ATMOSPHERE

General Characteristics

-It is a mixture of numerous gases

-This gaseous cover of the earth is held around it by gravitational attraction and rotates with it.

-The density of the atmosphere decreases rapidly with the altitude.

-About 97% of the air is concentrated in the lower 29 km.

-Air is colourless, odourless and tasteless substance.

-It is mobile, elastic and compressible.

-We feel the air only in its horizontal motion called as Wind.

-Air has weight and the pressure that it exerts on the surface is called Atmospheric Pressure.

-The absence of atmosphere will result in increasing temperature of about 260 oC, making earth impossible for life.

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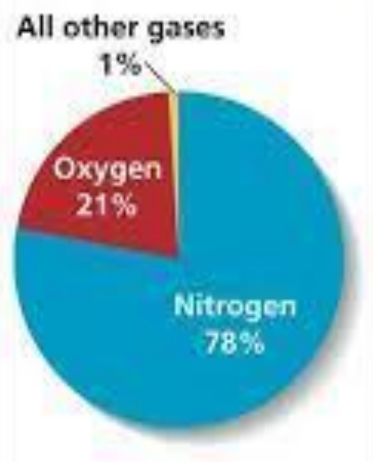
ORIGIN OF ATMOSPHERE

Video Watching and sharing the views

COMPOSITION OF ATMOSPHERE

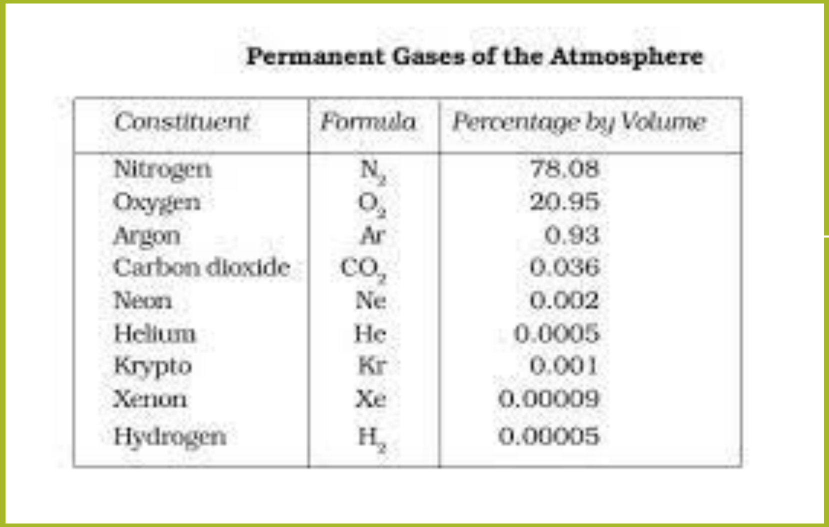


Gas	Percentage by Volume
Nitrogen (N_2)	78.084
Oxygen (O_2)	20.946
Argon (Ar)	0.934
Carbon dioxide (CO_2)	0.037
Neon (Ne)	0.00182
Helium (He)	0.00052
Methane (CH_4)	0.00015
Krypton (Kr)	0.00011

Table 1–2 Principal gases of dry air

Constituent	Percent by Volume	Concentration in Parts Per Million (PPM)
Nitrogen (N_2)	78.084	780,840.0
Oxygen (O_2)	20.946	209,460.0
Argon (Ar)	0.934	9,340.0
Carbon dioxide (CO_2)	0.036	360.0
Neon (Ne)	0.00182	18.2
Helium (He)	0.000524	5.24
Methane (CH_4)	0.00015	1.5
Krypton (Kr)	0.000114	1.14
Hydrogen (H_2)	0.00005	0.5

COMPOSITION OF ATMOSPHERE



Permanent Gases of the Atmosphere

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_2	0.00005

- The atmosphere is a mixture of many gases. In addition, it contains huge numbers of solid and liquid particles, collectively called **‘aerosols’.**

- 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. If the suspended particles, water vapour and other variable gases were excluded from the atmosphere, then the dry air is very stable all over the earth up to an altitude of about 80 kilometres.

- 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.

•**Nitrogen:**

Nitrogen accounts for **78%** of total atmospheric volume. It is a **relatively inert gas**, and is an important constituent of all organic compounds. The main function of nitrogen is to **control combustion by diluting oxygen**. It also indirectly helps in oxidation of different kinds.

•**Oxygen:**

Oxygen, although constituting only **21%**of total volume of atmosphere, is the most important component among gases. All living organisms inhale oxygen. Besides, oxygen can combine with other elements to form important compounds, such as, **oxides**. Also, **combustion is not possible without oxygen**.

•**Carbon dioxide:**

- The third important gas is Carbon Dioxide which constitutes only about **03%**of the dry air and is a product of combustion.
- Green plants, through photosynthesis, absorb carbon dioxide from the atmosphere and use it to manufacture food and keep other bio-physical processes going.
- Being an **efficient absorber of heat**, carbon dioxide is considered to be of great climatic significance.
- Carbon dioxide is considered to be a very important factor in the **heat energy budget.**
- With increased burning of fossil fuels – oil, coal and natural gas – the carbon dioxide percentage in the atmosphere has been increasing at an alarming rate.
- More carbon dioxide in the atmosphere means more heat absorption. This could significantly raise the temperature at lower levels of the atmosphere thus inducing drastic climatic changes.

Ozone:

Ozone (03) is another important gas in the atmosphere, which is actually a type of oxygen molecule consisting of three, instead of two, atoms.

It forms less than **0.00005%** by volume of the atmosphere and is **unevenly distributed**.

It is between **20 km and 25** km altitude that the greatest concentrations of ozone are found.

It is formed at higher altitudes and transported downwards.

Ozone plays a **crucial role in blocking the harmful ultraviolet radiation** from the sun.

Other gases found in almost negligible quantities in the atmosphere are **neon, helium, hydrogen, xenon, krypton, methane etc.**

Water vapour

Gaseous form of water present in the atmosphere is called water vapour.

Water vapour present in the atmosphere has made life possible on the earth Water vapour is the source of all kinds of precipitation.

Its maximum amount in the atmosphere could be **upto 4 percent.**

Maximum amount of water vapour is found in hot-wet regions and its least amount is found in the dry regions.

Generally, the amount of water vapour goes on decreasing from low latitudes to high latitudes.

In the same way, its amount goes on decreasing with increasing altitude.

Water vapour reaches in the atmosphere through evaporation and transpiration.

Evaporation takes place in the oceans, seas, rivers, ponds and lakes while transpiration takes lace from the plants, trees and living beings.

Dust Particles

Dust particles are generally found in the lower layers of the atmosphere.

These particles are found in the form of sand, smoke and oceanic salt.

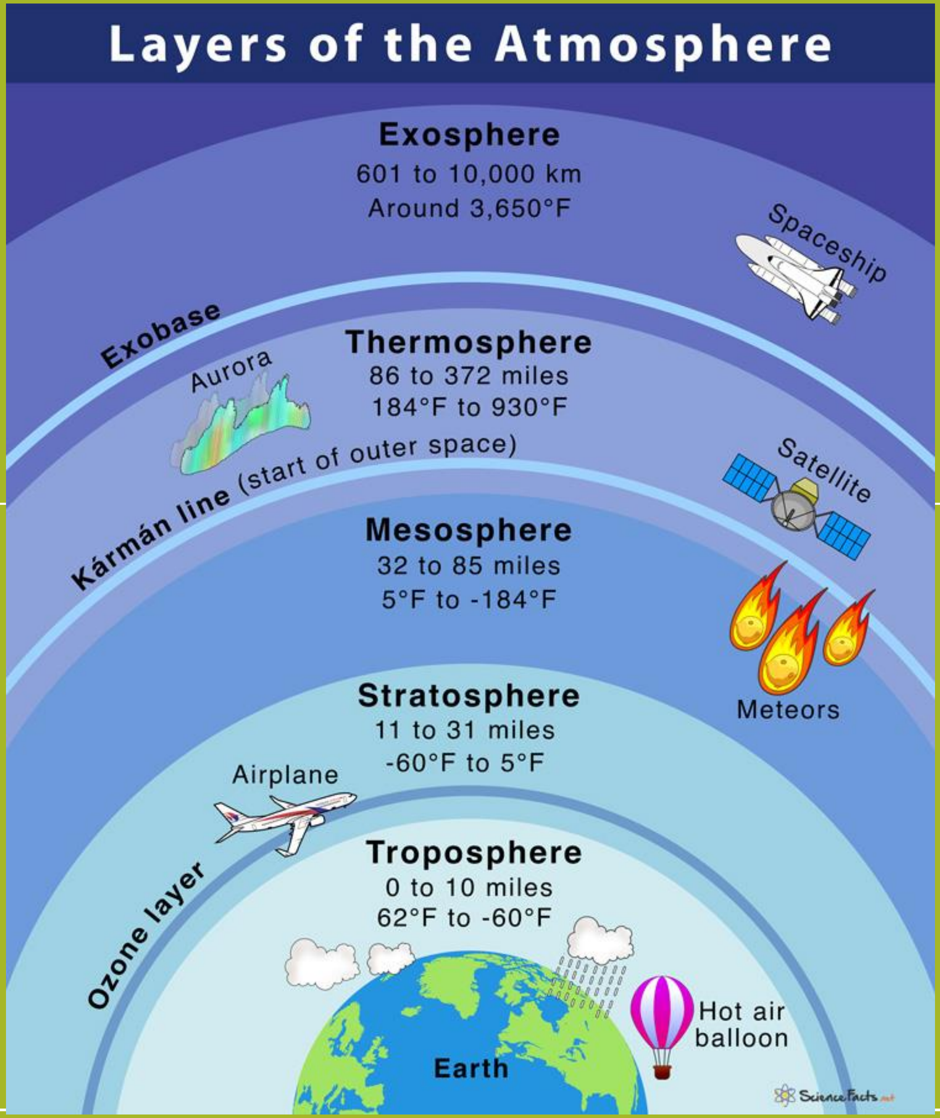
Sand particle have important place in the atmosphere.

These dust particles help in the condensation of water vapour.

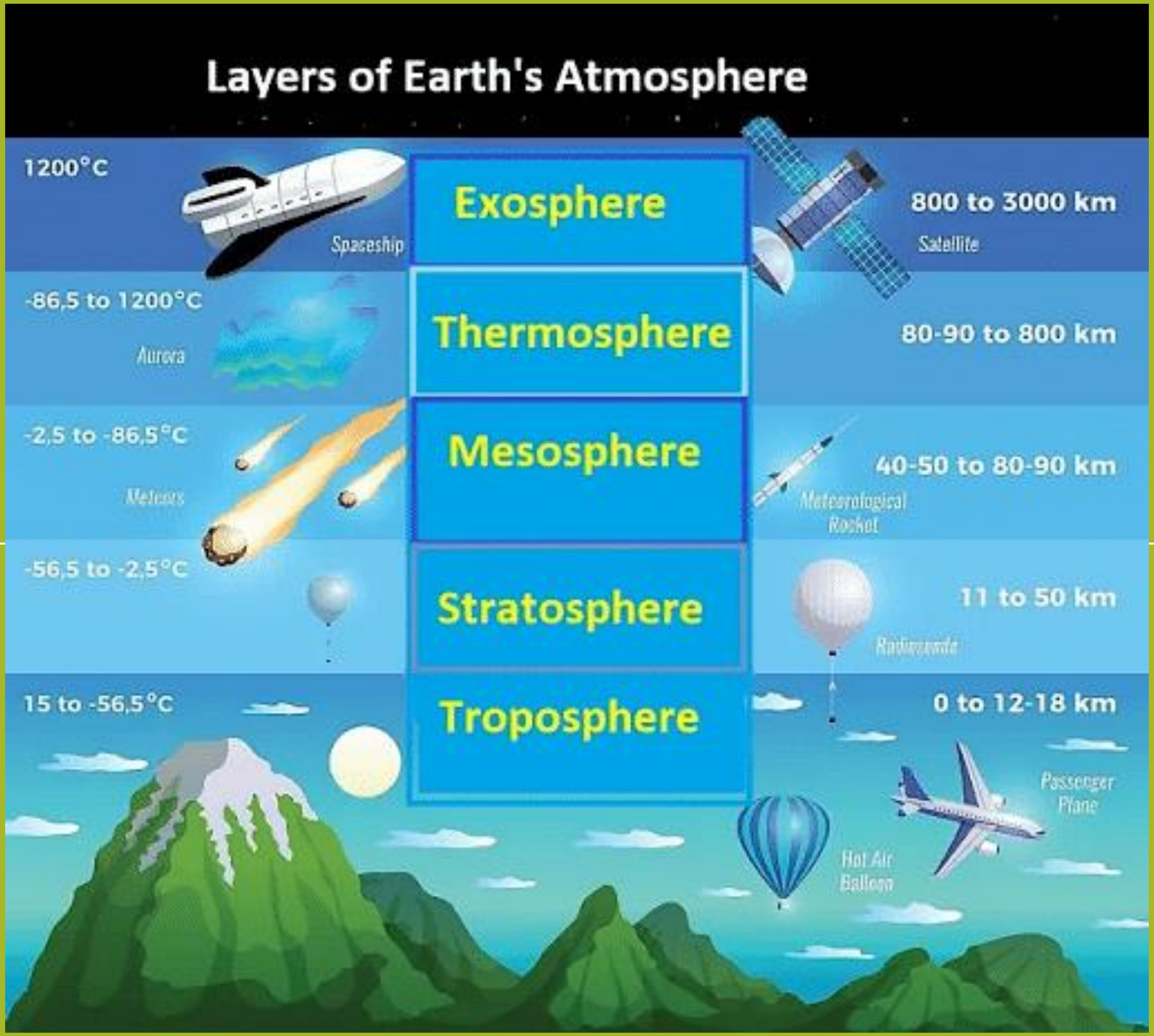
During condensation water vapour gets condensed in the form of droplets around these dust particles.

Due to this process the clouds are formed and precipitation is made possible

Structure of Atmosphere



Structure of Atmosphere



Structure of Atmosphere

Troposphere

The first of these layers, lying closest to Earth's surface, is the **troposphere**, which extends about 8-16 km above the earth.

The troposphere is where the majority of our weather occurs: clouds, rain, and snow. The temperature in this area of the atmosphere drops by around 6.5°C per kilometer as the distance above the earth increases.

The troposphere is home to nearly all of the air in the atmosphere, as well as nearly all of the water vapor (which forms clouds and rain).

Its thickness, which tends to vary seasonally, is least at the poles and greatest at the equator.

The water vapor and particulates of the atmosphere are concentrated in this one layer; they are rarely found in the atmosphere above the troposphere.

Also, the temperature normally decreases with increased altitude.

The average rate at which temperature within the troposphere decreases with altitude is called the **normal lapse rate (or environmental lapse rate)**.

Stratosphere

It is the second layer of the atmosphere. It is in the stratosphere that is the ozone layer that does so much to protect life on Earth from the Sun's UV radiation.

This spans from the tropopause to a height of around 50 kilometers. It holds a large portion of the ozone in the atmosphere. The absorption of ultraviolet (UV) energy from the sun by this ozone results in a rise in temperature with height.

The summer pole has the greatest temperature, while the winter pole has the lowest.

Ozone in the stratosphere protects humans from skin cancer and other health problems by absorbing harmful UV rays. However, chemicals (such as CFCs, freons, and halons) that were once used in refrigerators, spray cans, and fire extinguishers have lowered the amount of ozone in the stratosphere, resulting in the so-called "Antarctic ozone hole."

Temperatures at the **stratopause** (another boundary between troposphere and stratosphere), which is about 50 km above Earth, are about the same edge temperature found on Earth's Surface, although little of the heat can be transferred because the air is so thin.

Mesosphere/ Ozonosphere

Above the stratopause is the mesosphere in which temperature tends to drop with increased altitude, the mesopause separates the mesosphere from the thermosphere where temperature increases with increasing height until they approach 17000C. mesopause has the lowest temperature.

The mesopause, which is located at the top of this layer, has the coldest temperatures in the Earth's atmosphere, particularly in the summer near the pole.

The mesosphere has sometimes jocularly been referred to as the **"ignorosphere"** because it had been probably the least studied of the atmospheric layers.

The stratosphere and mesosphere together are sometimes referred to as the **middle atmosphere**.

Ionosphere

The ionosphere is a dynamic portion of the atmosphere that expands and contracts in response to the energy it collects from the Sun. The name ionosphere stems from the fact that solar light excites gases in these layers, causing them to generate ions, which have an electrical charge.

The mesosphere, thermosphere, and exosphere are all covered by the ionosphere.

It's an extremely dynamic portion of the atmosphere that expands and contracts in response to the amount of energy it takes from the sun.

Its name stems from the fact that solar energy excites gases in these layers, causing them to generate "ions," which have an electrical charge.

Ionization refers to the process whereby atoms are changed to ions through the removal or addition of electrons, giving them an electrical charge.

Parts of the ionosphere collide with the magnetosphere of Earth. The magnetic field of Earth is felt by charged particles in this area around the planet.

The magnetic fields of both the Earth and the sun affect charged particles in the ionosphere. Auroras can be seen here. Those are the dazzling, gorgeous bands of light that can be seen near the Earth's poles from time to time.

They’re caused by high-energy particles from the sun interacting with the atoms in this layer of our atmosphere.

The ionosphere in terms helps shield Earth from the harmful shortwave forms of radiation.

This electrically charged layer also aids in transmitting communication and broadcasts signals to distant regions of Earth. It is in the ionosphere that the auroras occur.

Exosphere

It extends beyond 640 km. it is highly ratified and extends into space.

The exosphere is a region above 500 kilometers. It is mostly made up of oxygen and hydrogen atoms, but because there are so few of them, they seldom collide. Instead, they follow "ballistic" trajectories under the force of gravity, and some of them even escape into space.

Based on the protective functions provided by the layers the atmosphere is divided into two distinct layers, the lowest of which is the **ozonosphere**.

Thermosphere

The thermosphere is a zone above the mesopause when temperatures begin to rise again with altitude.

From 80 to 400 kilometers above Mesopause, this layer can be found.

This layer reflects radio waves that are sent from the earth.

With increasing height in this layer, the temperature begins to rise again.

This layer is where the aurora and satellites occur.

The absorption of energetic UV and X-Ray energy from the sun causes this temperature rise.

The Exosphere and Ionosphere are considered as parts of the thermosphere.

REFERENCE MATERIAL

https://cdnsm5-ss13.sharpschool.com/UserFiles/Servers/Server_133136/File/Grade%208/GravesonPayne/Characteristics%20of%20the%20Atmosphere.pdf

ENRICHMENT ACTIVITY

https://wordwall.net/resource/27207575/atmosphere

HEAT BUDGET

Definition

A heat budget is a perfect balance between incoming heat (insolation) absorbed by the earth and outgoing heat (terrestrial radiation) escaping it in the form of radiation.

A **heat budget** is an exact balance between incoming heat collected by Earth and outgoing heat emitted as radiation.

If this balance is disrupted, the earth will get increasingly warmer or cooler as time passes.

In other words, it is the gain and loss of heat, as well as the balance of heat (received and emitted).

Albedo

The earth does not gain or lose heat as a whole. It keeps its temperature constant.

This is only possible if the amount of heat absorbed as insolation equals the amount lost by the earth as a result of terrestrial radiation.

Albedo is a measurement of how much light strikes a surface and is reflected back without being absorbed.

It has a value of less than one and is a **reflection coefficient.**

Some solar radiation is reflected, scattered, and absorbed as it passes through the atmosphere.

The albedo of the earth is the quantity of radiation reflected.

Varying surfaces will have different albedo values.

The **"Urban Heat Island Influence"** occurs when highly developed areas, such as cities, have higher average temperatures than surrounding suburban or rural areas due to the effect of albedo.

Less foliage, larger people density, and more infrastructure with dark surfaces can all be blamed for the higher average temperature (asphalt roads, brick buildings, etc.).

HEAT BUDET :

Variation in the Net Heat Budget of the Earth

Although the Earth as a whole maintains a balance between insolation and terrestrial radiation, we do not see this at all latitudes.

The amount of insolation in the tropical zone is greater than the amount of terrestrial radiation. As a result, it is a location with surplus heat.

The heat gain in the polar zone is smaller than the heat loss. As a result, it is a heat deficit region.

As a result, insolation causes a heat imbalance at various latitudes.

Winds and ocean currents, which carry heat from surplus heat zones to deficit heat regions, help to mitigate this imbalance to some extent.

This process of redistribution and balancing of latitudinal heat is called **Latitudinal Heat Balance.**

HEAT BUDGET :

Mechanism

The sun provides the majority of the energy to the earth in the form of **shortwave solar radiation.**

The solar energy radiated towards the earth's surface is expressed as 100% or 100 units.

35% of the total solar radiation entering the earth's atmosphere is scattered by dust particles (6%), reflected by clouds (27%), and reflected by the ground surface (2%).

51 % is received by the earth's surface (received as direct radiation), and 14 % is absorbed by atmospheric gases (ozone, oxygen, etc.) and water vapor in various vertical zones of the atmosphere.

The heat budget of the atmosphere is made up of 48% solar radiation, with 14% originating from shortwave entering solar radiation and 34% coming from outgoing **long-wave terrestrial radiation.**

After receiving energy from the sun the earth radiates energy by long waves out of its surface into the atmosphere.

As it aids in the heating of the lower atmosphere, terrestrial radiation is also known as **'effective radiation'.**

Significance

The heat balance of the Earth is a critical component of what makes it livable and this is achieved by the Heat Budget of the Earth.

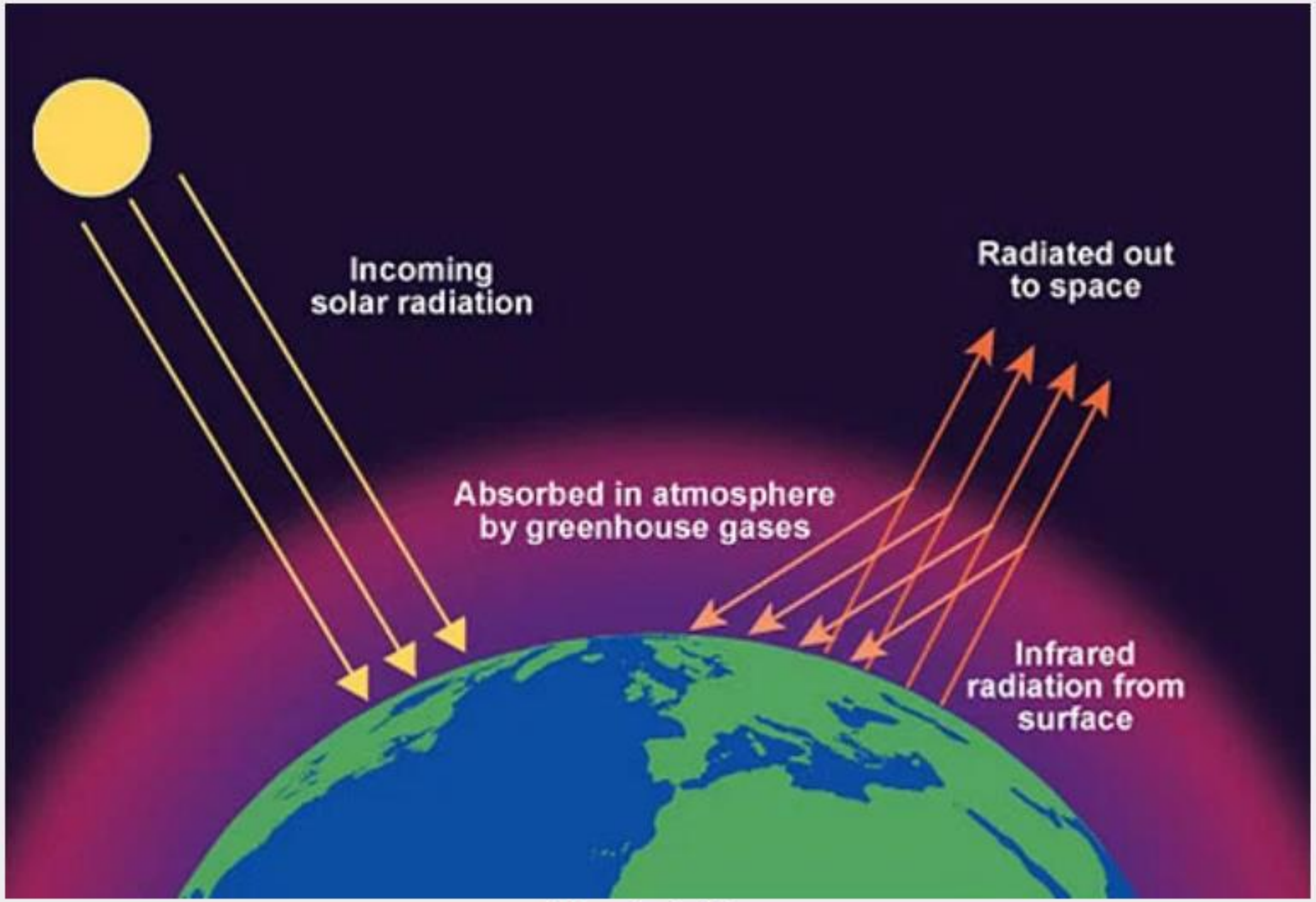
It keeps our earth warm.

It is critical for increasing the production of solar panels that capture and convert this energy.

It is responsible for temperature changes from the equator to the poles.

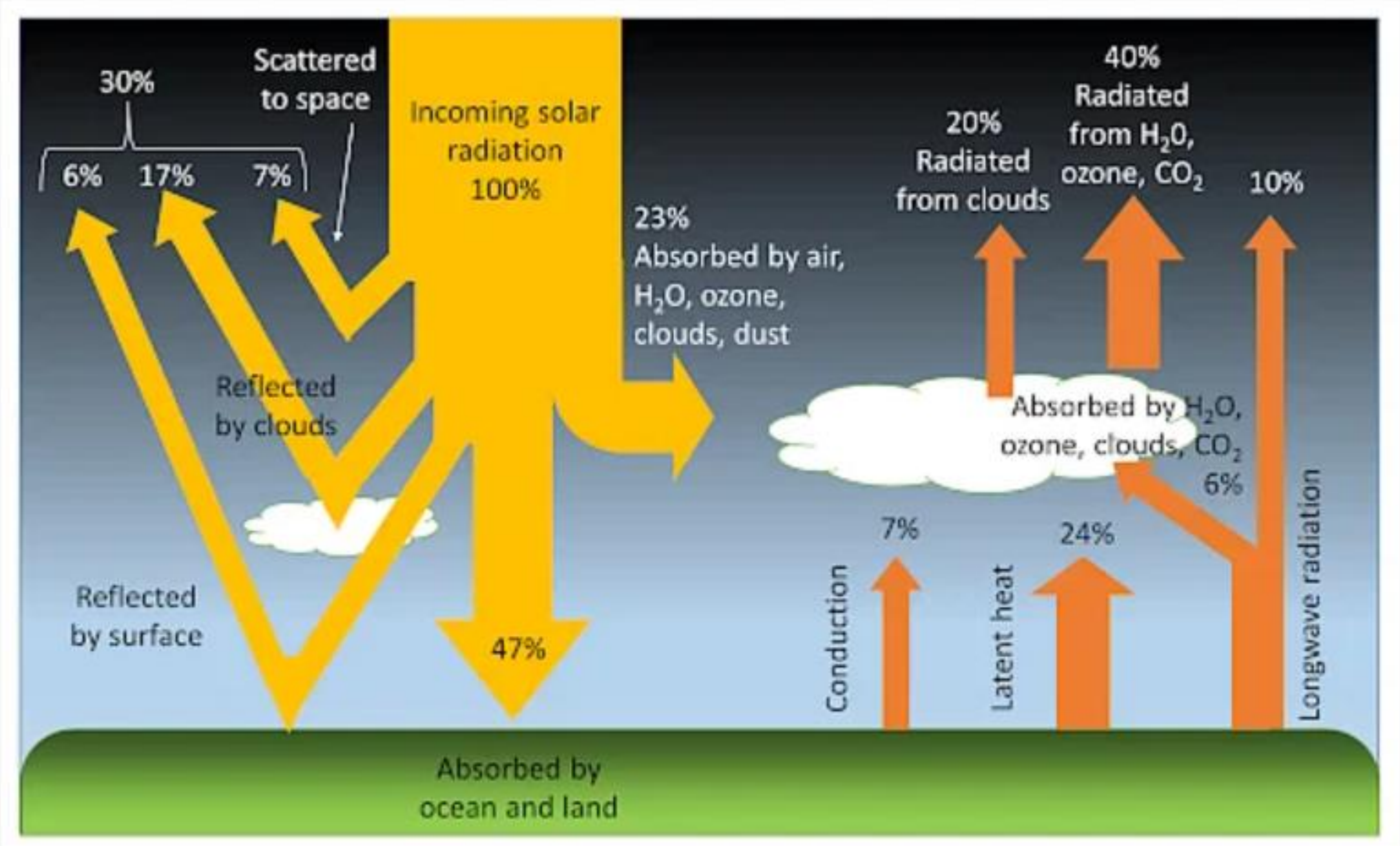
It aids in the photosynthesis process and so the growth of plants.

HEAT BUDGET



Albedo Effect

HEAT BUDGET



Heat Budget and the Atmosphere

HEAT BUDGET COMPONENTS :

Insolation: The thermal radiation from the Sun received per unit of Earth's surface area is known as insolation.

Insolation processes that contribute to maintaining thermal balance include the following:

Reflection: Reflection happens when incoming solar radiation hits a surface in the sky, on land, or on water and bounces back without producing heat.

Absorption: Radiation absorption is the process of transforming electromagnetic radiation into heat energy.

Scattering: When solar radiation collides with tiny things in the Earth's atmosphere, such as air molecules, water droplets, or aerosols, the radiation scatters, spreading the solar waves in all directions.

Terrestrial Radiation: Longwave radiation emitted by the Earth's surface or its atmosphere is called terrestrial radiation. The processes that Terrestrial Radiation uses to keep the temperature balanced include the following:

Latent heat transfer: Latent heat is the heat or energy absorbed or released during a substance's phase change. It could transition from a solid to a liquid, from a liquid to a gas, or vice versa. The amount of heat transferred when one substance is prepared to change its condition is known as latent heat transfer.

Sensible heat transfer: The energy needed to increase a substance's temperature without inducing a phase shift is known as sensible heat. Sensible heat transfer occurs when energy is supplied to an object as heat without causing the object's state to change. The earth or the air itself may absorb sunlight, causing a shift in temperature.

Emission by vapour and clouds: The clouds and water vapour also emit significant amounts of terrestrial radiation.

FACTORS AFFECTINFG INSOLATION

1.ANGLE OF INCIDENCE

1.-the altitude(the angle between the sun's rays and the surface of earth)of the sun controls the insolation.

-if the elevation angle decreases, the area of insolation increases.

-the vertical rays of sun heat a minimum area.

-the oblique rays spread over a larger area.

-The oblique rays travel for a longer distance in the atmosphere, before they hit the earth's surface.

-The longer they travel, larger amount of energy is destroyed.

2.-At mid day, the intensity of insolation is maximum, when compared with morning and evening hours.

3.- In winter and high latitudes, the amount of insolation received is less.

2.DURATION OF SUNSHINE

-Longer period of sunshine ensures larger supply of insolation.

-On Autumnal Equinox (September 21) and Vernal Equinox (March 21), the sun is overhead at equator.

-On these days, the days and nights are equal all over the earth.

-From Winter Solstice (December 22) onwards, the length of the day increase in the Northern hemisphere till the Summer Solstice (June 21).

-But in the southern hemisphere, the length of the day decreases and nights are longer.

-From June 21 to December 22, the length of the day in the Northern hemisphere decreases, and in southern hemisphere it increases.

-In summer solstice, the northern hemisphere has the longest day and shortest nights.

-In winter solstice, the southern hemisphere has the longest day and short nights.

DURATION OF SUNSHINE

length of the day. ... have been shown in Table 3.4.

Table 3.4 : Maximum length of day in different latitudes.

Latitude	Longest day or night	Latitude	Longest day or night
0	12 hours	63.4	20 hours
17	13 hours	66.5	24 hours
31	14 hours	67.4	1 month
41	15 hours	69.8	2 months
49	16 hours	78.2	4 months
58.5	18 hours	90.0	6 months

3. SOLAR CONSTANT

-The amount of insolation received in earths surface changes, but the percentage is very little (2 to 3%)

-When the sun spot appear in larger numbers, the intensity of insolation increases.

-When the sun spot appear in lesser numbers, the intensity of insolation decreases.

-the sun spot increases or decreases on a regular basis, for every 11 years.

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4. DISTANCE BETWEEN THE EARTH AND SUN

-The distance between the earth and sun is 149000000 kms.

-On January 3, earth comes close to Sun, (147 million kms). This is called **Perihelion**.

-On July 4, the earth is far from Sun (152 million kms). This is called **Aphelion**.

5. TRANSPARANCY OF THE ATMOSPHERE

-Reflection from dust, salt and smoke particles in the air are important for the returning of the short wave solar radiation to space.

-Reflection from the Cloud tops also depletes the amount of solar radiation.

-Areas with heavy cloudiness and turbid atmosphere receive less amount of solar radiation.

-Transperancy varies with time, space and latitudes.

-In the higher latitudes, the sun's rays are oblique. They will pass through the thick layers of the atmosphere, than in lower altitudes.

-In winter, when the altitude of the sun is lower, there is a great loss of incoming solar radiation, than in summer.