Unit IV:

Atmosphere - Structure and composition of the atmosphere – Preasure Belts- Winds Clouds – Precipitation – Types. Climate change and Global warming.

Atmosphere:

Atmosphere, the gas and aerosol envelope that extends from the ocean, land, and ice-covered surface of a planet outward into space. The density of the atmosphere decreases outward, because the gravitational attraction of the planet, which pulls the gases and aerosols (microscopic suspended particles of dust, soot, smoke, or chemicals) inward, is greatest close to the surface.

Nitrogen and oxygen account for 99 percent of the gases in dry air, with argon, carbon dioxide, helium, neon, and other gases making up minute portions. Water vapor and dust are also part of Earth's atmosphere.

The atmosphere acts as a gigantic filter, keeping out most ultraviolet radiation while letting in the sun's warming rays. Ultraviolet radiation is harmful to living things, and is what causes sunburns. Solar heat, on the other hand, is necessary for all life on Earth.

Structure of the atmosphere:

Earth's atmosphere has a layered structure. From the ground toward the sky, the layers are the troposphere, stratosphere, mesosphere, thermosphere, and exosphere. Another layer, called the ionosphere, extends from the mesosphere to the exosphere. Beyond the exosphere is outer space.

Troposphere

The troposphere is the lowest atmospheric layer. On average, the troposphere extends from the ground to about 10 kilometers (6 miles) high, ranging from about 6 kilometers (4 miles) at the poles to more than 16 kilometers (10 miles) at the Equator.

Stratosphere

The troposphere tends to change suddenly and violently, but the stratosphere is calm. The stratosphere extends from the tropopause, the upper boundary of the troposphere, to about 50

kilometers (32 miles) above the Earth's surface.

Mesosphere

The mesosphere extends from the stratopause (the upper boundary of the stratosphere) to about 85 kilometers (53 miles) above the surface of the Earth. Here, temperatures again begin to fall. The mesosphere has the coldest temperatures in the atmosphere, dipping as low as -120 degrees Celsius.The mesosphere has the coldest temperatures in the atmosphere, dipping as low as -120 degrees Celsius.

Ionosphere

The ionosphere extends from the top half of the mesosphere all the way to the exosphere. This atmospheric layer conducts electricity.The ionosphere is named for ions created by energetic particles from sunlight and outer space. The ionosphere—a layer of free electrons and ions—reflects radio waves.

Exosphere

The fluctuating area between the thermosphere and the exosphere is called the turbopause. The lowest level of the exosphere is called the exobase. At the upper boundary of the exosphere, the ionosphere merges with interplanetary space, or the space between planets.

Composition of the atmosphere*:*

The atmosphere contains many gases, most in small amounts, including some pollutants and greenhouse gases. The most abundant gas in the atmosphere is nitrogen, with oxygen second. Argon, an inert gas, is the third most abundant gas in the atmosphere.

The permanent gases whose percentages do not change from day to day are nitrogen, oxygen and argon. Nitrogen accounts for 78% of the atmosphere, oxygen 21% and argon 0.9%. Gases like carbon dioxide, nitrous oxides, methane, and ozone are trace gases that account for about a tenth of one percent of the atmosphere. Water vapor is unique in that its concentration varies from 0-4% of the atmosphere depending on where you are and what time of the day it is. In the cold, dry artic regions water vapor usually accounts for less than 1% of the

atmosphere, while in humid, tropical regions water vapor can account for almost 4% of the atmosphere. Water vapor content is very important in predicting weather.

Pressure Belts of Earth

On the earth's surface, there are seven pressure belts. They are the Equatorial Low, the two Subtropical highs, the two Subpolar lows, and the two Polar highs. Except for the Equatorial low, the others form matching pairs in the Northern and Southern Hemispheres. There is a pattern of alternate high and low-pressure belts over the earth. This is due to the spherical shape of the earth—different parts of the earth are heated unequally. The Equatorial region receives a great amount of heat throughout the year. Warm air being light, the air at the Equator rises, creating low pressure. At the poles the cold heavy air causes high pressure to be created/formed. It is also due to the rotation of the earth.

(i) Equatorial Low-Pressure Belts

This low-pressure belt extends from 0 to 5° North and South of Equator. Due to the vertical rays of the sun here, there is intense heating. The air, therefore, expands and rises as convection current causing low pressure to develop here. This low-pressure belt is also called as doldrums because it is a zone of total calm without any breeze.

(ii) Subtropical High-Pressure Belts

At about 30°North and South of Equator lies the area where the ascending equatorial air currents descend. This area is thus an area of high pressure. It is also called as the Horse latitude. Winds always blow from high pressure to low pressure. So the winds from subtropical region blow towards the Equator as Trade winds and another wind blow towards Sub-Polar Low-Pressure as Westerlies.

(iii) Circum-Polar Low-Pressure Belts

These belts located between 60° and 70° in each hemisphere are known as Circum-Polar Low-Pressure Belts. In the Subtropical region, the descending air gets divided into two parts. One part blows towards the Equatorial Low-Pressure Belt. The other part blows towards the Circum-

Polar Low-Pressure Belt. This zone is marked by the ascent of warm Subtropical air over cold polar air blowing from poles. Due to the earth's rotation, the winds surrounding the Polar region blow towards the Equator. Centrifugal forces operating in this region create the low-pressure belt appropriately called the Circumpolar Low-Pressure Belt. This region is marked by violent storms in winter.

(iv) Polar High-Pressure Areas

At the North and South Poles, between 70° to 90° North and South, the temperatures are always extremely low. The cold descending air gives rise to high pressures over the Poles. These areas of Polar high pressure are known as the Polar Highs. These regions are characterized by permanent Ice Caps.

Wind:

Wind is the movement of air caused by the uneven heating of the Earth by the sun. It is the great equalizer of the atmosphere, transporting heat, moisture, pollutants, and dust great distances around the globe.

Differences in atmospheric pressure generate winds. At the Equator, the sun warms the water and land more than it does the rest of the globe. Warm equatorial air rises higher into the atmosphere and migrates toward the poles. This is a low-pressure system. At the same time, cooler, denser air moves over Earth's surface toward the Equator to replace the heated air. This is a high-pressure system. Winds generally blow from high-pressure areas to low-pressure areas.

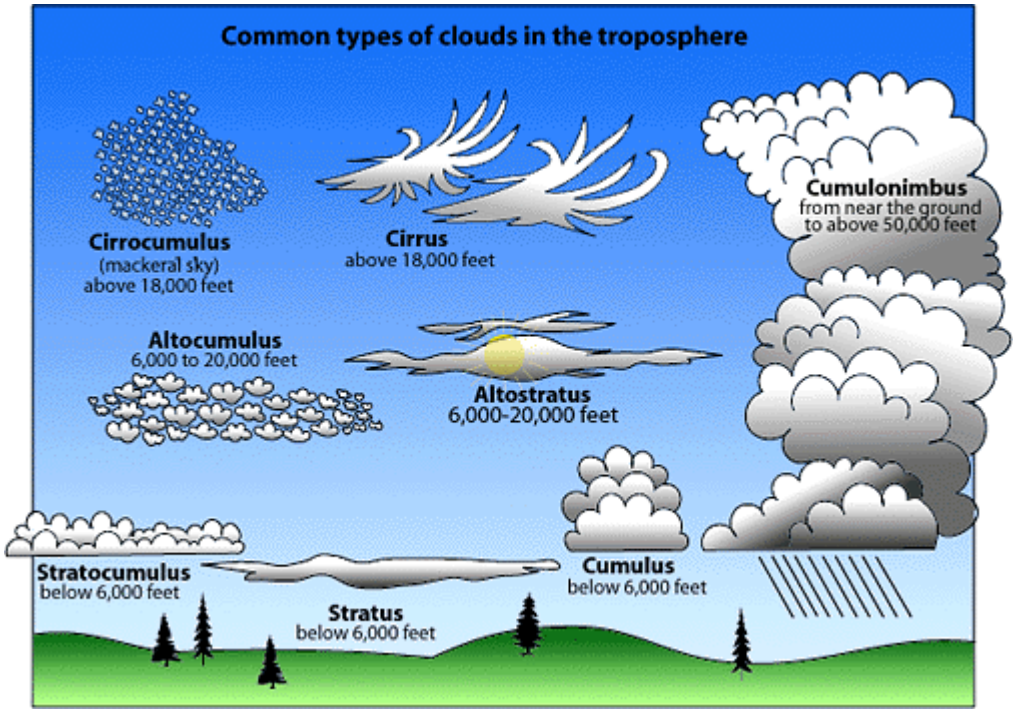
The boundary between these two areas is called a front. The complex relationships between fronts cause different types of wind and weather patterns.

Prevailing winds are winds that blow from a single direction over a specific area of the Earth. Areas where prevailing winds meet are called convergence zones. Generally, prevailing winds blow east-west rather than north-south. This happens because Earth's rotation generates what is known as the Coriolis effect. The Coriolis effect makes wind systems twist counter-clockwise in

the Northern Hemisphere and clockwise in the Southern Hemisphere.

Clouds:

Clouds are given different names based on their shape and their height in the sky. Some clouds are puffy like cotton while others are grey and uniform. Some clouds are near the ground, while others are near the top of the troposphere.



Precipitation is any type of water that forms in the Earth's atmosphere and then drops onto the surface of the Earth.

Water vapor, droplets of water suspended in the air, builds up in the Earth's atmosphere. Water vapor in the atmosphere is visible as clouds and fog. Water vapor collects with other materials, such as dust, in clouds.

Precipitation condenses, or forms, around these tiny pieces of material, called cloud condensation nuclei (CCN).

Clouds eventually get too full of water vapor, and the precipitation turns into a liquid (rain) or a solid (snow).
The most common types of precipitation are rain, hail, and snow.

Rain

Rain is precipitation that falls to the surface of the Earth as water droplets. Raindrops form around microscopic cloud condensation nuclei, such as a particle of dust or a molecule of pollution.

Rain that falls from clouds but freezes before it reaches the ground is called sleet or ice pellets.

Hail

Hail forms in cold storm clouds. It forms when very cold water droplets freeze, or turn solid, as soon as they touch things like dust or dirt. The storm blows the hailstones into the upper part of the cloud. More frozen water droplets are added to the hailstone before it falls.

Unlike sleet, which is liquid when it forms and freezes as it falls to Earth, hail falls as a stone of solid ice.

Hailstones are usually the size of small rocks, but they can get as large as 15 centimeters (6 inches) across and weigh more than a pound.

Snow

Snow is precipitation that falls in the form of ice crystals. Hail is also ice, but hailstones are just collections of frozen water droplets. Snow has a complex structure. The ice crystals are formed individually in clouds, but when they fall, they stick together in clusters of snowflakes.

Climate change and Global warming:

Global warming refers to the rise in global average temperature. Climate change is how the climate of different areas around the globe change over time, mostly due to this global average temperature increase and the changes that result to the water cycle, ice cover on land and in the polar oceans, and changes in land cover. Climate change can also occur naturally due to changes in sunlight, the growth of mountains, and the movement of the continents across the earth over time.

Global warming only describes the increase in global average temperature. The current global average temperature is 59°F (15°C, 288K) and is projected to increase 3-7°F (2-4°C, K) by 2100. It is generally agreed upon that the man-made increase in greenhouse gases due to the burning of fossil fuels is causing or expediting this warming. The rise in global average temperature doesn't mean the temperature will increase by the same amount everywhere. It doesn't even mean that everywhere in the world will get warmer. It just means that the average global temperature is increasing. This is where climate change comes in.

Climate change refers to the change in climates around the world over time. This could be due to the effects of the increase in global average temperature, among other things. Climate change means more than just a change in temperature, but a change in global weather patterns which could affect precipitation averages and extremes, too. For example, one effect of global warming could be that the northern part of the Northern Hemisphere will likely warm up more than other parts of the globe. This is because the increased temperatures are likely to melt large polar ice fields, replacing the ice with darker open ground. The dark ground would absorb sunlight much more quickly than the reflective ice did, leading to strong heating. Other effects could result in some locations getting more rain while others will be more likely to have long-term droughts. It is not clear how this would affect overall weather patterns, since the reduction in temperature gradient from equator to poles could decrease winds and storm activity, but the higher temperatures would have more energy overall.