

STRUCTURE OF THE ATMOSPHERE

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THE ATMOSPHERE

- ❖ Our Earth is enveloped by a deep blanket of gases extending several thousands of kilometers (about 9600kms.) above its surface.
- ❖ This gaseous cover of the Earth is known as the atmosphere.
- ❖ It is an integral part of the Earth.
- ❖ It is only a very thin layer of gases.
- ❖ Because of the force of Gravity it is inseparable from the Earth.

GENERAL CHARACTERISTICS OF THE ATMOSPHERE

The main characteristics of the atmosphere is:-

1. *Air is colorless, odorless, and tasteless.*
2. *It is mobile, elastic, and compressible.*
3. *We cannot feel its presence unless there is horizontal motion in it.*
4. *Air in horizontal motion is known as wind.*
5. *Air has weight and the pressure it exerts is known as atmospheric pressure.*
6. *Atmospheric pressure is a climatic element.*
7. *At sea level the pressure is 1034 gram per square cms. (14.7pound per square inch.)*

SIGNIFICANCE OF THE ATMOSPHERE

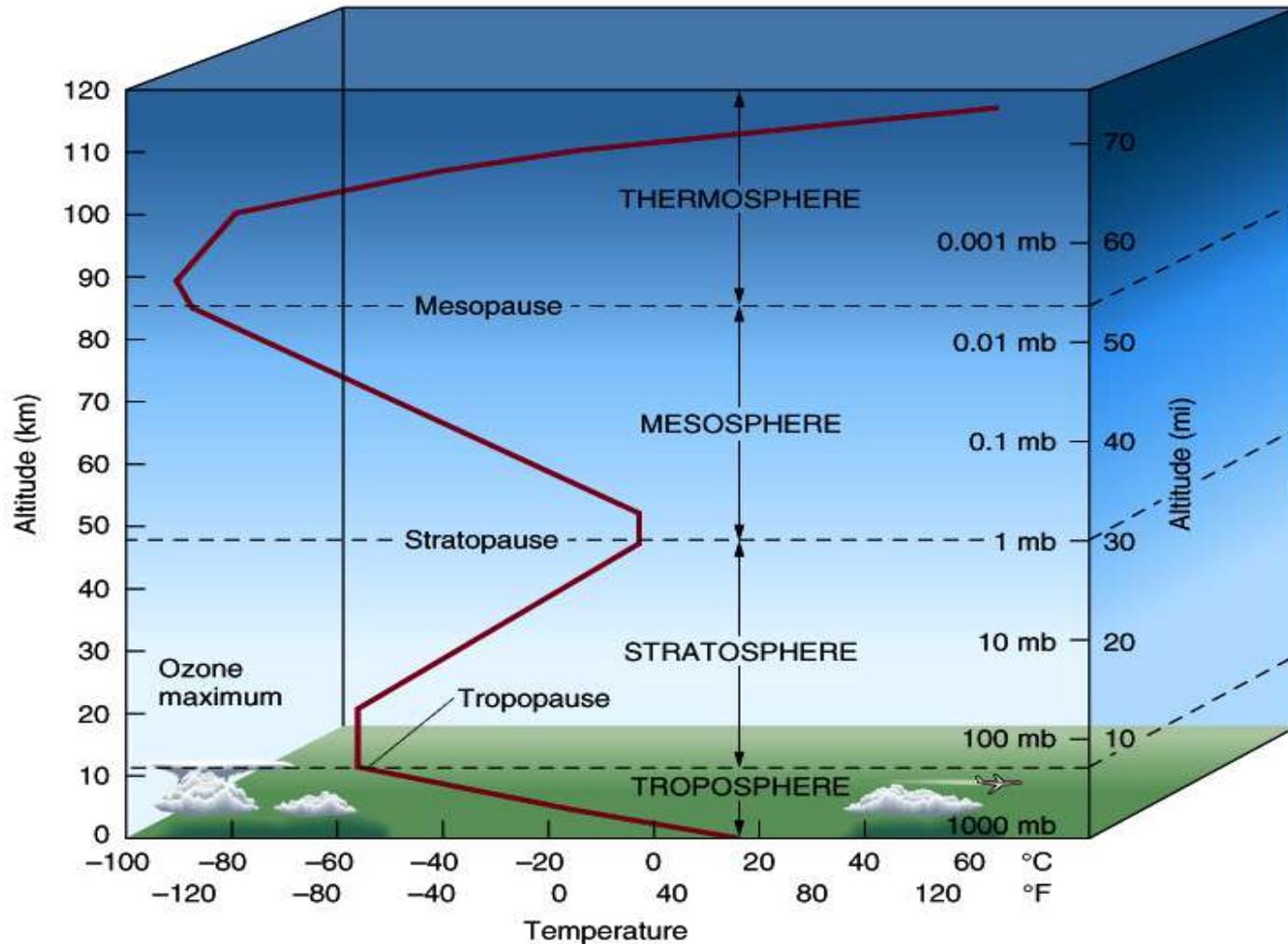
- ✘ *All the life forms owe their existence to the atmosphere.*
- ✘ *Animals need oxygen and plants need carbon-dioxide.*
- ✘ *It is the atmosphere that provide oxygen and carbon-dioxide.*
- ✘ *The atmosphere maintains the level of water and radiation in the Earth system.*
- ✘ *The atmosphere maintains the temperature that suits us. In the absence of atmosphere there would had been extremes of temperature at about 260 °C between day and night.*
- ✘ *It shields us from the Sun's ultra-violet radiation which is injurious to both plants and animals.*
- ✘ *It acts as a protective wall against the bombardment of meteors.*
- ✘ *The currents, motions, and various other activities of the atmosphere combine together to produce weather.*

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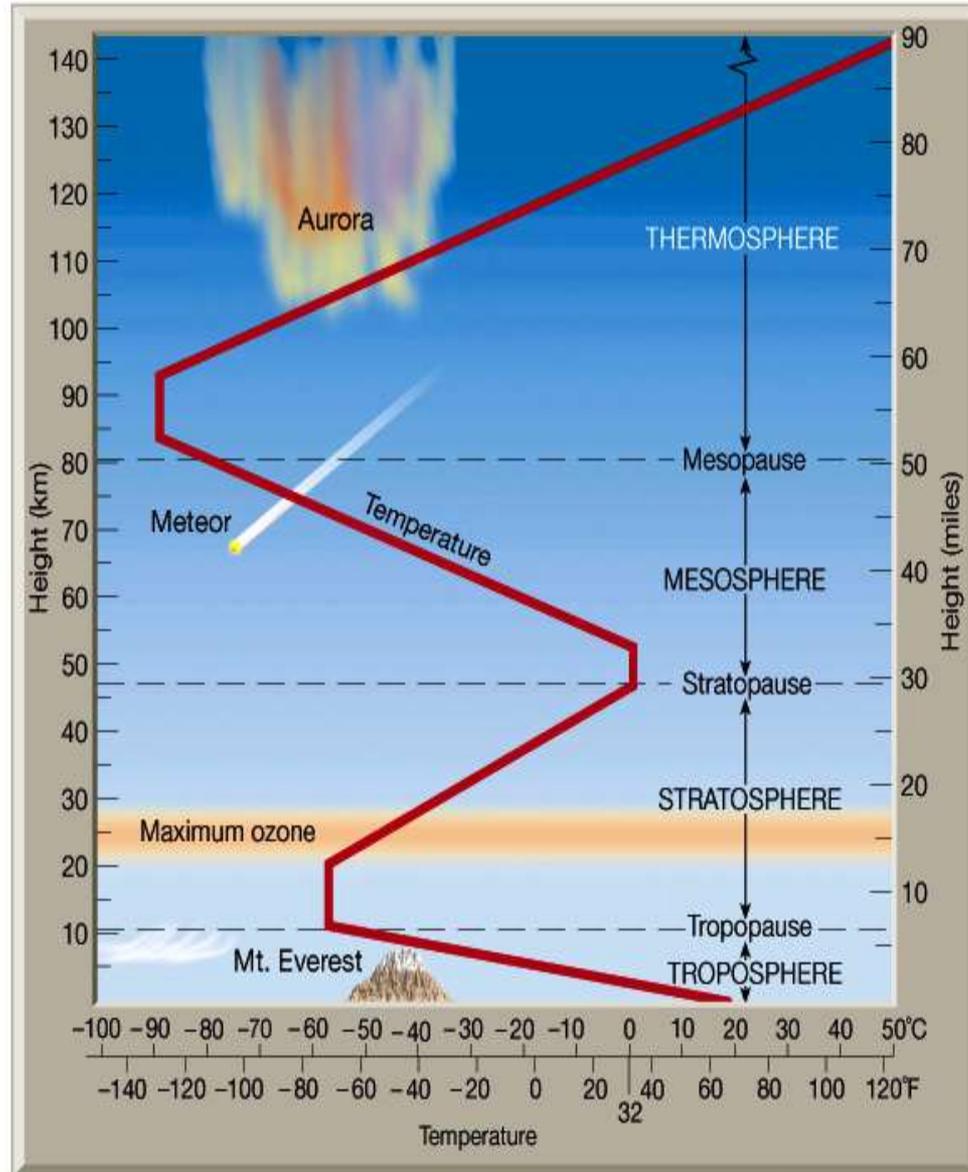
- ✘ The atmosphere consists of zones or layers arranged like spherical shells divided vertically into five layers based on temperature and altitude above the Earth's surface.
- ✘ Each zone has its own physical and chemical characteristics and properties such as density, pressure, chemical and electrical and temperature properties.
- ✘ The five layers are:-
 - The troposphere,
 - The stratosphere,
 - The mesosphere,
 - The ionosphere,
 - The exosphere.

The layer in which we live is the troposphere.

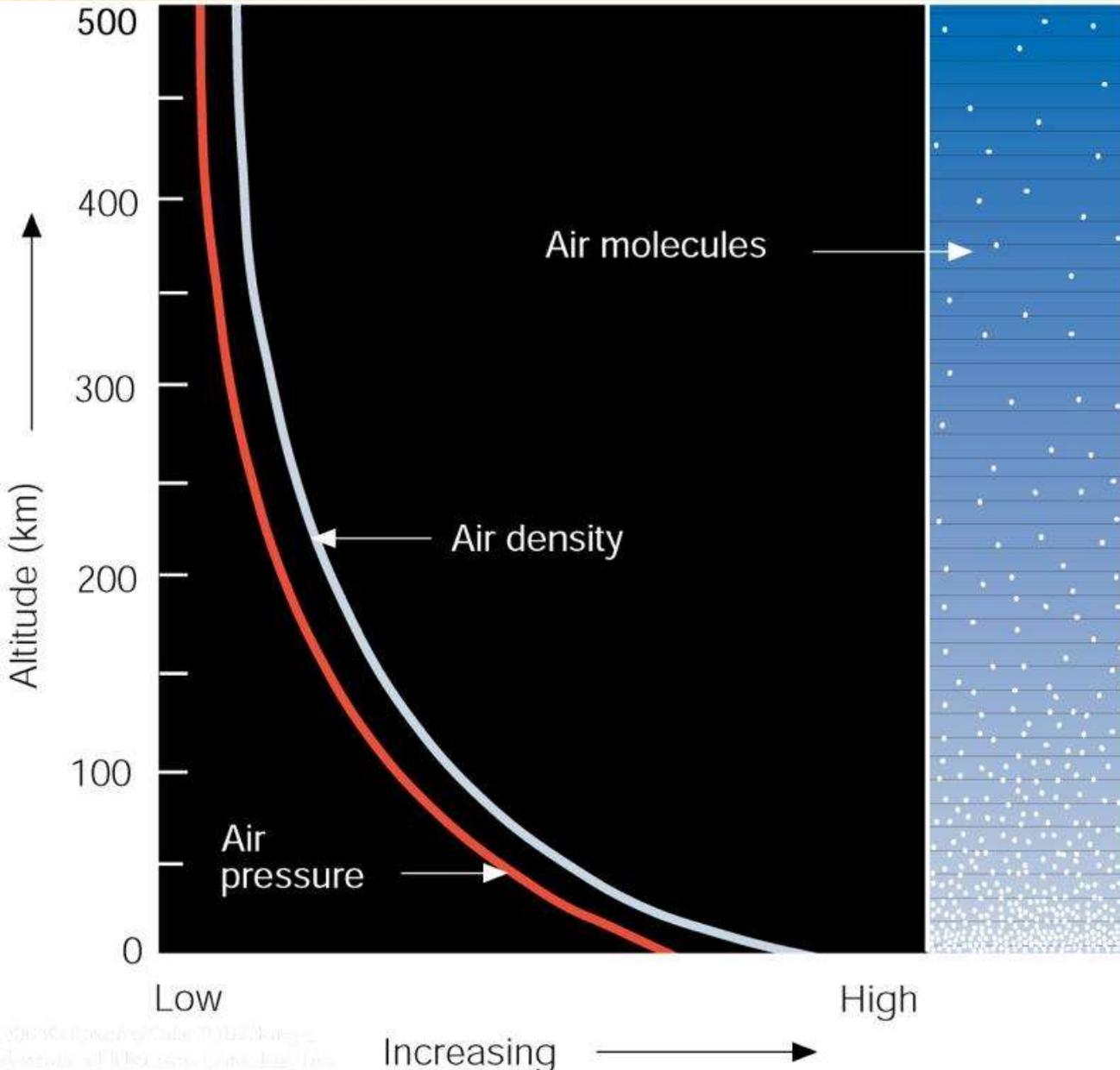
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VERTICAL STRUCTURE OF THE ATMOSPHERE



Pressure and Density Decrease with Height



Gravity pulls gases toward earth's surface, and the whole column of gases exerts a pressure of 1000 hPa at sea level, 1013.25 mb or 29.92 in.Hg.

TROPOSPHERE

The word troposphere comes from **tropein**, meaning to turn or change. All of the earth's weather occurs in the troposphere.

- ✘ The troposphere has the following characteristics.
- ✘ It extends from the earth's surface to an average of 12 km (7 miles).
- ✘ Under normal conditions its height at the Equator is about 16 kms. And at the Poles it is about 8 kms.
- ✘ Its height vary from place to place and from season to season.
- ✘ The pressure ranges from 1000 to 200 millibars (29.92 in. to 5.92 in.).
- ✘ The temperature generally decreases with increasing height up to the tropopause (top of the troposphere); this is near 200 millibars or 36,000 ft. The mean lapse rate is 6.5°C per km. or 3.6°F per 1000 ft.
 - + The temperature averages 15°C (59°F) near the surface and -57°C (-71°F) at the tropopause.
 - + The layer ends at the point where temperature no longer varies with height. This area, known as the tropopause, marks the transition to the stratosphere.
- ✘ It contains about 75% of the total gaseous mass and all the moisture and dust particles.
- ✘ The troposphere is 70% and 21% . The lower density of molecules higher up would not give us enough to survive.

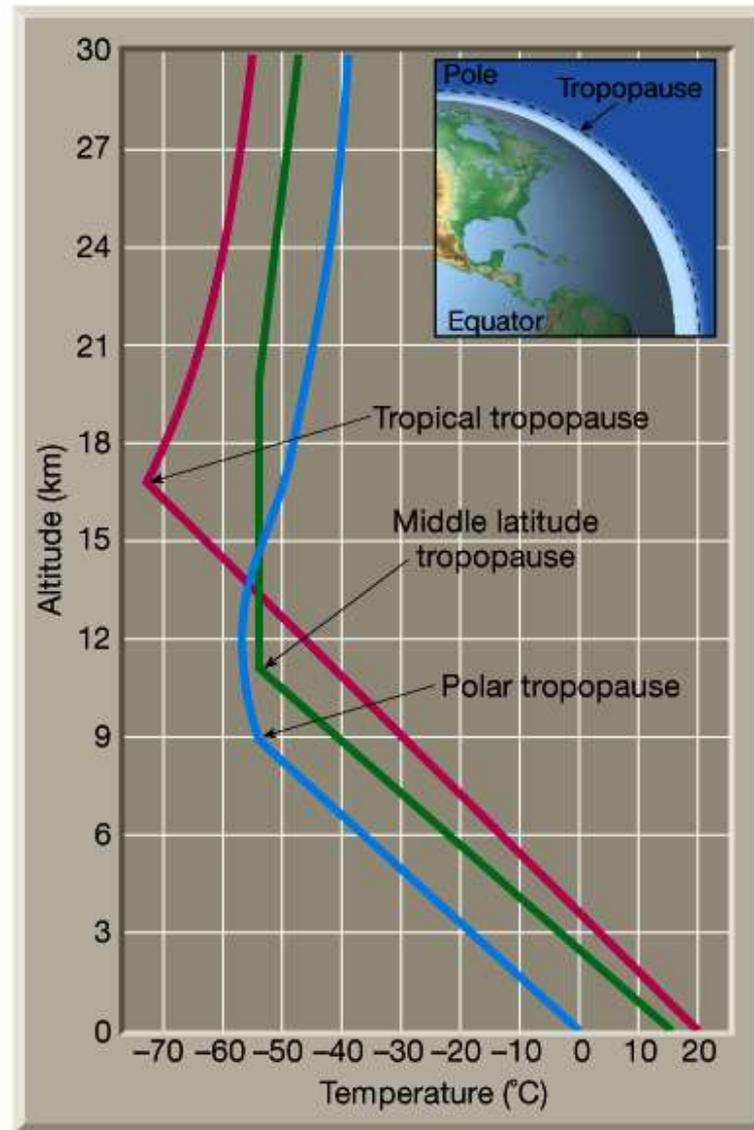
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- ✗ Wind velocity increases with height up to the jet stream and is maximum at the tropopause.
- ✗ Various types of clouds, anti-cyclones, cyclones, thunderstorms, etc. takes place in this layer because of the presence of water-vapours .
- ✗ The moisture concentration decreases with height up to the tropopause.
 - + The air is much drier above the tropopause, in the stratosphere.
 - + The sun's heat that warms the earth's surface is transported upwards largely by convection and is mixed by updrafts and downdrafts.
 - + It is also called the convective zone.

TROPOPAUSE

- ✘ Tropopause = boundary between troposphere (below) and stratosphere (above).
- ✘ By definition, temperature constant with height, because neither decreasing, as in troposphere, nor increasing, as in stratosphere.
- ✘ Because of warm temperatures and highly developed thermal mixing the tropopause has its greatest heights near the Equator that is about 18 kms.
- ✘ The lowest temperatures is found directly over the Equator and not at the poles.
- ✘ In the middle latitudes the height of the tropopause changes with the weather situations.
- ✘ At latitudes 45° N and S the average height in January is about 12.5 kms. And in July it is 15 kms.
- ✘ It is well defined in the Tropics but less in the Polar region.
- ✘ It is the upper limit of most of the clouds and storms.
- ✘ It marks the general upper limit of the transfer of atmospheric properties.
- ✘ It is characterised by a sharp temperature inversion.
- ✘ Above this zone there is a slight increase in temperature with increasing elevation.

Observed lapse rate and the tropopause



STRATOSPHERE

- ✘ *Stratosphere is the next highest layer, about 20 miles thick depending upon location/weather. The thickness of the layer is the highest at the Poles.*
- ✘ *The lower part of the stratosphere is isothermal in character that is the temperature does not change with altitude.*
- ✘ *This temperature situation is present upto about 30 kms.*
- ✘ *Temperature increases with altitude beyond 30 kms. This is the upper layer of the stratosphere.*
- ✘ *Because an inversion layer, vertical mixing is impossible, hence various layers are not mixed (= stratified, hence the name of the layer).*
- ✘ *Heat source = absorption of UVB (240-320 nm radiation) by the ozone layer.*
- ✘ *High wind speeds are found in this zone.*
- ✘ *Cirrus clouds occasionally forms in the lower stratosphere.*
- ✘ *No weather phenomena occurs in this layer.*

Stratopause = boundary between stratosphere (below) and mesosphere (above).

Troposphere and Stratosphere = "lower atmosphere".

OZONOSPHERE OR MESOSPHERE

- ✘ *Ozone layer region is where the abundance of ozone is relatively high, produces a substantial increase in temperature.*
- ✘ *Extends from the middle of the stratosphere to the lower mesosphere, between 30 to 60 kms. depending upon how the amount of ozone is measured (total abundance, or percentage)*
- ✘ *The percentage of ozone peaks near the top of the stratosphere, and that, in combination with the greater amount of UV at height (less reaches lower altitudes), produces the greatest heating of the middle atmosphere at the stratopause.*
- ✘ *The ozone layer acts as a filter for the ultra-violet rays of the Sun.*
 - *it protects us from Sunburn by absorbing a large %age of the ultra-violet radiation.*
 - *the depletion of this layer can lead to serious biological damage to human beings, plants and animals.*
- ✘ *In this layer the temperature increases with height at a rate of 5°C per km.*
- ✘ *There are dominance of chemical processes in this layer.*
- ✘ *Mesopause = boundary between mesosphere (below) and the ionosphere(above).*

IONOSPHERE

- ✗ *Ionosphere = "ionized region".*
- ✗ *It lies beyond the ozonosphere at a height of about 60 kms.*
- ✗ *In this layer the ionization of atmosphere takes place.*
- ✗ *Region encompassing the outer and middle atmosphere, in which collisions with high energy particles or absorption of high-energy photons, ionize atoms and molecules at a substantial rate.*
- ✗ *The 1st knowledge of this layer was acquired by the means of Radio-waves.*
- ✗ *More knowledge was acquired by means of sound waves and satellites.*
- ✗ *The temperature decreases with height.*
- ✗ *It is further divided into many sub layers.*
 - *the different sub layers helps in transmitting the low, medium, and high frequency radio-waves.*
- ✗ *Some of these sub layers are temporary which may appear during the day and disappear at with Sun-set.*

EXOSPHERE

- ✘ *Exosphere – literally, "outer-most atmosphere" which lies between 400 to 1000 kms.*
- ✘ *At such great heights the density of the atmosphere is very low in this layer.*
- ✘ *Hydrogen and Helium gases dominates in this layer.*
- ✘ *The temperature may reach as high as 5568 °C*

Temperature in the Exosphere

The exosphere is almost a vacuum. The "air" is very, very thin there. When air is thin, it doesn't transfer much heat to objects in the air, even if the air is very, very hot.

When the particles are moving very fast, the temperature is hot. When particles are bouncing around more slowly, the temperature is cooler. The particles in the exosphere are moving very quickly, so the temperature there is quite hot. However, the exosphere would feel quite cold to us. How can that be? Since the "air" is so thin in the exosphere - it is almost a vacuum - there are very, very few particles. We feel warmth when particles hit our skin and transfer heat energy to us. There are too few particles in the exosphere to transfer much energy, even though each particle is quite "hot" itself.

Objects in the exosphere are hot if lots of sunlight shines on them. Sunlight is very, very bright up there, so objects in the sunshine heat up quickly. However, objects in the shade can get really, really cold. For example, one side (the sunny side) of a satellite might be very hot, while the other side (in the shade) might be freezing cold.



Thank you