PARMAR SSC



Atmosphere

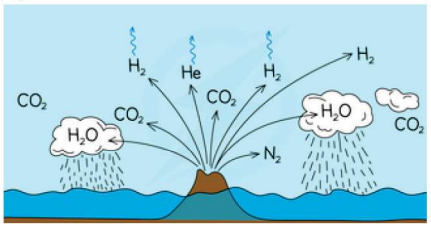
ATMOSPHERE

The atmosphere is a mixture of gases surrounding Earth, held in place by Earth's gravity.

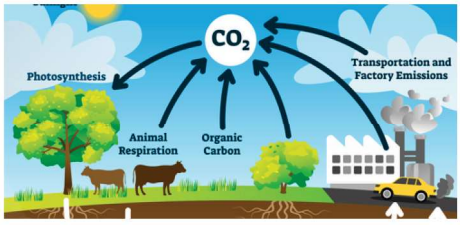


Evolution of Atmosphere

1. **Loss of Primordial Atmosphere**: Initially composed of hydrogen and helium, however this atmosphere was lost due to excessive solar flares.



2. **Volcanism:** The hot interior of Earth release gases through volcanic eruptions to form a new atmosphere (Degassing).

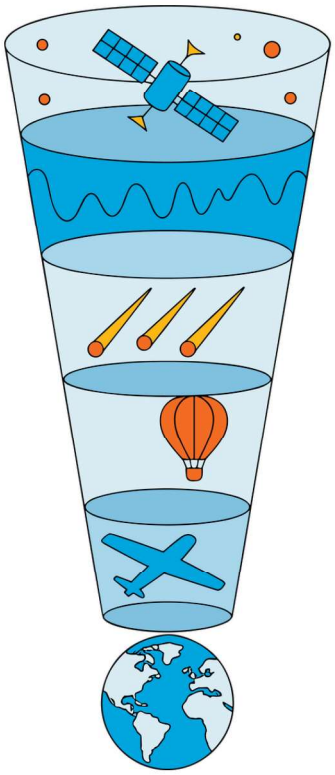


3. **Biological Modification:** Plants and living organisms played a key role in further transforming the atmosphere through Photosynthesis.

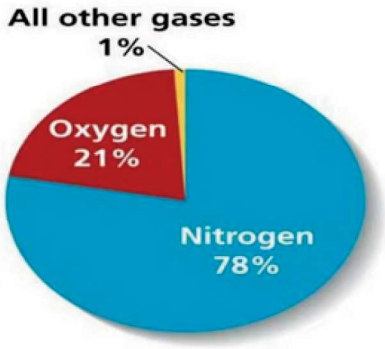
Different Layers of Atmosphere

1 Troposphere (Tropos : Region of Mixing)

- Troposphere is the lowest layer of Earth's atmosphere.
- All weather phenomena (rain, storms, clouds, etc.) occur in this layer.



Composition of Gases



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

Height Variation

- **At poles : 8 km**
- **At Equator : 18 km**
- **Average Height : 13 km**

Reason : Because Equator receives more heat than the poles and convectional heat is transported to a greater height in equator

- Tropopause is a line that separates Troposphere from Stratosphere.
- As we move upwards in the atmosphere, the density of the air decreases, and that is why the densest air is found in Troposphere.

Temperature Behavior

- **Lapse Rate** : It is the rate at which temperature changes with altitude in the atmosphere, usually expressed as temperature decreasing with height.
- **Negative Lapse Rate means** Temperature is Increasing with altitude.
- **Positive** lapse rate means Temperature is Decreasing with Altitude.

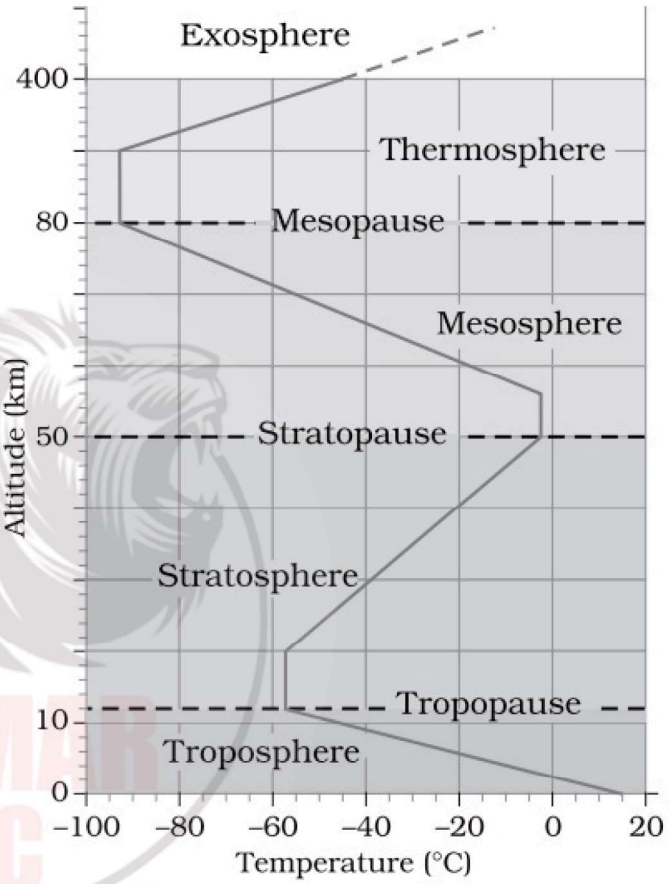
Standard Lapse Rate

165 meters → 1°C decrease

1 km → 6.5°C decrease

Reason of Temperature Drop

The atmosphere does not heat up directly from solar radiation (insolation). Instead the Earth's surface absorbs solar energy and then emits it as long-wave infrared radiation (Terrestrial Radiation), which warms the lower atmosphere. As the altitude increases, less terrestrial radiation is available, leading to drop in temperature



remember

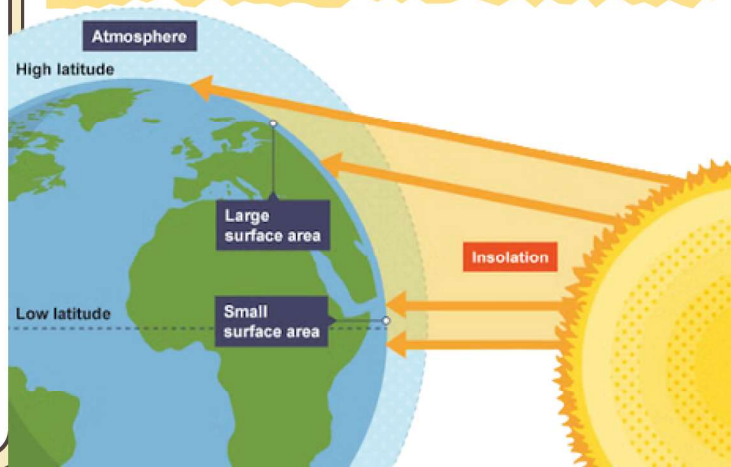
- Earth's Surface heats up due to Insolation but Earth's Atmosphere heats up due to Terrestrial Radiation.
- Atmospheric Gases is transparent for short wavelength but not for Long wavelength.

Effect of Insolation

- **At Equator** : Insolation is less here, due to presence of clouds.
- **At Tropics**: Insolation is maximum here due to minimal cloud covering. E.g. Desert.

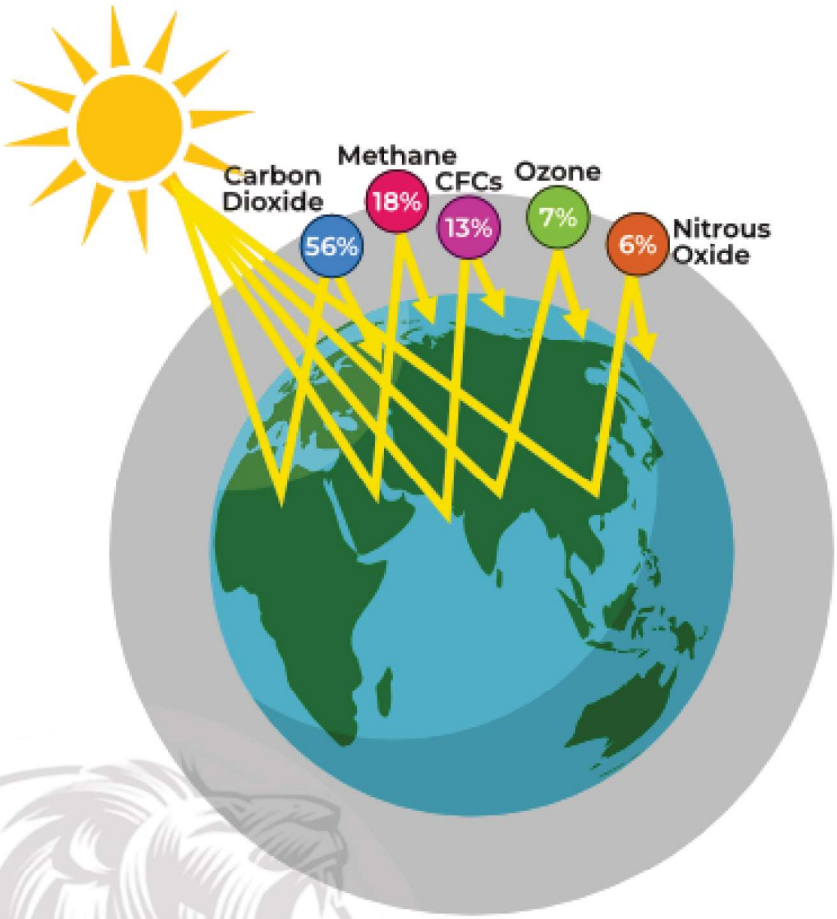
Factors influencing Insolation Includes

- **Transparency of the atmosphere**
- **Length of the day**
- **Earth's tilt and Rotation**
- **Surface reflection (Albedo)**
- **Latitude**
- **Position of Earth**
- **Altitude**



Green House Gases

Greenhouse gases Keeps earth warm by trapping heat in the atmosphere.



Key Green House Gases

Water Vapor, Carbon Dioxide, Methane, Nitrous Oxide (Laughing Gas), Ozone.

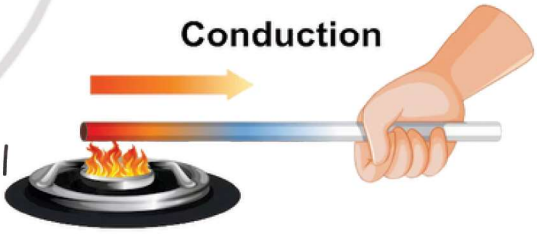
Note :
Nitrogen Dioxide is a not Green House gas.

Heat Transfer Mechanism

The Transfer of Heat in the atmosphere occurs through three primary mechanism.

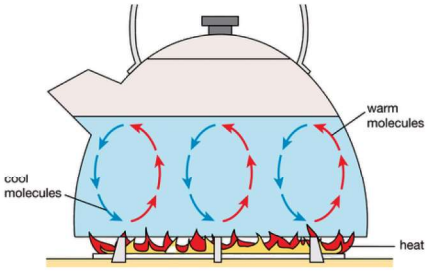
Conduction

The Process by which heat is transferred directly from one molecule to another without actual movement of air.



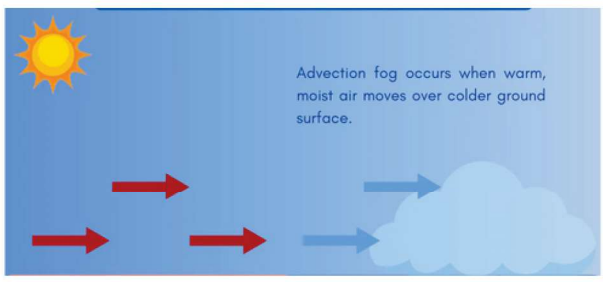
Convection

The vertical transfer of Heat through the movement of air mass.



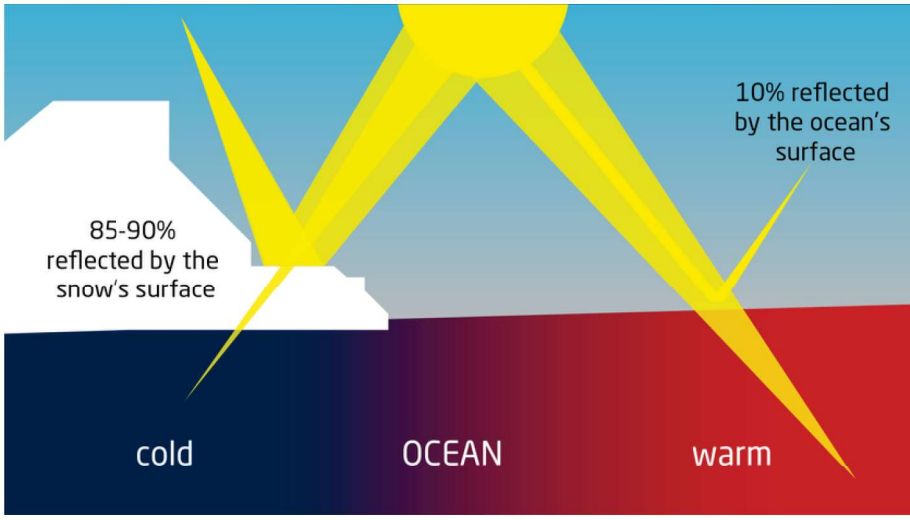
Advection

The Horizontal Transfer of Heat due to the movement of air .
Eg. Loo is a result of Advection



Albedo

- Albedo Refers to the proportion of incident light or Radiation that is reflected by a surface.
- High Albedo is seen in Snow, Ice Caps or Glaciers

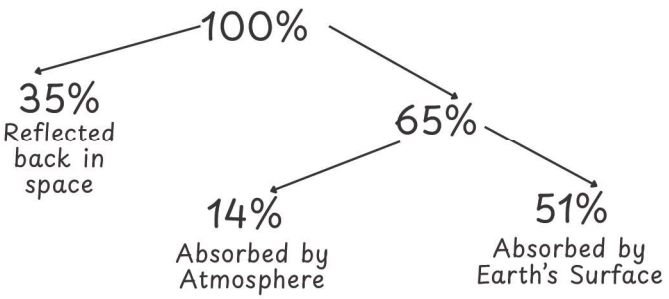


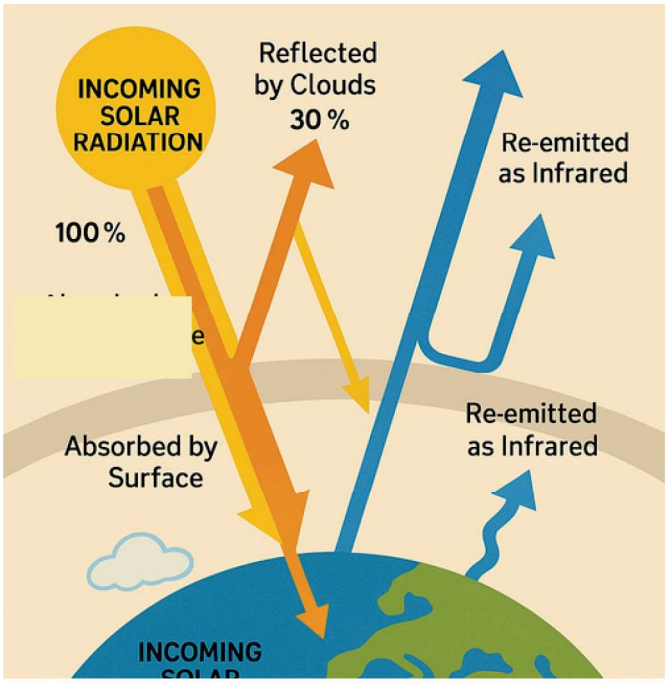
Albedo Values of Different Surfaces and Clouds

Earth Surface	(%)	Clouds	(%)
Ocean Lakes	8	Shallow broken clouds	30
		Cu, Cl, Cs, Cc	35
Land Surface	14-18	St	40
Sand, Desert	27	Thick Clouds (Cs)	74
Ice and Snow		Ac, As, Sc	68
Sea Ice	35	Cu	75
Old Snow	59	Ns	85
Fresh Snow	80	Cb	90

Heat Budget

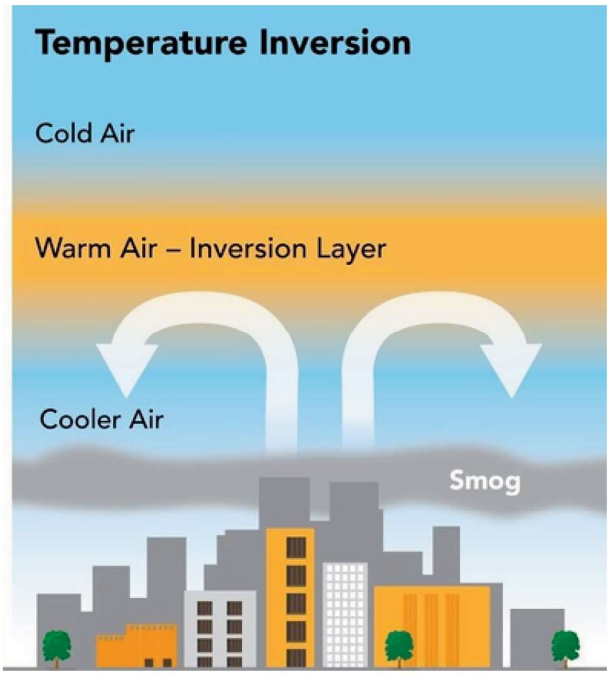
- A heat budget is the balance between the heat that the earth absorbs from the sun and the heat that radiates back into space.





Temperature Inversion

- A phenomenon where temperature increases with Height instead of decreasing.



Favourable Condition for Temperature Inversion

Long Winter Nights

During long nights, the earth's surface loses heat rapidly through radiation, Cooling the air near the surface.



Still Air

Calm and Stable air prevents the mixing of cold surface air with warmer air above, maintaining the inversion layer.

Clear Cloudless Sky

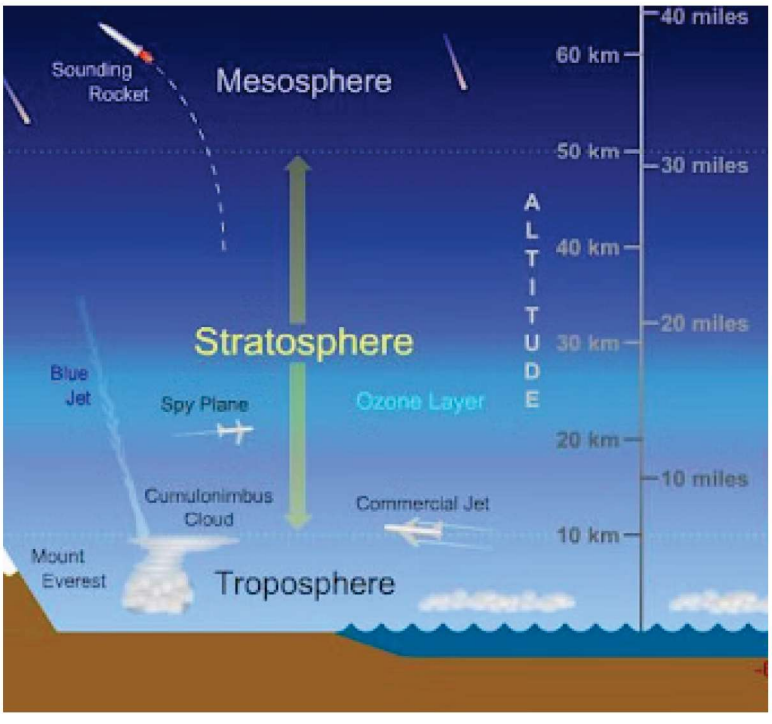
Clear skies enhance heat loss from the surface through terrestrial radiation, promoting rapid cooling and inversion formation

Note :

- Temperature inversion leads to stability, means No Rain.
- Temperature at tropopause near equator is lower(-60°C to -80°C) as compared to poles(-40°C to -50°C).

2 Stratosphere

- It is stretched upto 50 km above earth's crust of the Earth's Atmosphere.
- Temperature increases with altitude in this layer.
- Jet planes fly in this layer.
- Stratopause divided stratosphere and Mesosphere



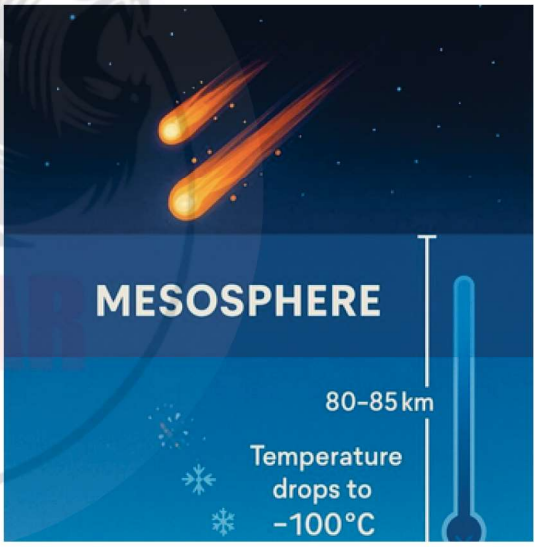
Ozone Layer



- Ozone layer is located in this layer (30-35 km above Earth's Surface), which protects us from Harmful UV-Rays of the Sun.
- Ozone layer thickness is measured in Dobson unit.
- Ozone Day is celebrated on 16 September to commemorate the adoption of the Montreal Protocol in 1987 in Montreal, Canada.
- This international agreement aimed to phase out Chlorofluorocarbons (CFCs), which deplete the ozone layer and contribute to the formation of the ozone hole.
- Kigali Amendment was made to phase out HFCs (Hydrofluorocarbons).

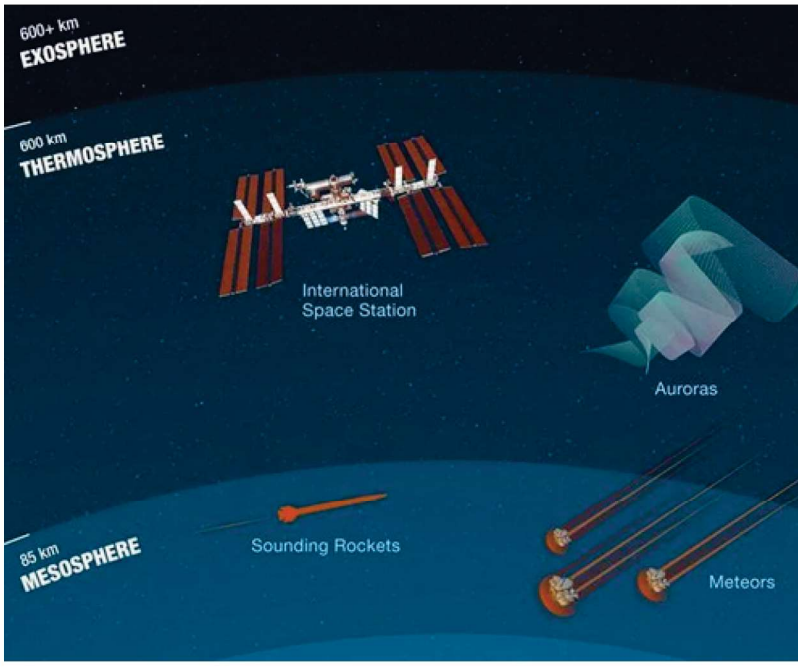
3 Mesosphere

- It is located upto 85 km above earth's surface in Earth's Atmosphere.
- It is the coldest layer of atmosphere.
- Meteoroids burn up and end in the mesosphere layer.
- While moving upwards, temperature decreases with altitude.



4 Thermosphere

- It is also known as Ionosphere.
- It is located upto 80-400 Km above earth's surface.
- It is the Hottest layer of atmosphere.
- While moving upwards, temperature increases with altitude
- It contains electrically charged particles known as ions, and hence, it is also known as the ionosphere.
- Radio waves transmitted from the earth are reflected back to the earth by this layer



5 Exosphere

- It is the 5th and the last layer of atmosphere.
- Mostly composed of Hydrogen and Helium



Karman line

- It is an imaginary boundary located 100 kilometers (about 62 miles) above sea level that separates Earth's atmosphere from outer space.

Isotherm Line

- These are lines or points on map/chart of the Earth's surface connecting points having same temperature at a given time.

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