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Handout #01...by Mrityunjay Upadhayay

GOH CHENGLEONG

Certificate Physical and Human Geography

PART 2: Weather, Climate, Vegitation

Chapter 13 Weather

CLIMATE (जलवायु)	WEATHER (मौसम)
Average atmospheric conditions of an area over a considerable time (30 - 35 yrs) Systematic observation of various elements of climate such as rainfall, temperature, humidity, air pressure, winds, clouds and sunshine	Atmospheric condition of a certain place at a certain time Vary tremendously and place can be subjected to haphazard changes in weather at any time

- **Degree of variability in the climate or weather of a country aslo differs.**

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- **Generally, the climate of temperate latitudes is far more variable than that of the tropics.**

"BRITAIN HAS NO CLIMATE, ONLY WEATHER"
Britain is in the temperate (शीतोष्ण) climate zone and does not have extremes of temperature or rainfall. The Gulf Stream (गल्फ स्ट्रीम), a large Atlantic Ocean current of warm water from the Gulf of Mexico, keeps winters quite mild whilst during summertime, warm but not excessively hot temperatures are experienced.
"EGYPT HAS NO WEATHER, ONLY CLIMATE".....THINK??

Death rates are normally high in tropical countries and low in deserts....why???
Due to germs are not transmitted readily in the regions of high temperature and low humidity. Cool, fresh mountain air is always good for health.

Elements of weather and climate

Rainfall

- **Including other forms of precipitation (snow, sleet and hail)**
- **Measured by a metal instrument called a rain gauge.**
- **Rain-day - Period of 24 hours with at least 0.01 inch or more rain, If this amount is exceeds 0.04 inch, it is considered as a wet-day.**

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- **Mean annual rainfall - Average of annual rainfall taken over a long period of time (35 yrs).**
- **Isohyet (समवर्षा रेखा) - Places having the same mean annual rainfall are joined by a line called an isohyte.**

Pressure

- **Of what ?? ..... Air having Weight**
- **Exerted on the earth's surface, which varies from place to place and from time to time.**
- **Measured by - Barometer, invented by Galileo**
- **Any liquid could be used for this purpose, but mercury has been chosen...**

Why is mercury (पारा) used in a barometer rather than ordinary water..??
Because it is the heaviest liquid known...So if ordinary water were used in place of mercury the corresponding column for normal atmospheric pressure would be 34 feet!

- **A normal atmospheric pressure equivalent to 1013 millibars/760 mmHg.**
- **Isobars (समदाब रेखा) - Equal pressure are joined by lines called isobars.**
- **In aeroplanes, a modified type of aneroid barometer called an altimeter is used. Barogram is used for the continous record of pressure changes.**
- **Pressure decreases with altitude at an approx. rate of 1 inch for every 900 feet ascent.**

Temperature

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- **Measured by thermometer which is a narrow glass tube filled with mercury or ..... ??**
- **Working Principle of thermometer.....??**
- **In the terms of Centigrade °C - Freezing Point is 0°C & Boiling point is 100°C.**

Fahrenheit = (1.8 X ...°C) + 32°F

- **Mean daily temperature is the average of maximum and minimum temperatures.**
- **Diurnal range (प्रतिदिन) - Difference between the maximum and minimum temperatures of a day gives the diurnal range of temperature.**
- **Annual range - Difference between the hottest month (.....) & coldest month (.....) gives the annual range of temperature.**
- **Isotherms (समताप रेखा) - Places having the same ..... are joined by lines called an isotherms.**

Humidity (आर्द्रता)

- **Measure of the dampness (नमी) of the atmosphere which varies greatly from place to place at differenet times of day.**
- **Absolute humidity (निरपेक्ष आर्द्रता) - Actual amount of water vapour present in the air, which expressed in grams per cubic metre.**
- **Relative humidity (सापेक्षिक आर्द्रता) - Ratio between the actual amount of water vapour and the total amount the air can hold at a given temperature, expressed as a %.**
- **Warm air can hold more water vapour than cold air.**

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If the air contains only half the amount of water vapour, it could carry, the relative humidity is .....%.

- **In equatorial (भूमध्यरेखीय) regions, over 80%, is common in the morning, which means the air contains four-fifths as much water vapour as it can carry.**
- **Saturation point (संतृप्ति बिंदु) - When the relative humidity reaches 100%, the air is completed saturated. The air temperature is said to be at dew-point (ओसांक).**
- **After saturation, further cooling will condense (संघनन) the water vapour into clouds or rain.**

MCQ #1.

Consider the following statements w.r.t relative humidity and select the correct option:

1. **When the relative humidity is high the air is dry, as in the equatorial regions.**
2. **When the relative humidity is low the air is moist as in the deserts.**

(a) 1 only **(b) 2 only**

(c) Both 1 & 2 **(d) Neither 1 nor 2**

- **The instrument for measuring relative humidity is the hygrometer.**

Wind

- **Air in motion and has both direction and speed.**

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- **The instrument widely used for measuring wind direction is a wind vane or weather cock.**
- **Winds are always named from the direction they blow.**
- **Speed of wind is usually measured by an anemometer.**

Clouds

- **Is what we will be covering throughout the course (types of clouds, features and their effects)**

Sunshine

- **The amount of sun-shine a place receives, depends on the seasons, a factor determined by latitude and by the position of the earth in its revolution around the sun.**

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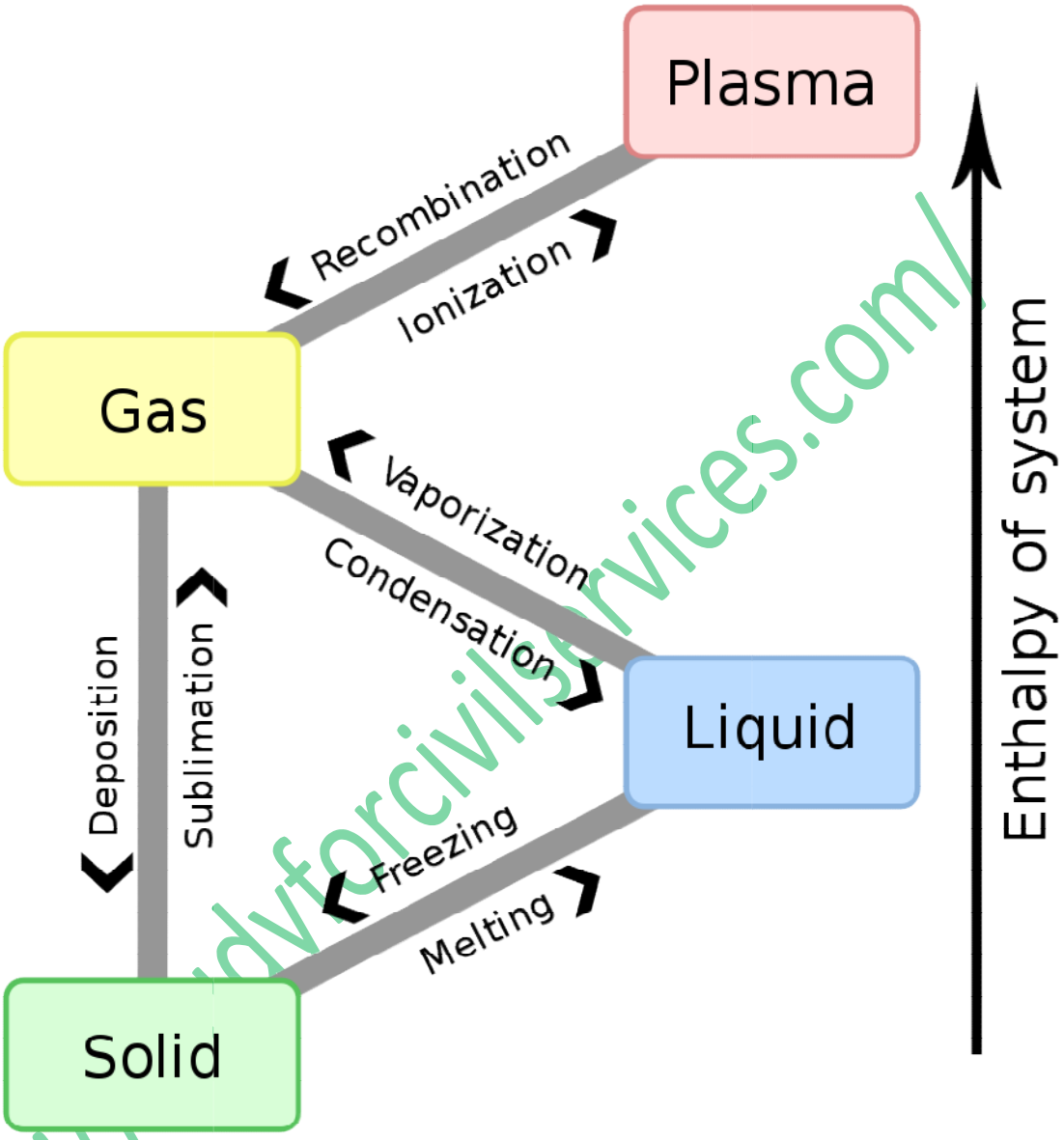

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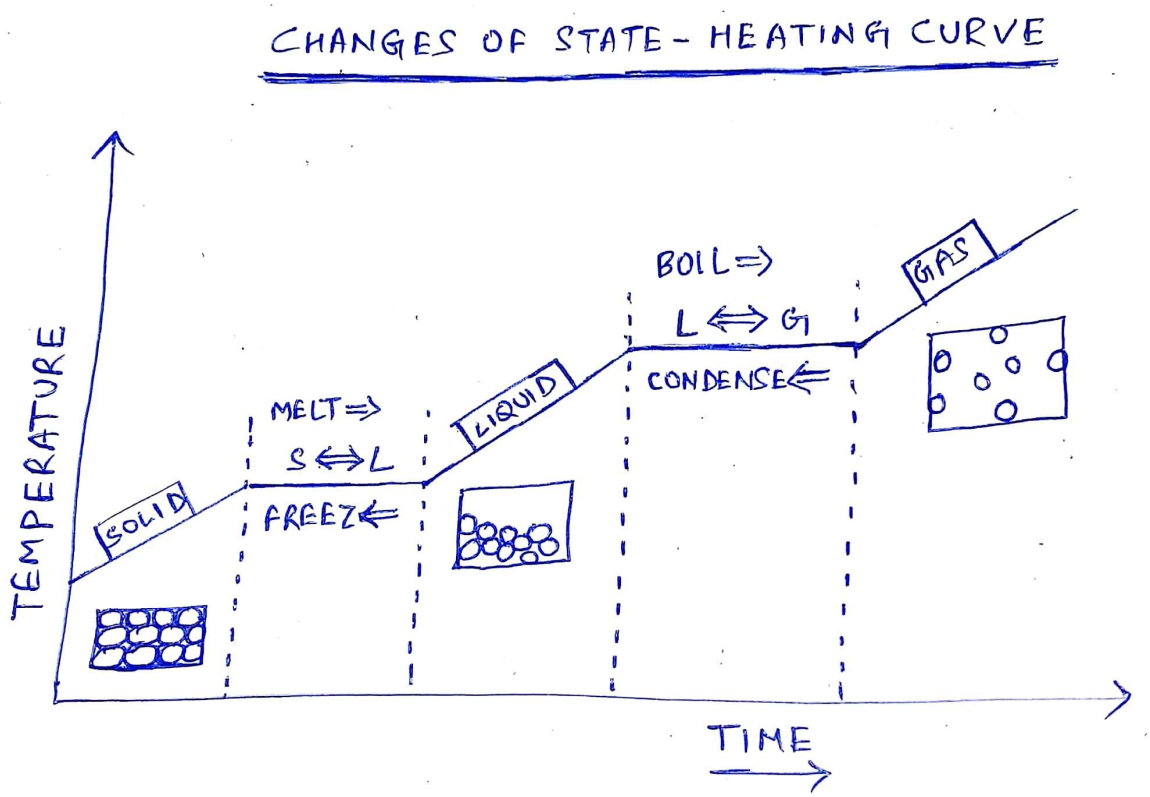

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In our last lecture we were discussing about the elements of climate…

<u>Sunshine</u>

- ***The amount of sun-shine a place receives, depends on the seasons, a factor determined by latitude and by the position of the earth in its revolution around the sun.***



Handout #02...by *MRITYUNJAY UPADHAYAY*

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Certificate Physical and Human Geography

PART 1: PHYSICAL GEOGRAPHY

Chapter 1 THE EARTH AND THE UNIVERSE

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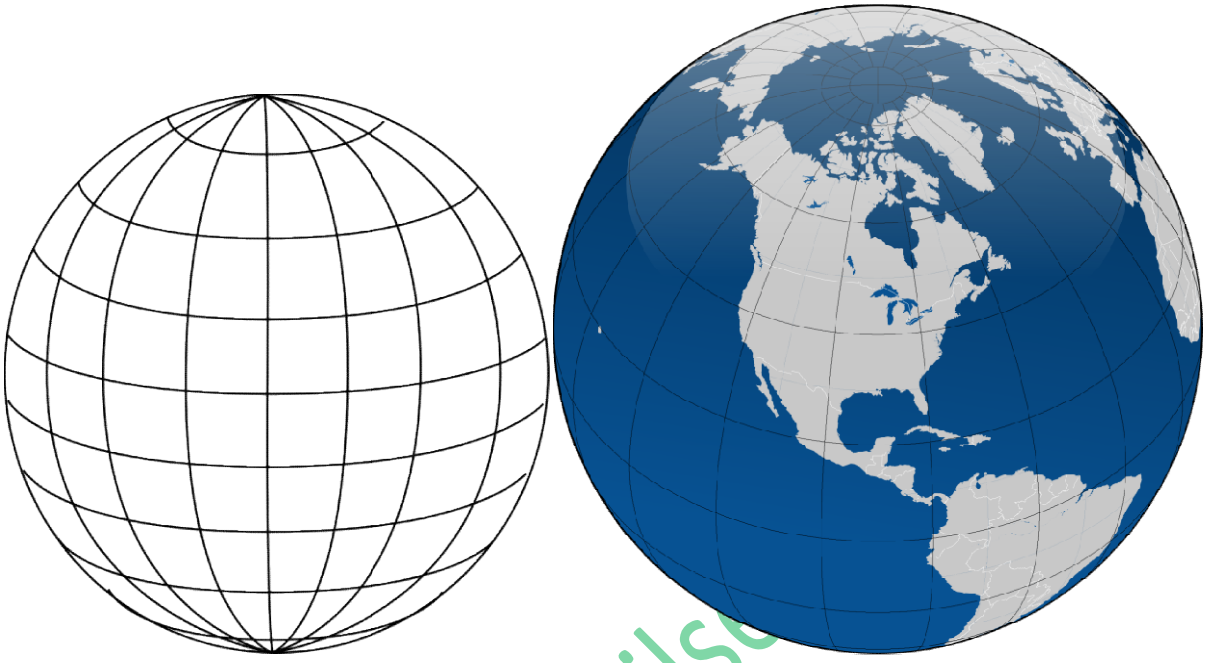
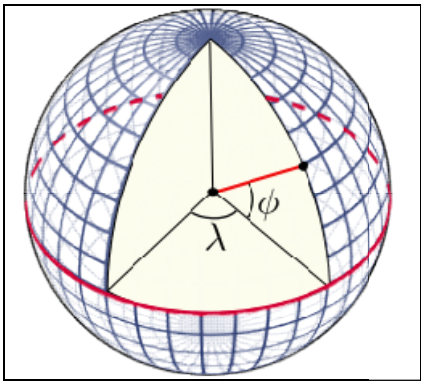
Latitudes and Longitudes

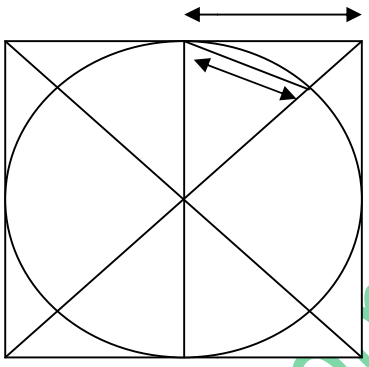
- **Latitudes (अक्षांश) and Longitudes (देशांतर) are imaginary lines used to determine the location of a place on earth.**
- **The shape of the earth is 'Geoid' (पृथ्वी का आकार). And the location of a place on the earth can be mentioned in terms of latitudes and longitudes.**
- **Example: The location of New Delhi is 28°37′ N, 77°10′ E.**



LATITUDE

- Latitude is the angular distance (कोणीय दूरी) of a point on the earth's surface, measured in degrees from the center of the earth.
- It is parallel (समानांतर) to a line, the equator (भूमध्य रेखा), hence called parallels of latitude.
- As the earth is slightly flattened (चपटा) at the poles, the linear distance (रैखिक) of a degree of latitude at the pole is a little longer than that at the equator.
- For example at the equator (0°) it is 68.704 miles, at 45° it is 69.054 miles and at the poles it is 69.407 miles. The average is taken as 69 miles (111km).
- 1 mile = 1.607 km.





The shape of the earth is not a sphere. It is 'Geoid' (earth is slightly flattened at poles). So the linear distance of a degree is greater at poles than at equator.

Important parallels of latitudes

After the Equator (0°), the North Pole (90°N) and the South Pole (90° S), there are 4 important parallels of latitudes–

1. **Tropic of Cancer (कर्क रेखा) (23½° N) in the northern hemisphere (उत्तरी गोलार्द्ध).**
2. **Tropic of Capricorn (मकर रेखा) (23½° S) in the southern hemisphere.**
3. **Arctic circle at 66½° north of the equator.**
4. **Antarctic circle at 66½° south of the equator.**

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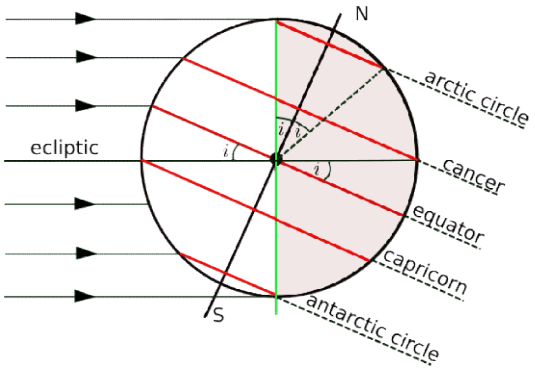

Latitudinal Heat zones of the earth

TORRID ZONE (उष्ण कटिबंध)

- The mid-day sun is exactly overhead at least once a year on all latitudes in between the Tropic of Cancer and the Tropic of Capricorn.
- This area, therefore, receives the maximum heat and is called the torrid zone.

TEMPERATE ZONE (शीतोष्ण कटिबंध)

- The mid-day sun never shines overhead on any latitude beyond the Tropic of Cancer and the Tropic of Capricorn.
- The angle of the sun's rays goes on decreasing towards the poles. Hence, the areas bounded by the Tropic of Cancer and the Arctic circle in the northern hemisphere, and the Tropic of Capricorn and the Antarctic circle in the southern hemisphere, have moderate temperatures. Hence these are called temperate zones.

FRIGID ZONE (शीत कटिबंध)

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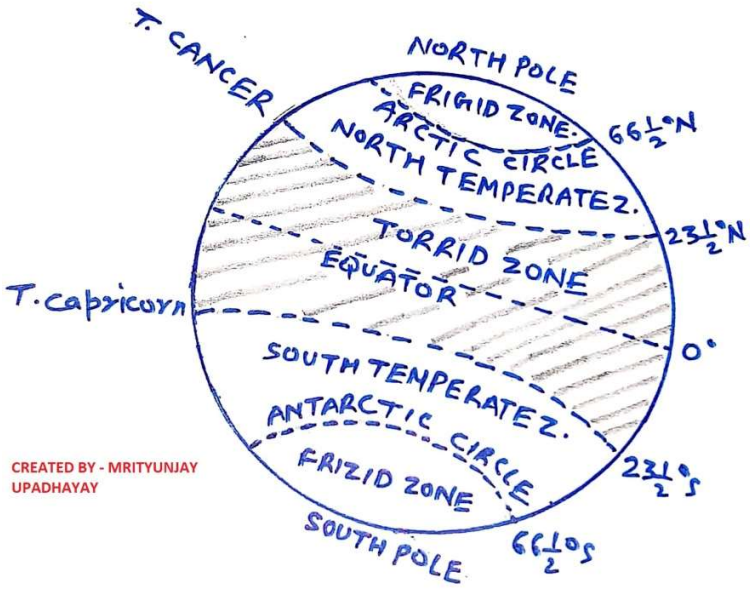
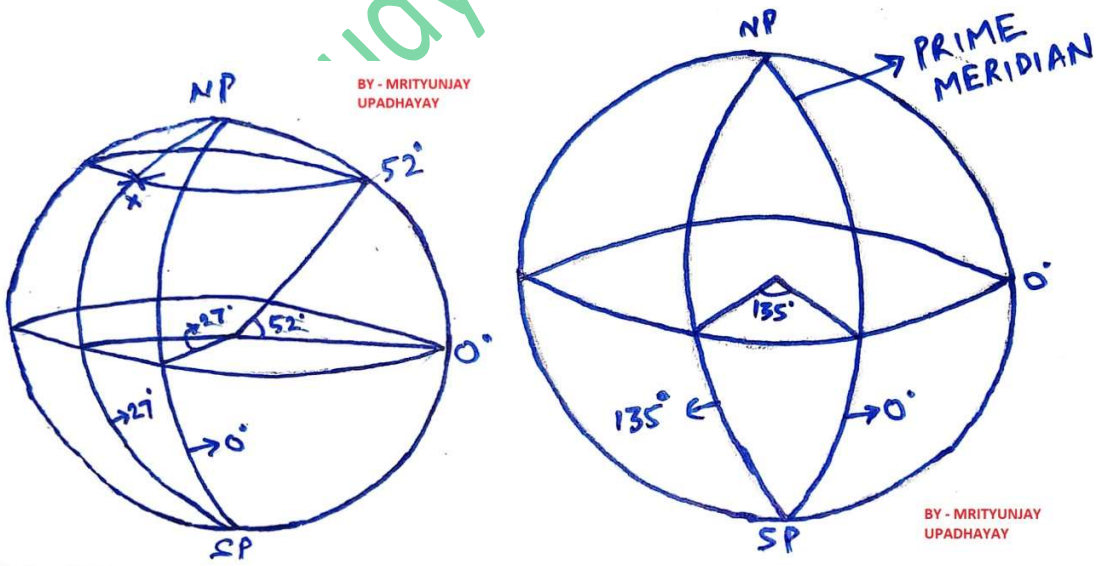
- **Areas lying between the Arctic circle and the north pole in the northern hemisphere and the Antarctic circle and the south pole in the southern hemisphere, are very cold. It is because here the sun does not raise much above the horizon. Therefore, its rays are always slanting. These are, therefore, called frigid zones.**



LONGITUDE

- **Longitude is an angular distance, measured in degrees along the equator east or west of the Prime (or First) Meridian (मानक मध्याह्न रेखा).**
- **On the globe longitude is shown as a series of semi-circles that run from pole to pole passing through the equator. Such lines are also called meridians.**

- **Unlike the equator which is centrally placed between the poles, any meridian could have been taken to begin the numbering of longitude.**
- **It was finally decided in 1884, by international agreement, to choose as the zero meridian the one which passes through the Royal Astronomical Observatory at Greenwich, near London.**
- **This is the Prime Meridian (0°) from which all other meridians radiate eastwards and westwards up to 180°.**
- **As the parallels of latitude become shorter poleward, so the meridians of longitude, which converge at the poles, enclose a narrower space.**
- **They have one very important function, they determine local time in relation to G.M.T. or *Greenwich Mean Time*, which is sometimes referred to as *World Time*.**



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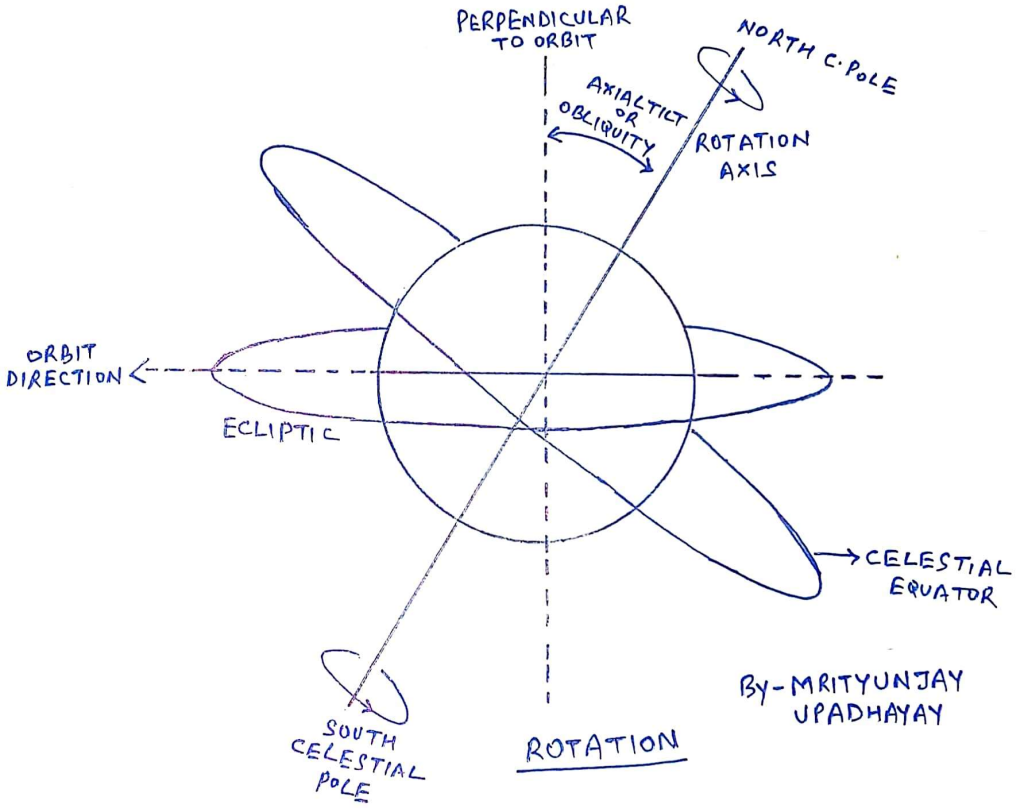
Motions of the earth: Rotation and Revolution

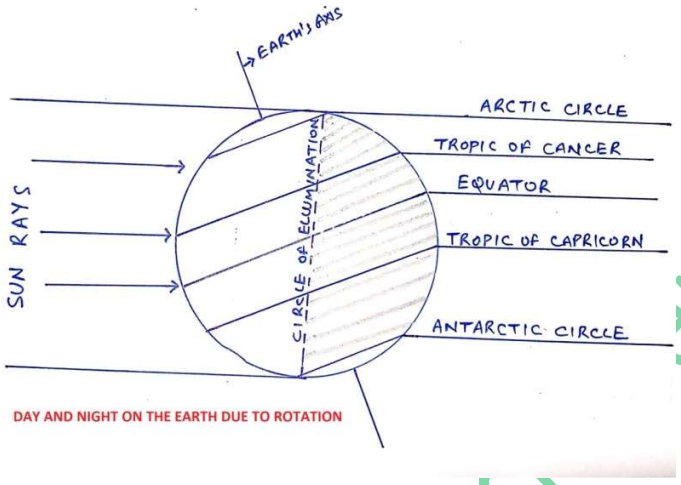
Primarily two motions: Rotation (घूर्णन) and Revolution (चक्कर).



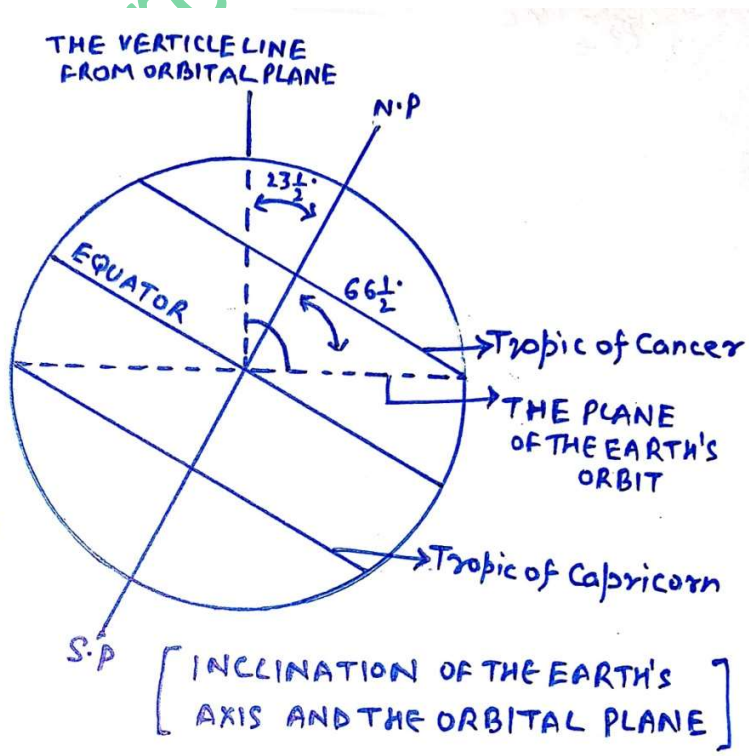
ROTATION OF EARTH

- **Earth rotates along its axis from west to east.**
- **It takes approximately 24 hrs to complete one rotation.**
- **Days and nights occur due to rotation of the earth.**

- **The circle that divides the day from night on the globe is called the circle of illumination (रोशनी के चक्र).**
- **When the earth rotates on its axis only one portion of the earth comes into the rays of Sun and experiences daylight. The other portion will be in darkness.**



DAY AND NIGHT ON THE EARTH DUE TO ROTATION



[INCLINATION OF THE EARTH'S AXIS AND THE ORBITAL PLANE]

By-MRITYUNJAY UPADHYAY

- **Earth rotates on a tilted axis. Earth's rotational axis makes an angle of 23.5° with the normal i.e. it makes an angle of 66.5° with the orbital plane. Orbital plane is the plane of earth's orbit around the Sun.**

Days always longer than nights at the equator?

- **If No Atmosphere → no refraction → day time and night time nearly equal at the equator, at least during equinoxes.**
- **But there is Atmosphere → sun's rays gets refracted (bending of light).**
- **Refraction is particularly stronger during the morning and the evening time when the sun's rays are slant.**
- **Even though the actual sun is below the horizon, its apparent image would appear above the horizon due to refraction. This makes the days longer than nights at the equator.**

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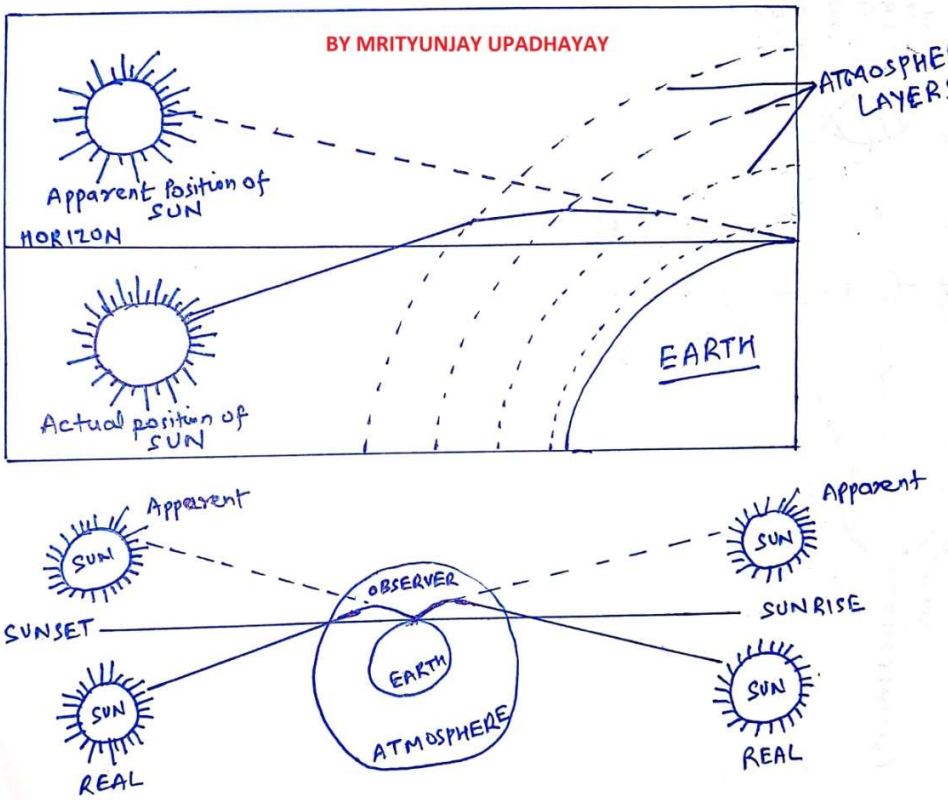

ADVANCE SUNRISE & DELAYED SUNSET

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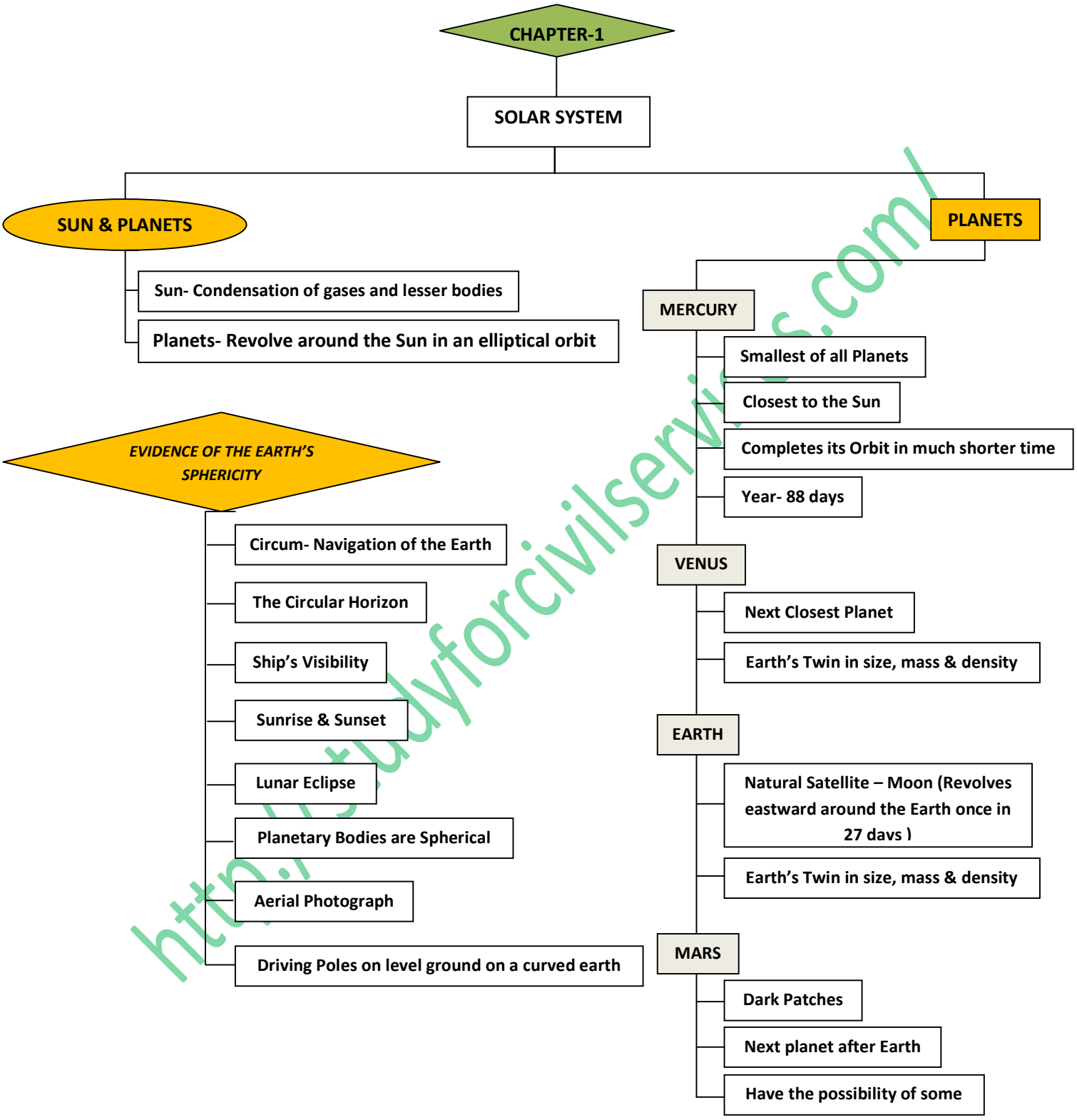

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- **JUPITER**
  - Largest Planet
  - Made up from – Hydrogen, Helium, Methane
  - Has 12 Satellites
- **SATURN**
  - 03 Rings & 09 Satellites
  - 2nd Largest after Jupiter
  - 29 years to complete its Orbit
- **URANUS**
  - First seen as faint bluish green
  - Another Giant Planet
  - 50 Times Larger than Earth & 15 Times as Heavier than Earth
  - Orbits around the Sun in a clockwise direction from East to West
- **NEPTUNE**

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Handout #03...by *MRITYUNJAY UPADHAYAY*

In our last lecture we have been discussing about the TYPES OF MOTION OF THE EARTH …..

- ***So in this lesson we will discuss remaining concepts of chapter 1, such as revolution, its effects and chapter 14, "CLIMATE"***



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PART 1: PHYSICAL GEOGRAPHY

Chapter 1 THE EARTH AND THE UNIVERSE

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Why temperature falls with increasing latitude (as we move from equator towards poles)???

- Spherical (Geoid) shape of the earth and the position of the sun.
- The energy received per unit area decreases from equator to poles. → FIGURE 1
- Equator receives direct sunlight while Poles receive slant (तिरछा) or oblique (परोक्ष) rays of the Sun. → FIGURE 2

Revolution (परिक्रमण) → FIGURE 3

- The second motion of the earth around the sun in its orbit is called revolution. It spins on an elliptical orbit (अण्डाकार कक्षा) at a speed of 18.5 m/s. It takes 365¼ days (one year) to revolve around the sun.

- **Six hours saved every year are added to make one day (24 hours) over a span of four years. This surplus day is added to the month of February. Thus every fourth year, February is of 29 days instead of 28 days. Such a year with 366 days is called a leap year.**

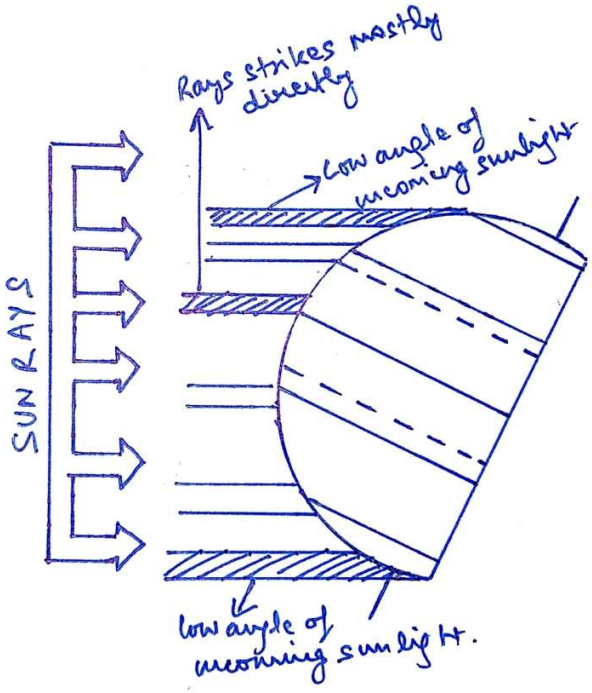

FIGURE 1

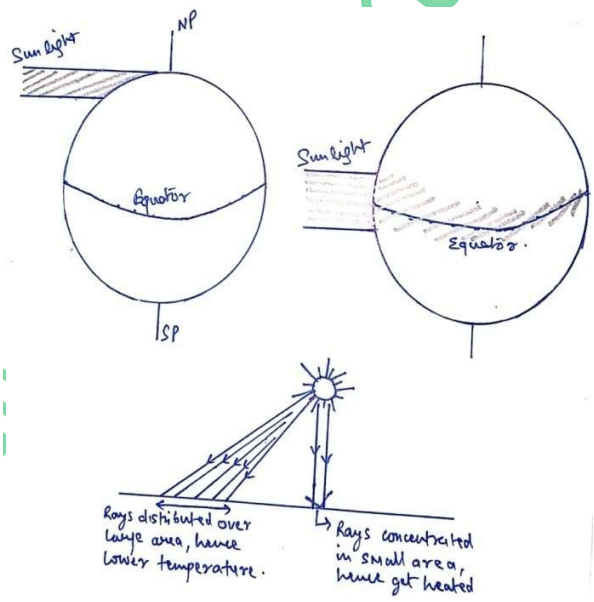

FIGURE 2

- **In our figure 1 as we move from equator towards poles angle of incoming sunlight decreases, hence temperature decreases.**
- **In figure 2 unlike poles, latitudes in between the tropics receives sunlight overhead hence receives maximum temperature.**

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REVOLUTION OF THE EARTH AROUND THE SUN

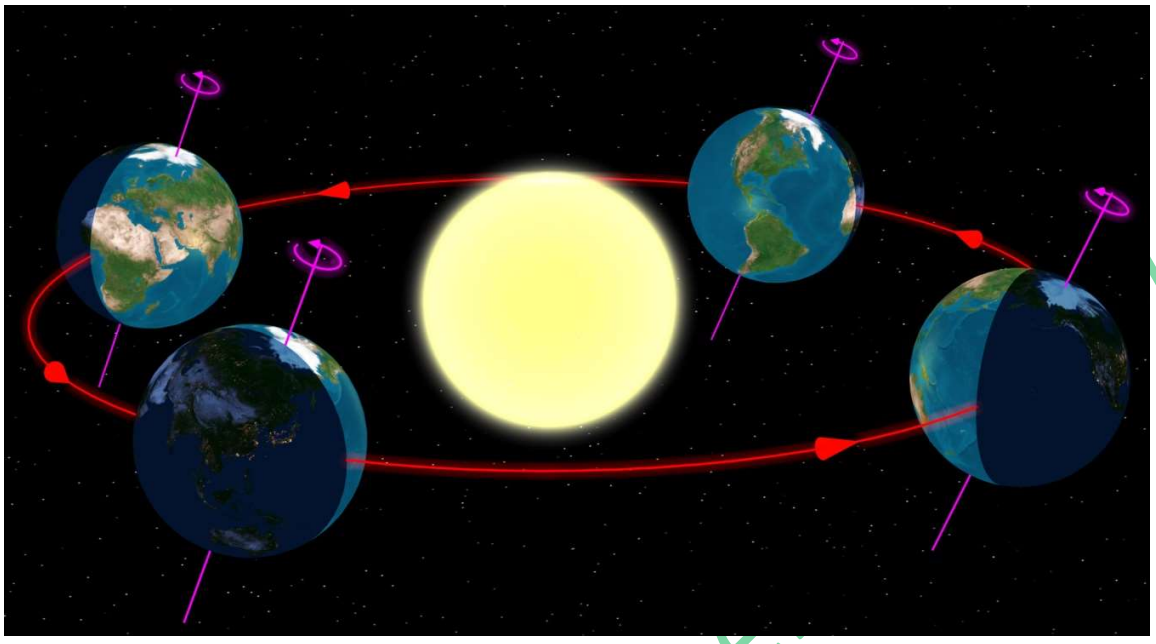

FIGURE 3

Solstice

21st June → Summer Solstice (ग्रीष्मकालीन अयनांत)

- On 21st June sun is vertically overhead at the Tropic of Cancer (23½°N) in the Northern Hemisphere. The rays of the sun fall directly on the Tropic of Cancer. As a result, these areas receive more heat.
- The areas near the poles receive less heat as the rays of the sun are slanting.
- North Pole → Towards Sun → Places Beyond Arctic Circle Summer in Region ← Continuous Daylight (6 months)
- Longest day and the shortest night → 21st June.

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- At this time → Southern Hemisphere → Winter Season
  Reverse of NH ← Nights are Longer than the Days ←
- This position of the earth is called the summer solstice.

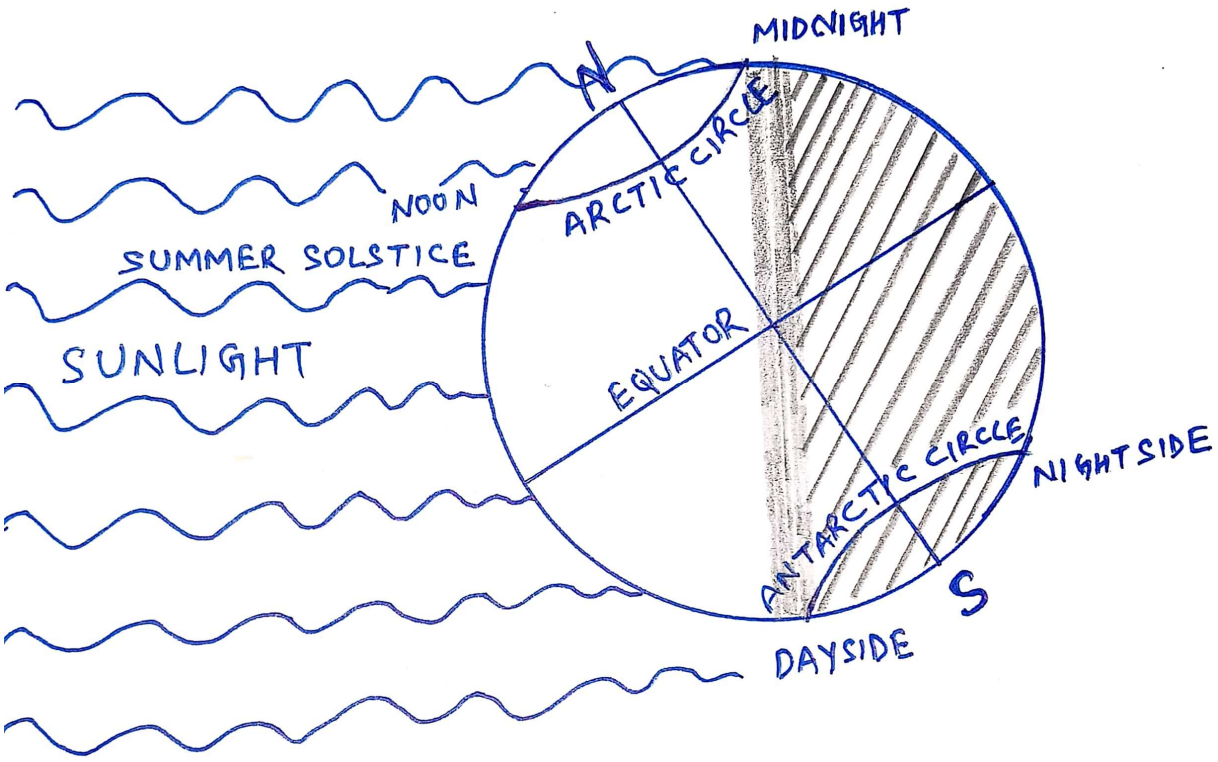

FIGURE 4

22nd December → Winter Solstice (शीतकालीन अयनांत)

- On 22nd December → direct rays of the sun → Tropic of Capricorn (23½° s) → South Pole tilts towards → Summer Longer days & shorter nights ← Southern Hemisphere ←
- The reverse happens in the northern hemisphere. This position of the earth is called the winter solstice.

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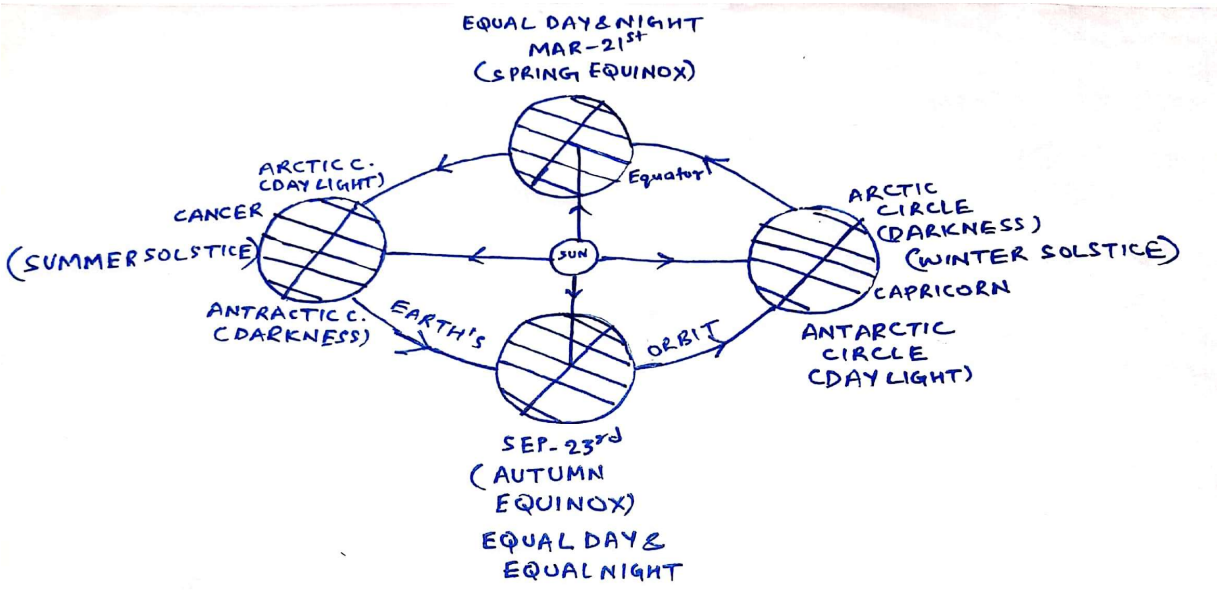

FIGURE 5

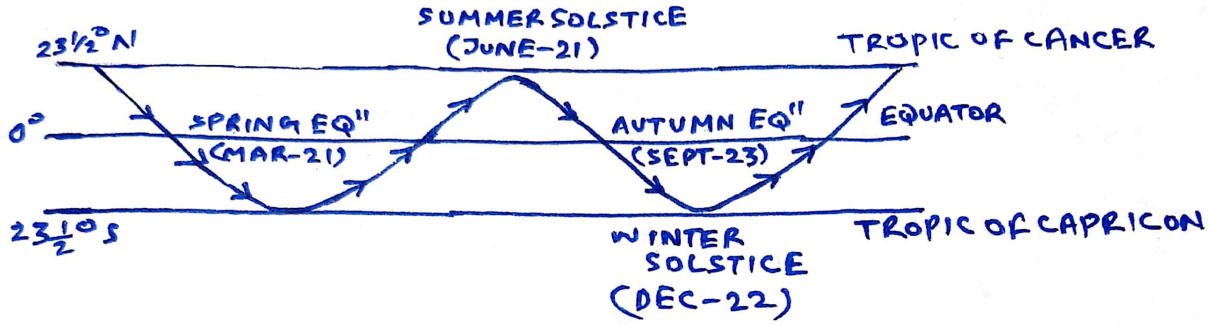

FIGURE 6

Equinox (विषुव)

On *21st March* and *September 23rd*, direct rays of the sun fall on the equator. At this position, neither of the poles is tilted towards the sun; so, the whole earth experiences equal days and equal nights. This is called an *equinox*.

23rd September → Autumn Equinox (शरद विषुव)

21st March → Spring Equinox (वसंत विषुव)

- **On 23rd September, it is autumn season [after summer & before winter] in the north hemisphere and spring season [after winter & before summer] in the southern hemisphere.**
- **The opposite is the case on 21st March, when it is spring in the northern hemisphere and autumn in the south hemisphere.**

The Altitude (ऊँचाई) of the Midday Sun

- **As of now we have discussed the Solstices and Equinoxes. So we can conclude that the tropics thus, mark the limits of the overhead sun, for beyond these, the sun is never overhead at any time of the year.**
- **Beyond the Arctic and Antarctic Circle, where darkness lasts for 6 months & daylight is continuous for the remaining half of the year, it is always cold, for even during short summer the sun is never high in the sky.**

Seasonal Changes & their Effects on Temperature

- **Summer is usually associated with much heat and brightness and winter with cold and darkness because of**

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sun is higher in the sky than in winter. In addition days are longer than nights in summer & received more heat.

Varying Lengths of Day and Night

- The axis of the earth is *inclined* to the *plane of the ecliptic* (क्रांतिवृत्त के विमान) (the plane in which the earth orbits round the sun) at an angle of 66½°, giving rise to different seasons and varying lengths of day and night.
- If the axis were perpendicular to this plane, all parts of the globe would have equal days and night at all time of the year.
- Northern Hemisphere → Winter → Moving Northwards → Hours of Darkness ↑ → Arctic Circle ← 24 hours Night
- Beyond the Arctic Circle the number of days with complete darkness increases, until we reach the north pole, when half the year will have darkness.
- Summer Conditions are reversed …
- Northern Hemisphere → Summer → Moving Northwards → Hours of ……..↑ → Arctic Circle ← ……
- In the Summer the region north of the Arctic Circle is popularly referred to as 'Land of the Mid-night Sun' .
- At the North Pole, there will be 6 months of continuous daylight.

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Dawn and Twilight

- **Dawn (भोर) – Brief period between sunrise and full daylight**
- **Twilight (सांझ) – Time between sunset and complete darkness**
- **During the period of dawn and twilight the earth receives diffused or refracted light from the sun whilst it is still below the horizon.**
- **Sun rises and sets in a vertical path at the equator the period during which refracted light is received is short.**
- **But in temperate latitudes the sun rises and sets in an oblique path and the period of refracted light is longer.**
- **It is much longer at poles hence winter darkness is really only twilight most of the time.**

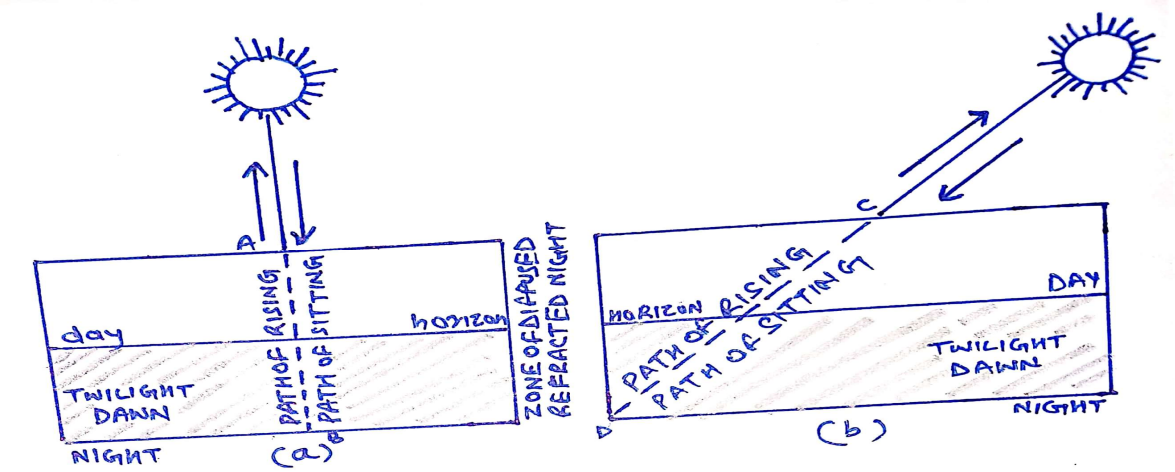

FIGURE-7

Dawn and Twilight (a) → At the Equator
(b) → In Temperate Latitudes.

→ AT THE EQUATOR THE SUN RISES AND SETS ALMOST VERTICALLY SO THE TIME IT TAKES TO PASS THROUGH THE 'TWILIGHT ZONE' (A,B), WILL BE SHORTER THAN FOR TEMPERATE LATITUDES, WHERE THE SUN RISES AND SETS OBLIQUELY (C,D).

Daylight saving time (DST) concept, we will discuss along with Standard time and Time zones in later classes..

Chapter 14 CLIMATE

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Atmosphere (वातावरण)

- Our planet earth is enveloped by a deep blanket of gases extending several thousands of kilometres above its surface. This gaseous cover of the earth is known as the atmosphere.
- This huge blanket of atmosphere provides us the air we breathe and protects us from the harmful effects of the sun's rays.
- Without this blanket of protection, we would be baked alive by the heat of the sun during day and get frozen during night. So it is this mass of air that has made the temperature on the earth liveable.
- It is an integral part of the earth like land (lithosphere, स्थलमंडल) and water (hydrosphere, जलमंडल).
- Because of the force of gravity (गुरुत्वाकर्षण), it is inseparable (जो अलग न हो सके) from the earth.

- 99 % of the total mass of the atmosphere is confined to the height of 32 km from the earth's surface.
- The atmospheric pressure at sea level is 1034 gm/cm^2.

Various Role of Earth's Atmosphere

- It contains various gases like oxygen (O_2), carbon dioxide (CO_2), nitrogen (N_2) etc.
- CO_2 is significant for the plants to survive, while animals and many other organisms need O_2 for their survival.
- The atmosphere provides these life giving gases.
- It regulates the entry of solar radiation by absorbing certain frequencies of solar radiations.
- It also regulates the temperature over the earth's surface. In the absence of the atmosphere extremes of temperature would exist between day and night over the earth's surface.
- It prevents Harmful ultraviolet radiation from the sun.
- When extraterrestrial objects like meteors, passing through the atmosphere (particularly mesosphere) ,gets burnt up due to friction.

Composition of Atmosphere

- It is a mixture of many gases along with huge numbers of solid and liquid particles, collectively called 'aerosols'.

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- **Some of the gases may be regarded as permanent atmospheric components which remain in fixed proportion to the total gas volume.**
- **Other constituents vary in quantity from place to place and from time to time.**

Constituent	Formula	Percentage by Volume
Nitrogen	N_2	78.08
Oxygen	O_2	20.95
Argon	Ar	0.93
Carbon dioxide	CO_2	0.036
Neon	Ne	0.002
Helium	He	0.0005
Krypto	Kr	0.001
Xenon	Xe	0.00009
Hydrogen	H	0.00005

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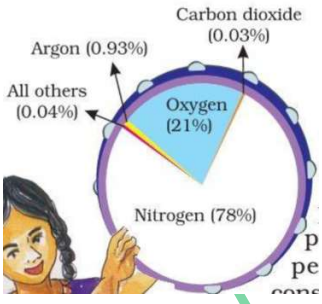
The proportion of gases changes in the higher layers of the atmosphere in such a way that oxygen will be almost in negligible quantity at the height of 120 km. Similarly, carbon dioxide and water vapour are found only up to 90 km from the surface of the earth.



- Nitrogen and oxygen make up nearly 99% of the clean, dry air. The remaining gases are mostly inert and constitute about 1% of the atmosphere.
- Besides these gases, large quantities of water vapour and dust particles are also present in the atmosphere. These solid and liquid particles are of great climatic significance.

HANDOUT #02.....CONCEPT

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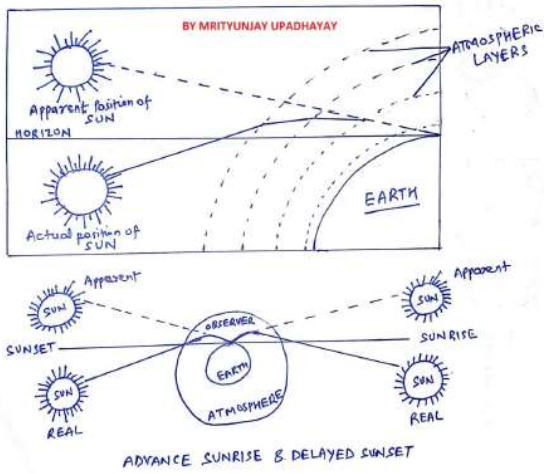

Days always longer than nights at the equator?

- If No Atmosphere no refraction day time and night time nearly equal at the equator, at least during equinoxes.
- But there is Atmosphere sun's rays gets refracted (bending of light).
- Refraction is particularly stronger during the morning and the evening time when the sun's rays are slant.
- Even though the actual sun is below the horizon, its apparent image would appear above the horizon due to refraction. This makes the days longer than nights at the equator.

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In our next lecture we will discuss the structure of the atmosphere and different constituents of the atmosphere, with their individual characteristics

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Handout #04...by MRITYUNJAY UPADHAYAY

In our last lecture we have been dealing with Chapter 14 "CLIMATE"....ATMOSPHERE .....

- *So in this lesson we will discuss the different constituents of the atmosphere, with their individual characteristics and the structure of the atmosphere*



GOH CHENGLEONG

Certificate Physical and Human Geography

PART 2: WEATHER, CLIMATE & VEGETATION

Chapter 14 CLIMATE

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Major constituents of the Atmosphere

Oxygen	• 21% of total volume of atmosphere **Combustion (ज्वलन)** is not possible w/o oxygen
Nitrogen	• 78% of total atmospheric volume • Relatively inert gas (**निष्क्रिय गैसें**) • Control combustion by diluting oxygen • Indirectly helps in oxidation (**ऑक्सीकरण**)(lose of an ele-)
CO_2	• 0.03% of the dry air and is a product of combustion • **Efficient absorber of heat** • Very important factor in the heat energy budget
Ozone (O_3)	• Unevenly distributed • Between **20 km and 25 km altitude** that the greatest concentrations • Formed at higher altitudes and transported downwards
Water Vapour	• Between **0.02% and 4%** of the total volume (in cold dry and humid tropical climates respectively • **90% of moisture (नमी) content in the atmosphere exists**

	within 6 km of the surface of the earth • Like carbon dioxide, water vapour plays a significant role in the insulating action, of the atmosphere • Absorbs not only the long-wave terrestrial radiation (लम्बी-तरंग स्थलीय विकिरण) (infrared or heat emitted by earth during nights), but also a part of the incoming solar radiation • Water vapour is the source of precipitation (rain) and clouds • On condensation, it releases latent heat of condensation (संघनन की गुप्त उष्मा)—the ultimate driving force behind all storms
Solid Particles	• Sand particles (from weathered rocks and also derived from volcanic ash), pollen grains, small organisms, soot, ocean salts • Absorbs(अवशोषित), reflects and scatters(प्रकीर्ण) the radiation • Responsible for the orange and red colours at sunset and sunrise and for the length of dawn & twilight • The blue colour of the sky is also due to selective scattering (प्रकीर्ण) by dust particles • Act as nuclei of condensation hence helps in the formation of clouds, fog and hailstones

Major Greenhouse Gases

Carbon dioxide (CO_2)	• Transparent to the incoming solar radiation but opaque to the outgoing terrestrial radiation. • Absorbs a part of terrestrial radiation and reflects back some part of it towards the earth's surface. • It is largely responsible for greenhouse effect.

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Ozone	• Very small proportions at the surface
Water vapour	• Variable gas in the atmosphere, which decreases with altitude • Decreases from the equator towards the poles
	• In warm and wet tropics, it may account for 4% of the air by volume, while in the dry and cold areas of desert and polar regions, it may be less than 1% of the air • Acts like a blanket allowing the earth neither to become too cold nor too hot • Water vapour also contributes to the stability and instability in the air
Methane	• Produced from decomposition of animal wastes and biological matter • The Arctic region is one of the many natural sources of the greenhouse gas methane. • Arctic methane release is the release of methane from seas and soils in permafrost regions of the Arctic. Permafrost (स्थायी तुषार भूमि) is any ground that remains completely frozen—32°F (0°C) or colder—for at least two years straight.

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*NOTE - Latent heat can be understood as heat **energy in hidden** form which is supplied or extracted to change the state of a substance without changing its temperature. Examples are latent heat of fusion and latent heat of vaporization involved in phase changes, i.e. a substance condensing or vaporizing at a specified temperature and pressure.*

Structure of Atmosphere

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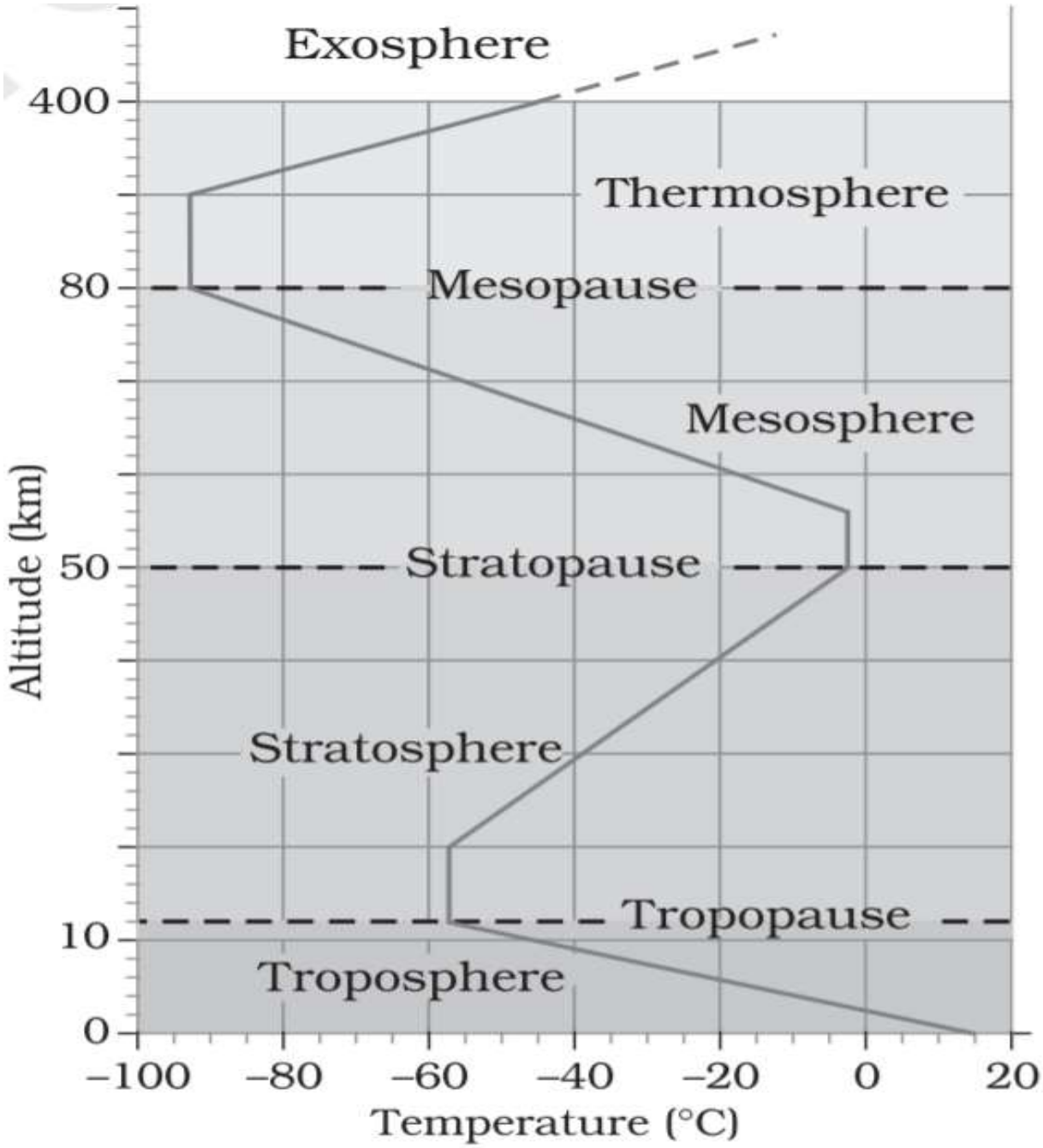
- **A layered entity in which each layer having its own peculiar characteristics.**



Troposphere (क्षोभ मंडल)	• Atmospheric layer between the earth's surface and an altitude of 8 km at the poles and 18 km at the equator • The thickness is greater at the equator, due to the heated air rises to greater heights • Ends with the Tropopause • Temperature as one goes upwards, falls at the rate of 6.5°C per kilometer, and reaches -45°C at the poles and -80°C over the equator at Tropopause (greater fall in temperature above equator is due to the greater thickness of troposphere – 18 km) • The fall in temperature is called …….. • This layer is marked by temperature inversion (तापमान का व्यूत्क्रमण), turbulence and eddies • Almost all the weather phenomena like rainfall, fog, hailstorm, cyclones, anticyclones and storms etc. are confined to this layer because all water vapours and solid particles lie within this • Convective region, because all convection stops at Tropopause • It is influenced by seasons and jet streams
Tropopause (क्षोभसीमा)	• Top most layer of troposphere • Acts as a boundary between troposphere and stratosphere • This layer is marked by constant temperatures
Stratosphere (स्ट्रैटस्फ़ियर)	• Beyond troposphere, up to an altitude of 50 km from the earth's surface • The temperature in this layer remains constant for some hight but then rises to reach at 0°C at 50 km altitude • This rise is due to the presence of ozone (harmful ultraviolet radiation is absorbed by ozone). • This layer is almost free from clouds and associated weather phenomenon, making conditions most ideal for flying aeroplanes. So aeroplanes fly in lower stratosphere, sometimes in upper

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	troposphere where weather is calm • Sometimes, cirrus clouds (discuss later) are present at lower levels in this layer
Ozonosphere (ओज़ोनोस्फेरे)	• At an altitude between 30 km and 60 km from the earth's surface and spreads the stratosphere and lower mesosphere • Because of the presence of ozone molecules, this layer reflects the harmful ultraviolet radiation • The ozonosphere is also k/a chemosphere because, a lot of chemical activity goes on here • The temperature rises at a rate of 5°C/km through the ozonosphere
Mesosphere (मध्यमण्डल)	• An intermediate layer beyond the ozone layer and continues upto an altitude of 80 km from the earth's surface • The temperature gradually falls to -100°C at 80 km altitude • Meteorites (उल्कापिंड) burn up in this layer on entering from the space
Thermosphere (थर्मोस्फीयर)	• Temperature rises very rapidly with increasing height. It extends between 80-400 km • Ionosphere is a part of this layer • Significant for radio transmission as radio waves transmitted from the earth are reflected (परावर्तित) back to the earth by this layer • It is not warm because of the thermosphere's extremely low pressure • The International Space Station and satellites orbit in this layer (Though temperature is high, the atmosphere is extremely rarified – gas molecules are spaced hundreds of kilometers apart) • Aurora's are observed in lower parts of this layer
Ionosphere (आयनमंडल)	• located between 80 km and 400 km and is an electrically charged layer • This layer is featured by ionization of atoms

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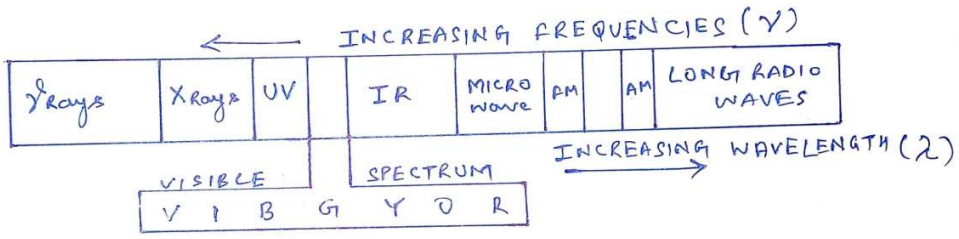
	• Because of the electric charge, radio waves transmitted from the earth are reflected back to the earth by this layer • Temperature again starts increasing with height because of radiation from the sun
Exosphere (बहिर्मंडल)	• Uppermost layer of the atmosphere extending beyond the ionosphere above a height of about 400 km • The air is extremely rarefied and the temperature gradually increases through the layer as it is exposed to direct sunlight • Light gases like helium and hydrogen float into the space from here

- Speed of sound follows temperature profile because speed of sound is directly proportional (सीधे आनुपातिक) to temperature as we move away from earth.

Temperature Distribution on Earth

- Sun is the ultimate source of heat, which has a surface temperature of more than 10800°F.
- The main reason behind all climatic features is the differential heating received from sun by different regions on earth.
- So it is important to understand the patterns of distribution of temperature in different seasons in order to understanding various climatic features like wind systems, pressure systems, precipitation etc..



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Insolation (आतपन या सूर्यताप)

- Earth recieves only 1 in 2 billion parts of solar radiation. This recieved radiation is called Insolation.
- Insolation → Proportion of Solar energy received or intercepted by earth.
- Some heat within the core and mantle is transferred to the surface and ocean bottoms through volcanoes, springs and geysers. But this heat received at the surface form interiors of the earth is negligible compared to that received from sun.
- Earth receives Sun's radiation (heat) → Short waves → Visible light + wavelengths below visible light – most of it is ultraviolet radiation)
  Electromagnetic Nature ←
- Earth absorbs → Short wave radiation during daytime and reflects back the heat received into space as long-wave radiation (mostly infrared radiation) during night.

Ways of Transfer of Heat Energy

Heat energy from the solar radiation is received by the earth through 3 mechanisms……

1. **Radiation (विकिरण)** → Heat transfer from one body to another without actual contact or movement. It is possible in relatively empty space, such as, from the sun to the earth through space.
2. **Conduction**(प्रवाहकत्त्व) →Heat transfer through matter by molecular activity. Heat transfer in iron and other metals is by conduction. Generally, denser materials like water are good conductors and a lighter medium like air is a bad conductor of heat.
3. **Convection**(संवहन)→ Transfer of heat energy by actual transfer of matter or substance from one place to another. (heat transfer by convection cycles in atmosphere as well as oceans)

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- **It is estimated that the total radiation coming to us, 35% reaches the atmosphere and is directly reflected back to the space by dust, clouds and air molecules. It plays practically no part in heating the earth and its atmosphere.**
- **Another 14% is absorbed by the water vapour, carbon dioxide and other gases. Its interception by the air causes it to be scattered and diffused so that the visible rays of the spectrum between the UV & IR give rise to the characteristic Blue sky, that we see above us.**
- **The remaining 51% reaches the earth and warms the surface.**
- **In turn the earth warms the layers of air above it by direct contact or conduction, and through the transmission of heat by upward movement of air currents or convection.**

LAND HEATED AND COOLS QUICKLY THAN WATER??

Because water is transparent, heat absorbed more slowly and becauseit is always in motion, its absorbed heat is distributed over a greater depth and area. Thus any appreciable rise in temperature takes a much longer time.

On the other hand the opaque nature of land allows greater absorption but all the radiant heat is concentrated at the surface, and temperature rises rapidly. Because of these differences between land and water surfaces land also cools more quickly than water.

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Aurora

An aurora sometimes referred to as polar lights, northern lights (aurora borealis), southern lights (aurora australis), is a natural light display in the Earth's sky, predominantly seen in the high-latitude regions (around the Arctic and Antarctic).

Auroras are produced when the magnetosphere is sufficiently disturbed by the solar wind that the trajectories of charged particles in both solar wind and magnetospheric plasma, mainly in the form of electrons and protons, precipitate them into the upper atmosphere (thermosphere/exosphere) due to Earth's magnetic field, where their energy is lost.

