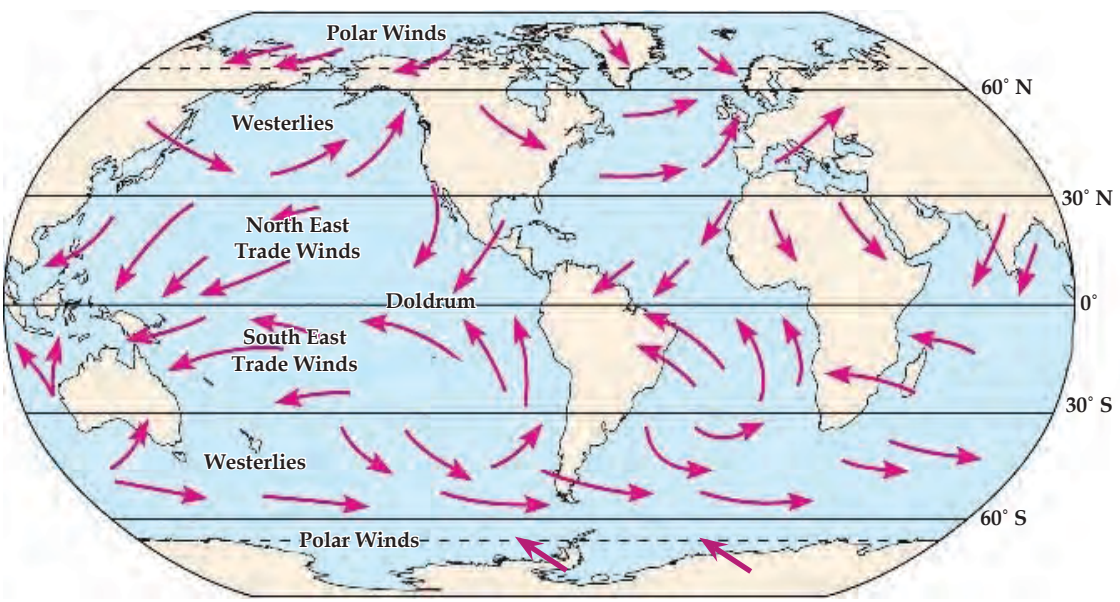


Fig 1.17

Permanent Winds	Pressure belts
• Trade Winds	From the Sub tropical high pressure belts to the equatorial low pressure belt
•	
•	

Trade winds are North Easterlies in the Northern Hemisphere and are South Easterlies in the Southern Hemisphere. Why?

Westerlies are comparatively stronger in the Southern Hemisphere than in the Northern Hemisphere. Why?

ITCZ

The equatorial low pressure region where the trade winds from the Northern Hemisphere and the Southern Hemisphere converge is known as Inter Tropical Convergence Zone (ITCZ) . ITCZ shifts with the apparent movement of the sun.

Periodic Winds

Winds subjected to the periodic reversal of their direction are termed as **Periodic winds**. Diurnal winds such as the land breezes, sea breezes, mountain breezes and valley breezes as well as the monsoon winds which repeat on summer and winter are periodic winds.

Land Breezes and Sea Breezes

You have learnt about the formation of land breezes and sea breezes in the previous class.

Illustrate the land breezes and sea breezes and write a note on their formation in your note book.

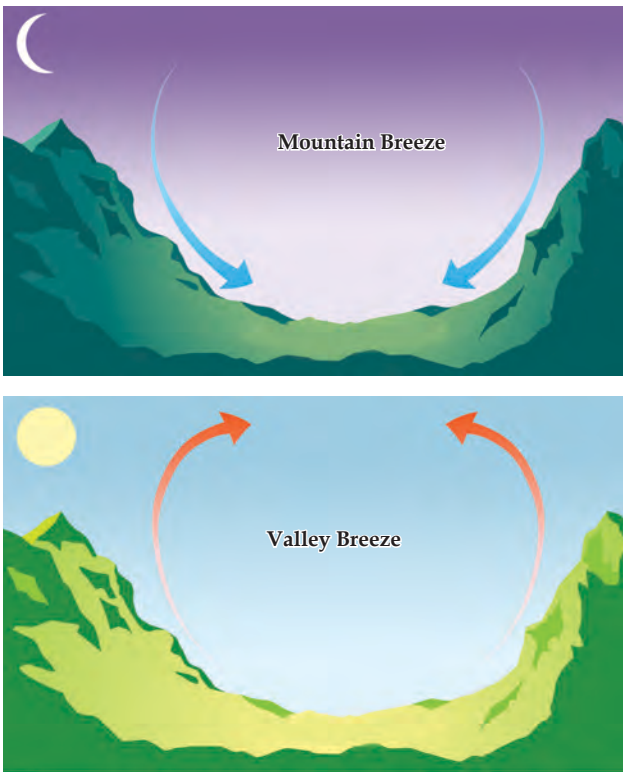


Fig 1.18

Mountain Breezes and Valley Breezes

During night, air along the mountain slopes cools, contracts and moves down slope. These winds are called **mountain breezes.**(Fig 1.18)

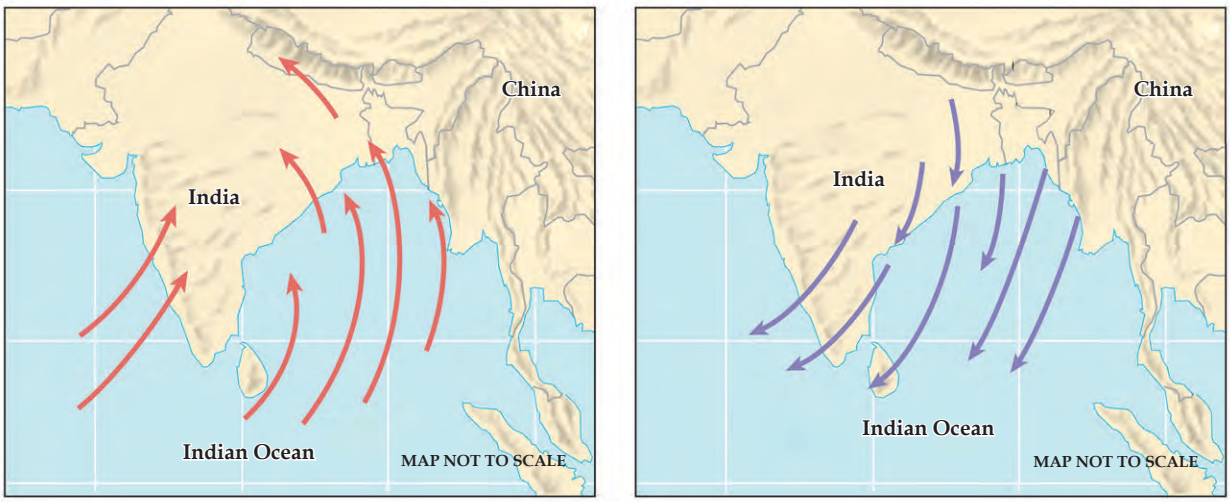
During day time, the heating by sunlight and rising up of air along the mountain slopes make the wind to blow up slope from the valley. These winds are called **valley breezes**. (Fig 1.18)

Monsoon Winds

The term 'monsoon' implies the seasonal reversal in the wind pattern. During summer the South Asian land masses, especially the Indian Sub Continent, gets heated up intensely and severe low pressure develops. Wind blows towards the land mass from the Indian Ocean where comparatively high pressure prevails. These winds blowing as South West winds due to Coriolis effect causes widespread rainfall on entering the land. This is **Southwest monsoon.**

During winter, as the northern land masses get severely cooled, high pressure develops over North India. This causes the winds to blow continuously from the land towards the Indian Ocean as north east winds. These winds which are generally dry in nature are called **Northeast monsoon winds.**

Observe the diagram (Fig 1.19) to familiarise the direction of monsoon winds.



South West Monsoon North East Monsoon

Fig 1.19

Local Winds

Local winds are winds formed as a result of local differences in temperature and pressure in different parts of the world. Most of the local winds are periodic in nature. These winds are known by local regional names. Details regarding a few such local winds are given in the table (Table 1.1).

Local Winds	Region	Characteristics
Loo	North Indian Plains	Hot wind
Chinook	Slopes of Rocky Mountains in North America	Dry hot wind
Foehn	Slopes of Alps Mountain in Europe	Dry hot wind
Harmattan	Sahara Desert in Africa	Relief to intense heat

Table 1.1

Variable Winds

Winds of short duration, of which the intensity or direction cannot be predicted are called variable winds. Cyclones and Anticyclones belong to this category.

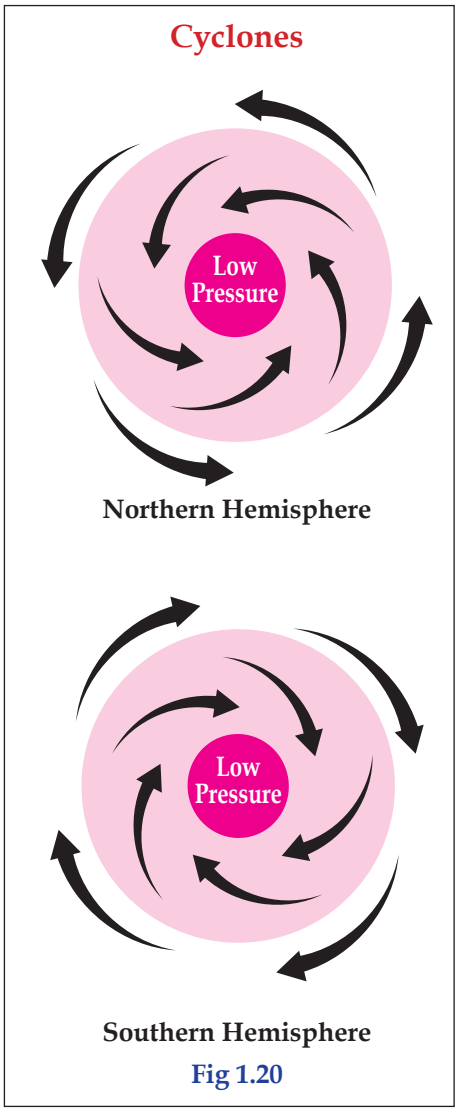


Fig 1.20

Cyclones

Cyclones are low pressure systems towards which winds whirl from the surroundings. Even if the cyclones developed over the tropical region are comparatively lesser in diameter, they are devastative than temperate cyclones. Tropical cyclones originate over tropical oceans. The tropical cyclones moving in north-west direction over the oceans, get dissipated on hitting the lands. Different temperature conditions prevailing on land and also the friction causes the dissipation of cyclones on entering land. The tropical cyclones cause intense rainfall and strong whirlwinds along the coasts. They are known by different names in different parts of the world such as Hurricanes, Typhoons, Willy Willies, Tornadoes etc.

Temperate cyclones are formed in temperate regions where warm and cold air masses meet. Even if the temperate cyclones are larger in diameter, they are less devastative. Unlike the tropical cyclones, these low-pressure systems can move over land also.

The direction of flow of air into the cyclones are anticlockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.

Compare the tropical cyclones with temperate cyclones and prepare a note.

Anticyclones

Anticyclones are high pressure system from which winds whirl outwards. Generally anticyclones do not cause atmospheric disturbances. The direction of flow of winds from anticyclones is clockwise in the Northern Hemisphere and anticlockwise in the Southern Hemisphere.

You have understood how the variability in sunshine at various places and at times leads to the air movements and circulations. Another weather element caused by solar energy is the atmospheric humidity. Let's discuss some important facts regarding atmospheric humidity.

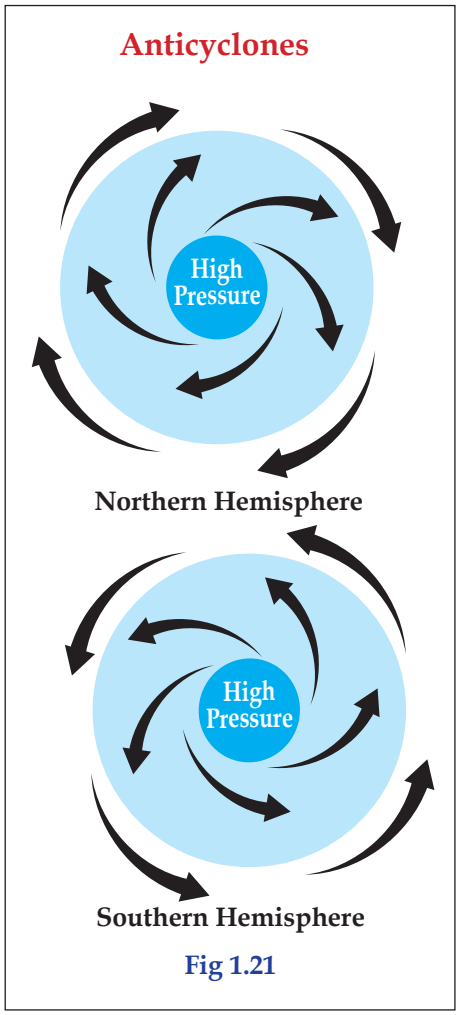


Fig 1.21

Humidity

You might have noticed that water rises as water vapour on heating. As a result of heating by sunlight water from different sources on the earth's surface turns to water vapour and reaches the atmosphere in different quantities.

Name the process by which water turns to water vapour?

Water vapour remains invisible in the atmosphere. The invisible water content in the atmosphere is called **Humidity**.

What are the sources through which water vapour reaches atmosphere?

Actual amount of water vapour present per unit volume of atmosphere is called **Absolute humidity**.

Atmospheric humidity varies from place to place depending on the temperature and availability of water. There is a limit to the amount of water vapour that the atmosphere can hold at a particular temperature. The ratio between the actual amount of water present in the atmosphere and the total water-holding capacity of atmosphere at that particular temperature and time is referred to as **Relative Humidity**. It is expressed in percentage.

$$\text{Relative Humidity} = \frac{\text{Absolute Humidity}}{\text{Total water holding capacity of the atmosphere}} \times 100$$

Hygrometer and Wet and Dry Bulb Thermometer

Fig 1.22

Fig 1.23

Hygrometer is the instrument used to measure atmospheric humidity. Relative humidity can be estimated based on the difference in temperature recorded in wet and dry bulb thermometers.

Measure the relative humidity everyday for a particular period by using the wet and dry bulb thermometer in the school weather station/ social science lab and prepare a table.

The state at which the atmosphere is fully saturated with moistur/water vapour is known as **saturation level** and the temperature at which this level is attained is termed as **saturation point.** When the atmosphere is fully saturated with water vapour, condensation begins.

At the saturation level, what may be the relative humidity in percentage?

What is condensation?

The atmospheric moisture is visible only when the water vapour condenses to form tiny droplets of water. Different forms of condensation are shown in the pictures (Fig 1.24) given below.

Forms of Condensation

Dew | Frost | Mist and Fog | Cloud

Fig 1.24

Dew: During the night, as the earth's surface cools down, the atmosphere close to the earth's surface also cools. The water vapour condenses to form tiny droplets of water which may cling on to the grass tips, leaf blades as well as other cold surfaces.

Frost: Whenever the atmospheric temperature falls below 0^{o} Celsius, especially during nights, tiny crystals of ice are formed instead of dew.

Mist and Fog: When the atmosphere gets cooled, the water vapour condenses to form tiny droplets of water and remains suspended in the lower atmosphere. Fog or mist is formed as a result of condensation of water vapour around tiny dust particles in the lower atmosphere. Fog and mist can be distinguished based on the range of visibility through them.

Clouds: Clouds are formed as a result of condensation around the tiny dust particles in the atmosphere. The water droplets thus formed are less than 0.001 cm in diameter. This is why, they remain suspended in the atmosphere.

We can see various types of clouds in the sky. Clouds can be classified based on their form as well as the height at which they are formed.

Thin, delicate, feather-like clouds formed at very high altitudes are called **Cirrus clouds.**

Cirrus Cloud

Cumulus Cloud

Nimbus Cloud

Stratus Cloud

Fig 1.25

Thick-layered clouds, usually formed in the lower atmosphere, are called **Stratus clouds.**

Cotton wool-like clouds formed as a result of intense convection currents, are called **Cumulus clouds**. These clouds have great vertical development.

Dark, rain-bearing clouds, formed in the lower part of the atmosphere, are called **Nimbus clouds**. The dark colour is due to the thick concentration of water droplets which does not allow light to penetrate through them.

The clouds mentioned above are not usually seen independently. Mostly we see the combinations of different types of clouds. Such clouds are called as cirro stratus, strato cumulus, cumulo nimbus, nimbo stratus etc.

Watch the sky and try to distinguish the various types of clouds. Remember to note the season and time at which the different clouds appear.

As a result of continuous condensation, the size of water droplets within the clouds gradually increases. As the size of water droplets grows beyond the limit of resistance against gravity, water droplets will be released from the clouds and may fall on earth in various forms. This is termed as **precipitation**. Rainfall, snow fall and hailstones are the different forms of precipitation.

Rainfall is the common and familiar manifestation of precipitation which is in the form of water droplets.

Temperature falls below 0^{o} Celsius in cold climatic regions as well as in temperate regions during winter. In such places, precipitation occurs in the form of tiny crystals of ice. This form of precipitation is called **snowfall**.

The water droplets released from the clouds are subjected to repeated condensation at different levels of atmosphere. It reaches the earth in the form layered ice pellets. These are termed as **hailstones**.

Rain

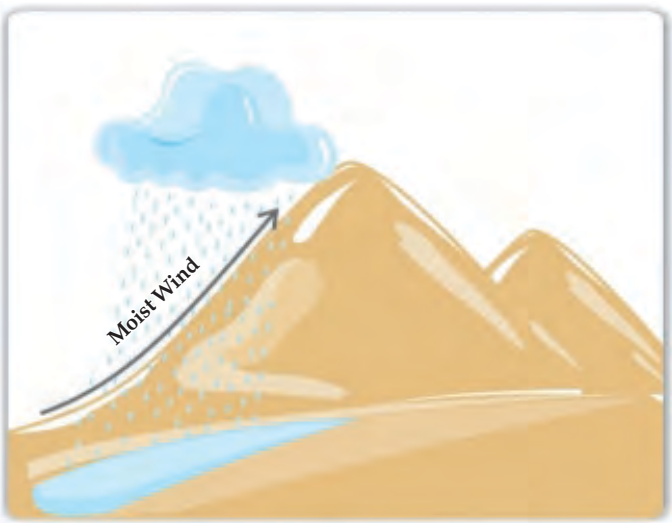
Snowfall

Hailstones

Fig 1.26

Is hailstone a winter phenomena? Inquire.

What is the form of precipitation most familiar to you?

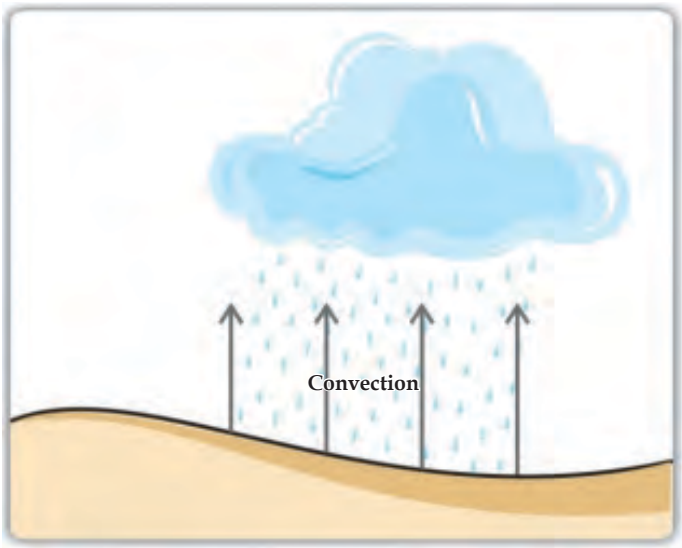


Orographic Rainfall
Fig 1.27

Types of Rainfall

Moisture-laden winds from the sea enter the land and will be raised along the mountain slopes. This leads to condensation and formation of rain clouds along the windward slopes of mountains. Rainfall occurring in this manner is called **Orographic rainfall** or **Relief rainfall**. While the windward slopes of mountains get plenty of rainfall, the descending dry air makes the leeward side rainless. Such regions are called **Rain Shadow Regions.**

While Kerala receives Southwest monsoon rains, the western parts of Tamil Nadu receives very little rainfall. Why?



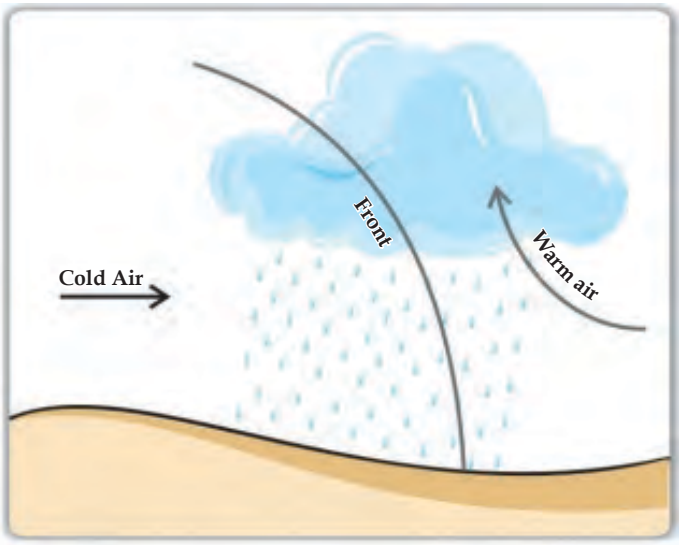
Convectional Rainfall
Fig 1.28

Haven't you noticed the occurrence of afternoon rains during summer season? This is due to convection process. Rainfall occurring in this manner are called **Convectional Rainfall.**

In equatorial climatic regions convectional rainfall is a diurnal phenomenon. Why?

As the convectional rainfall commonly occurs during afternoons, it is also called **4 O'Clock rains**.

In cyclonic systems where warm and cold air meet, the warm air will be raised up to cause condensation and rainfall. This type of rainfall is called **Cyclonic Rainfall**. As the boundary lines between warm and cold air masses are known as **fronts**, this type of rainfall are also called **Frontal Rainfall**.



Cyclonic Rainfall
Fig 1.29

You might have realised that every pulse on our earth is being sustained by the sun. You have also understood that the earth maintains a natural heat balancing system. Studies reveal that this balance is being disturbed due to abrupt changes in the composition of the atmosphere. The following chapter discusses in detail the natural and anthropogenic causes for global climatic change. We must check the unscientific and non-sustainable human interventions, to keep the delicate balance of the atmosphere, so as to safe guard this living planet for generations to come.

Torrential rain and Cloud burst

Intense rainfall occurring at certain specific areas for a shorter duration is refereed to as torrential rain. This may lead to flash floods and landslides. If the amount of rainfall exceeds 10 cm per hour, it is considered as Cloud burst. It is most common in mountainous regions. Meteorologists recognised that the landslides that occurred in Kavalappara and Puthumala in Kerala during 2019 were the result of torrential rain following cloud burst. Experts perceive the landslides of Mundakkai and Chooralmala in 2024 to be the result of cloud burst.

Extended Activities

1. Read the daily maximum temperature and minimum temperature using the max-minimum thermometer in the school weather station/social science lab. Estimate the daily mean temperature and diurnal range of temperature, and display it in the school notice board.
2. Measure the daily amount of rainfall using rainguage for a particular period. Prepare a bar diagram using the data and exhibit it in your class room. Remember to display the daily amount of rainfall in the notice board.
3. Prepare a digital album by collecting pictures of different types of clouds using ICT.