CLIMATOLOGY

Presented by:

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INTRODUCTION

- **Climatology** is the branch of science which deals with the study of atmospheric components and their characteristics.

- The thick gaseous layer which surrounds the Earth and is sustained by the Earth's gravity is known as the **Atmosphere**. And it extended several thousand of km.

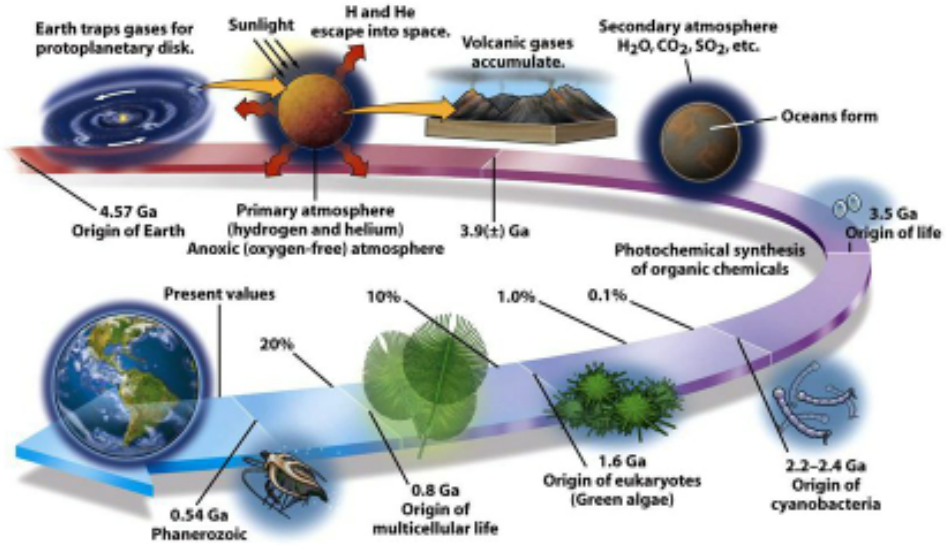
- **Climate vs. weather:** its depends on measure of time. Weather is what condition of atmosphere are over a short period of time and climate is how the atmosphere behaves over relatively longs period of time.

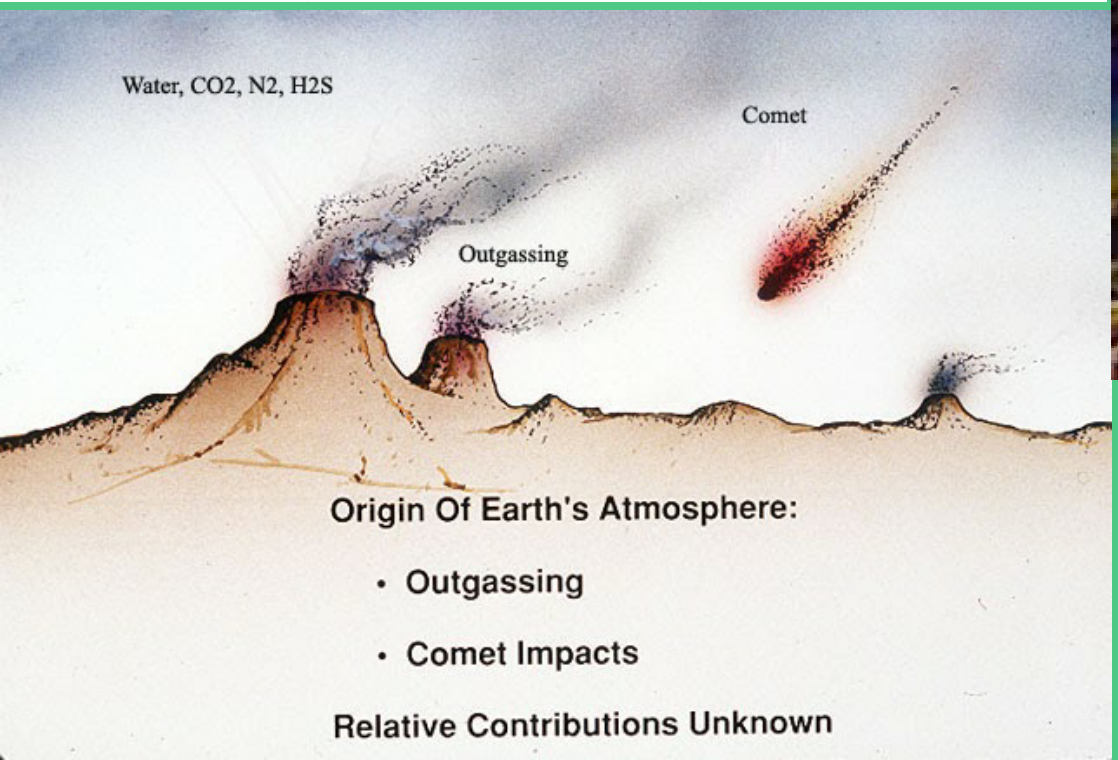
ORIGIN OF ATMOSPHERE ON EARTH

- Early atmosphere has Hydrogen and Heliyam in abundance lighter gases escaped.
- During early life of the earth- extensive volcanism- degassing. N, S, Water vapour, argon and co_2 came out.
- Water vapour- condensed- clouds- rainfall- washed out bulk of co_2 into ocean. Co_2=0.03%.
- Oxygen- from anaerobic respiration of bacteria like, cyanobacteria.

Atmospheric Formation

- Earth's atmosphere has changed through time.
- Changes have been coupled to biotic evolution.





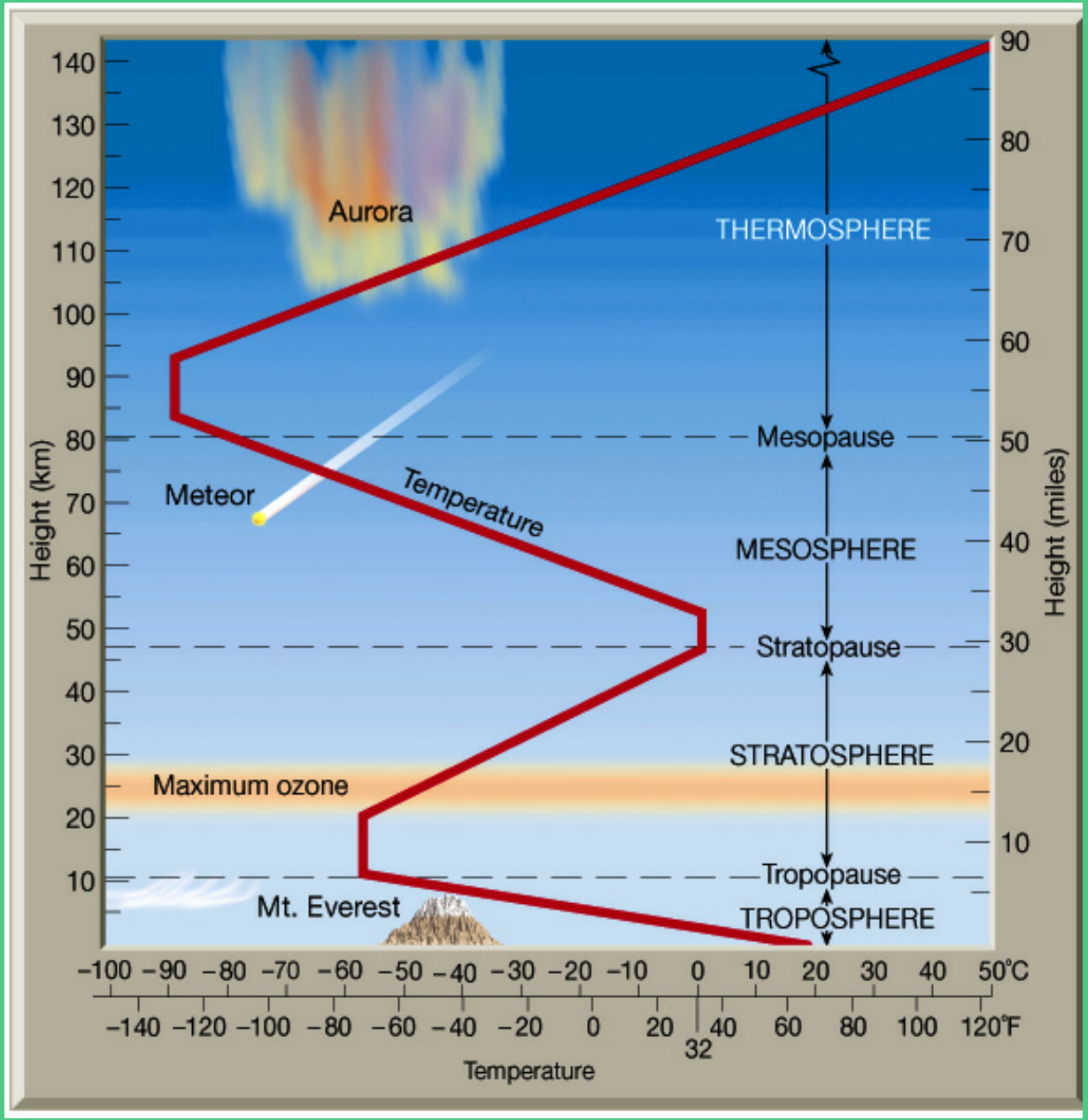
Atmospheric origin

PROPORTION OF GASES

- N, O, H AND Argon are the permanent gases.
- Water vapour, o3 and co2 are variable gasses, GHG.
- N and Argon- inert gasses.
- Atmospheric gasses – no chemical interaction among them.
- They don't lose their properties.
- They act as a single unified gasses.

Gas	Symbol	Volume (%)
Nitrogen	N_2	78.0840
Oxygen	O_2	20.9480
Argon	A	0.9340
Carbon Dioxide	CO_2	0.0314
Neon	Ne	0.0018
Helium	He	0.0005
Hydrogen	H_2	<0.0001

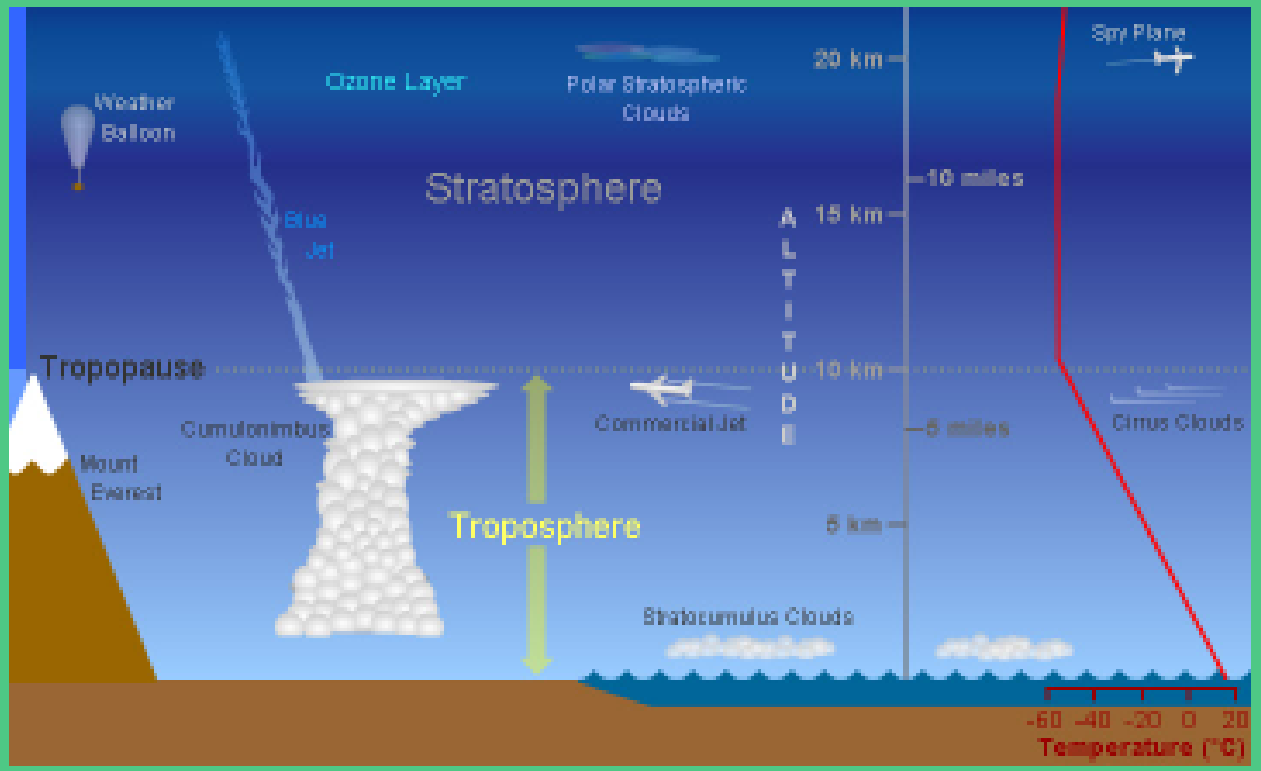
STRUCTURE OF THE ATMOSPHERE

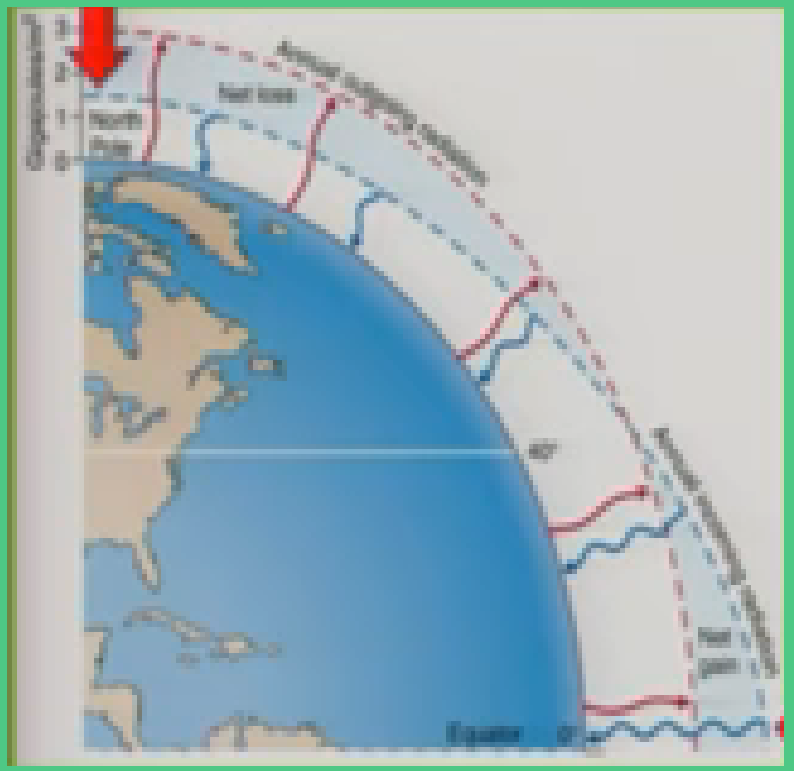


TROPOSPHERE

- The troposphere is the lowest and most dense layer of the atmosphere. It contains almost 75 % of the total weight of air.
- The average height of the troposphere from the Earth's surface is about 14 km. It extends roughly to a height of 8 km near the poles and about 18 km at the equator.
- The thickness of the troposphere at the equator is the greatest because heat is transported to a great height by strong conventional currents. Due to these it is also known as the convectional layer.
- Due to the presence of dust particles and water vapour, almost all weather phenomena like fog, cloud, dew, frost, rainfall, hailstorm, cloud-thunder, lightning, etc occur in this layer.
- The temperature in this layer decreases at the rate of 1°C for every 165m of height. **Note:** Aviators of jet aeroplanes often avoid this layer due to the presence of bumpy air pockets.
- There is a transition zone between Troposphere and Stratosphere which is called Tropopause.

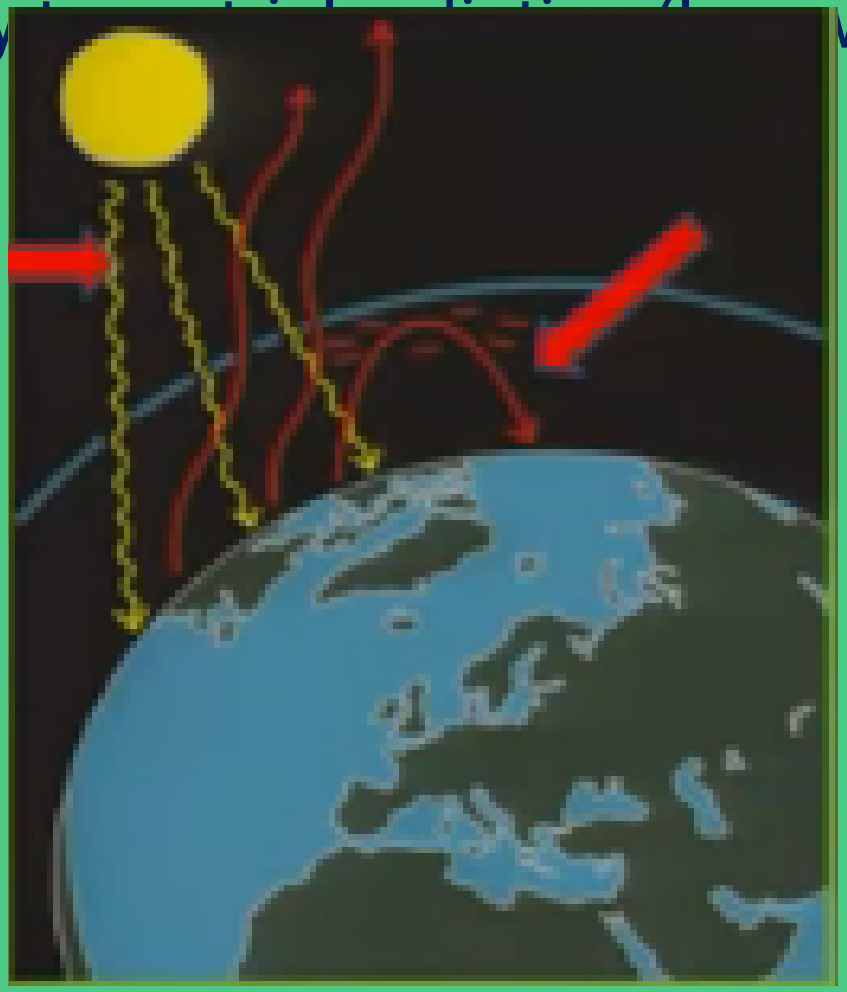
TROPOSPHERE





GREEN HOUSE EFFECT ON TROPOSPHERE

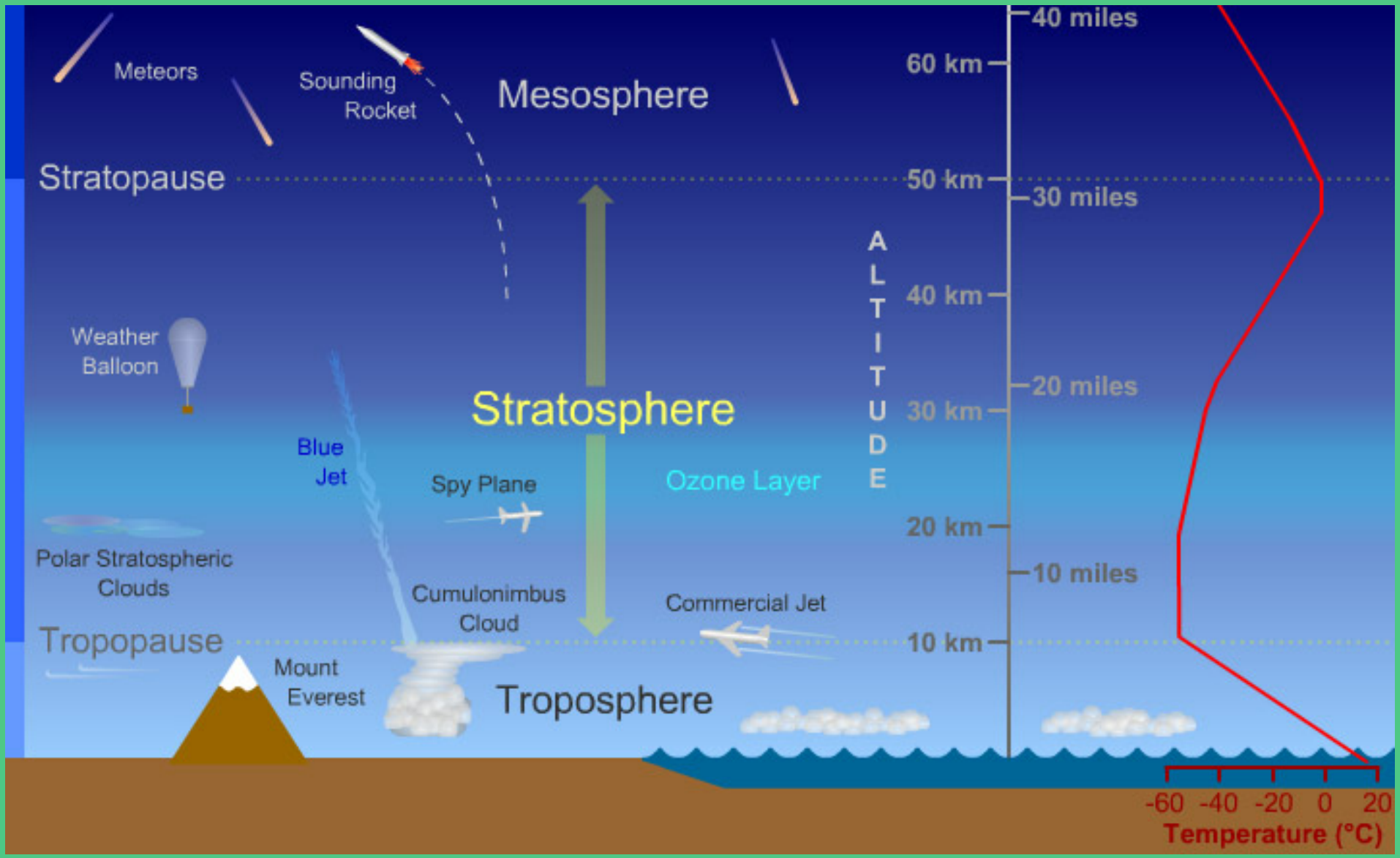
- Temperature decrease at height increase.(rate is 6.4°c/ 1000 m)
- Transport to insolation (short wave)
- heated by wave).



STRATOSPHERE

- The stratosphere extends up to a height of 50 km beyond the troposphere.
- In the lower part of this layer, i.e. up to a height of 20 km, temperature remains constant. Afterwards, it gradually increases up to a height of 50 km.
- The maximum density of Ozone occurs between 20 km and 35 km. Therefore it is called the ozone layer.
- Clouds are almost absent in the stratosphere and there is very little dust or water vapour. Hence, it provides ideal flying conditions for large jet aeroplanes.
- In the uppermost part of stratosphere the temperature is found up to 0°C.
- The upper limit of the stratosphere is called stratopause.

STRATOSPHERE



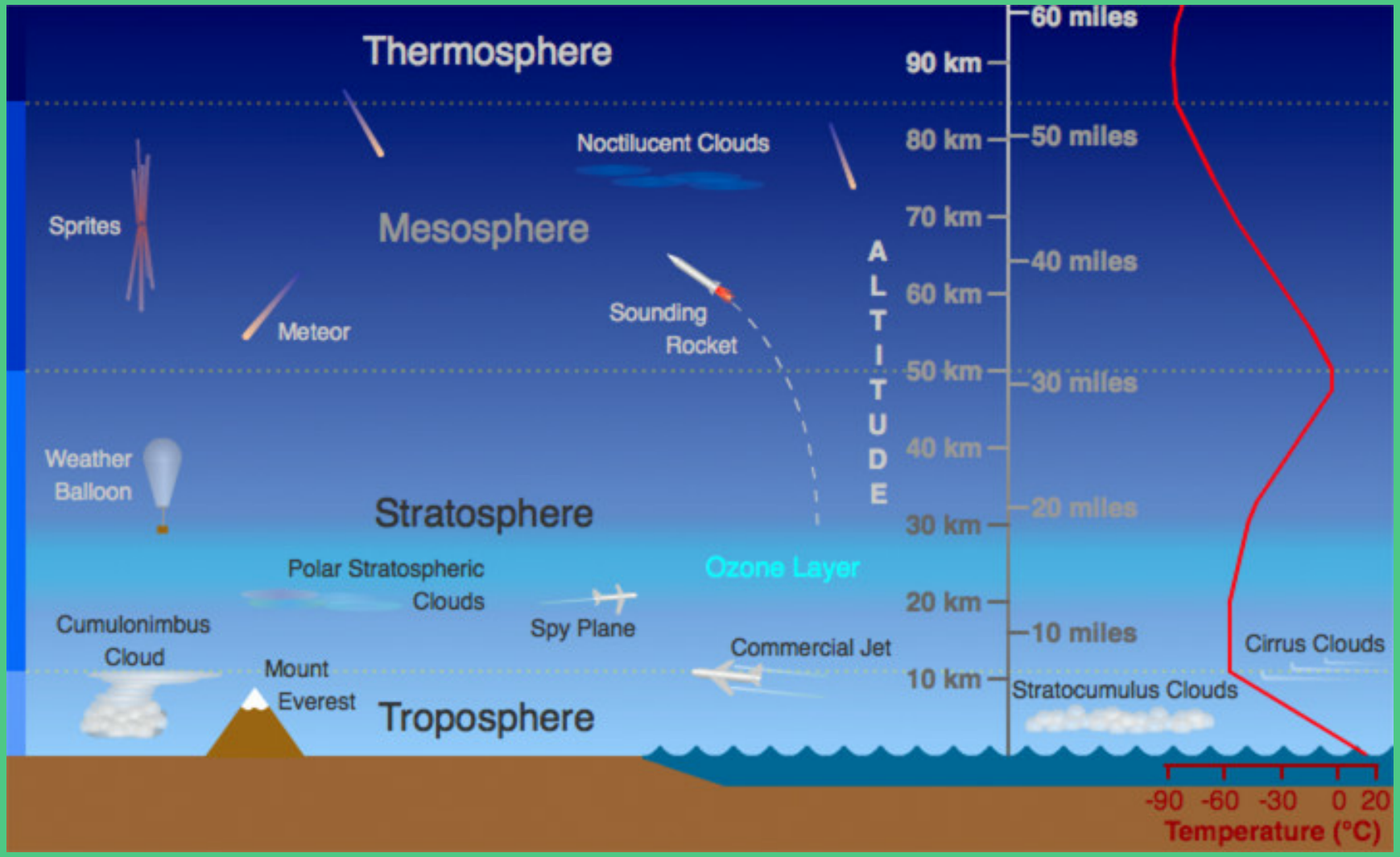
MESOSPHERE

- Beyond the stratosphere lies the mesosphere. It extends up to 80 km from the stratosphere.
- Further, in this layer also, temperature is decreasing with increase in height and at the height of 80 km it stands up to -100°C.
- The uppermost part of this layer is known as mesopause.

NOCTILUCENT CLOUDS

- Clouds visible at high latitudes.
- During summer season.
- Condensation of mixture of meteoric dust and some moisture.

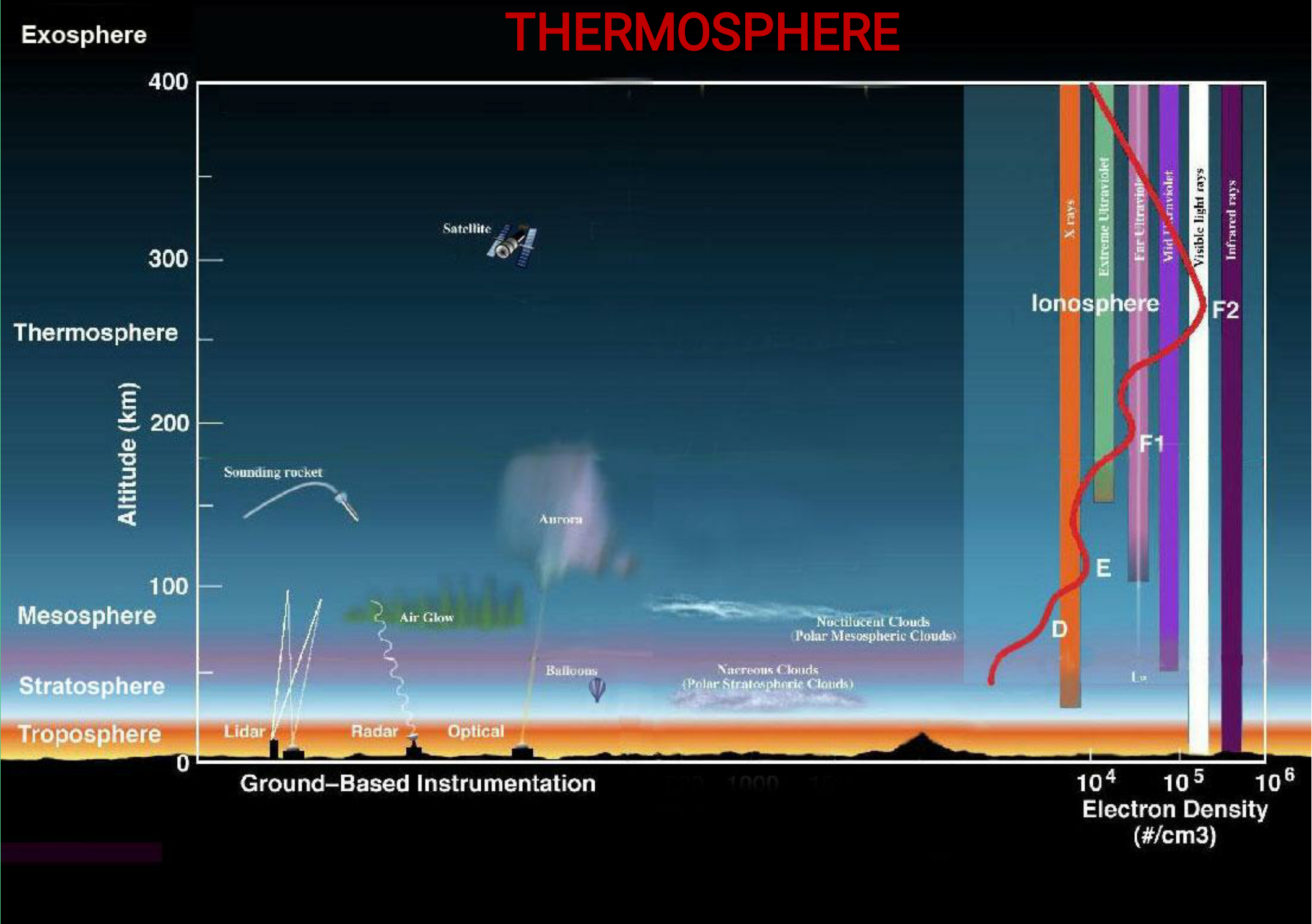
MESOSPHERE


Thermosphere
Noctilucent Clouds
Sprites
Mesosphere
Meteor
Sounding Rocket
Weather Balloon
Stratosphere
Polar Stratospheric Clouds
Ozone Layer
Spy Plane
Cumulonimbus Cloud
Mount Everest
Commercial Jet
Troposphere
ALTITUDE
90 km
80 km
70 km
60 km
50 km
40 km
30 km
20 km
10 km
60 miles
50 miles
40 miles
30 miles
20 miles
10 miles
Cirrus Clouds
Stratocumulus Clouds
-90 -60 -30 0 20
Temperature (°C)

THERMOSPHERE

- It lies at 80 km to 640 km above the earth's surface.
- It is also known as ionosphere.
- Temperature increases rapidly with increasing height.
- It is an electrically charged layer. This layer is produced due to interaction of solar radiation & the chemicals present, thus disappears with the sunset.
- There are a number of layers in thermosphere e.g. D-layer, E-layer, F-layer & G-layer.
- Radio waves transmitted from earth are reflected back to the earth by these layers.

THERMOSPHERE



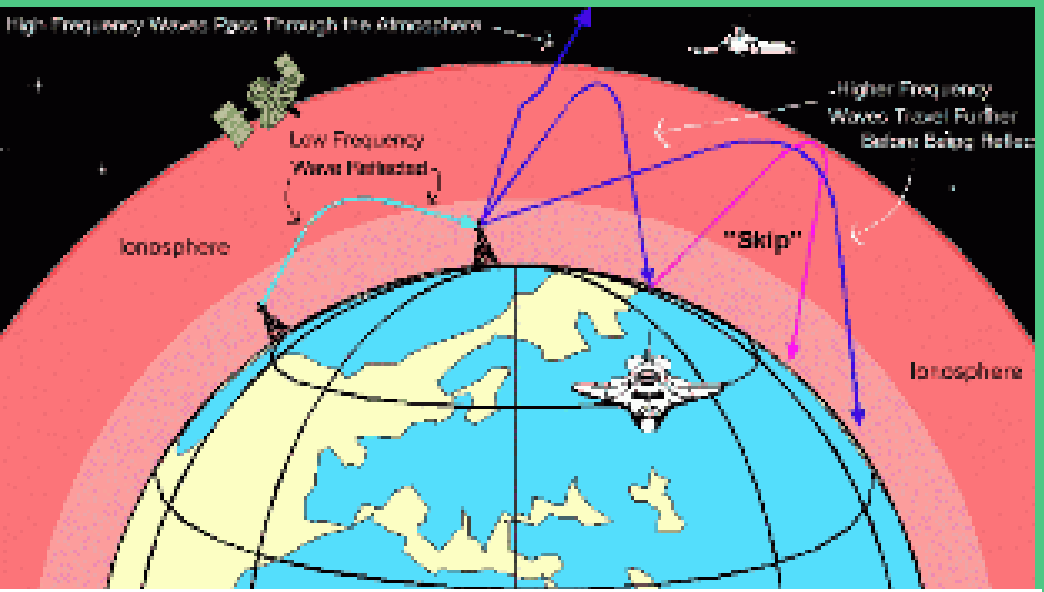
IONOSPHERE

- Ionosphere extends from 80 km to 400 km.
- Temperature rises in this layer rapidly and reaches up to 1000°C in its uppermost part.
- The radio waves transmitted from this layer are reflected back to the Earth from this layer.

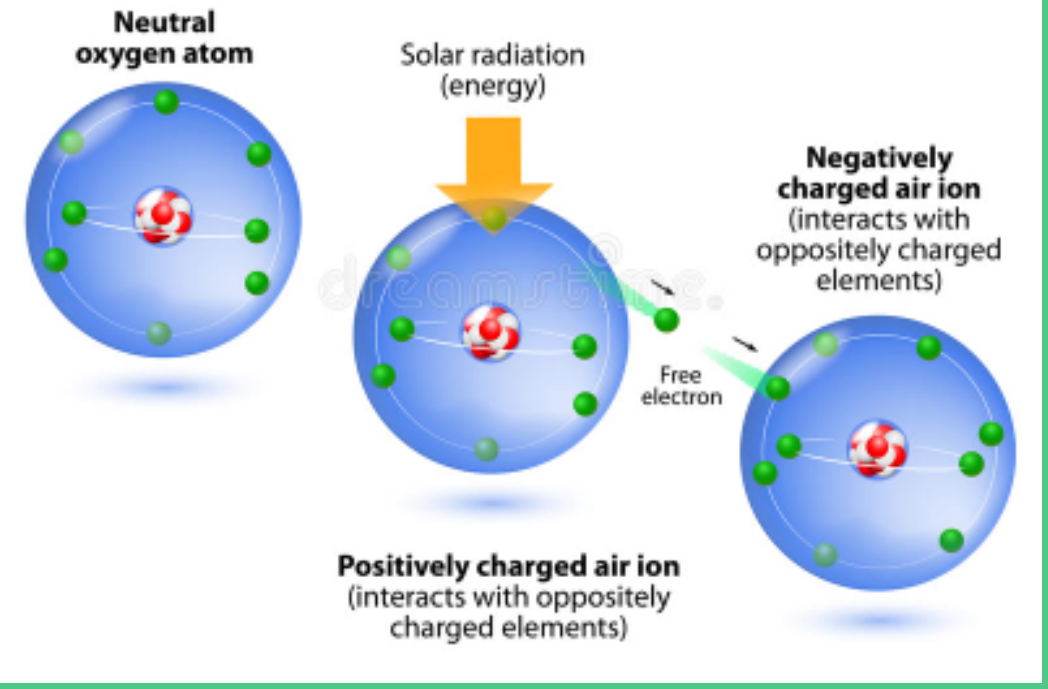
ORIGIN OF IONOSPHERE

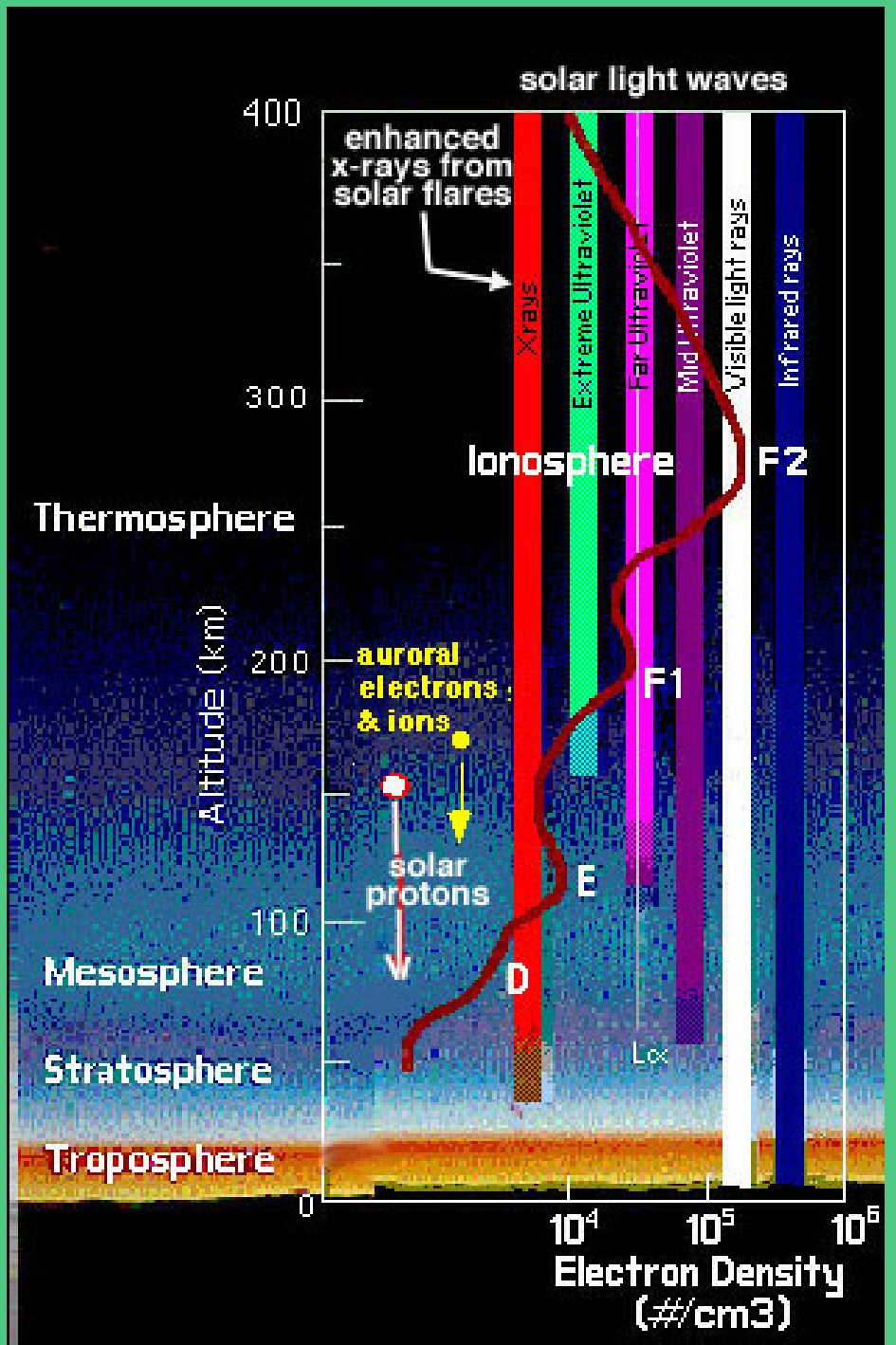
- High energy sunrays and cosmic rays break the atoms of air molecules- become ionised (+ ve charged).
- Behave as free particles.
- At night time only cosmic rays ionisation- weak.

IONOSPHERE



ION FORMATION



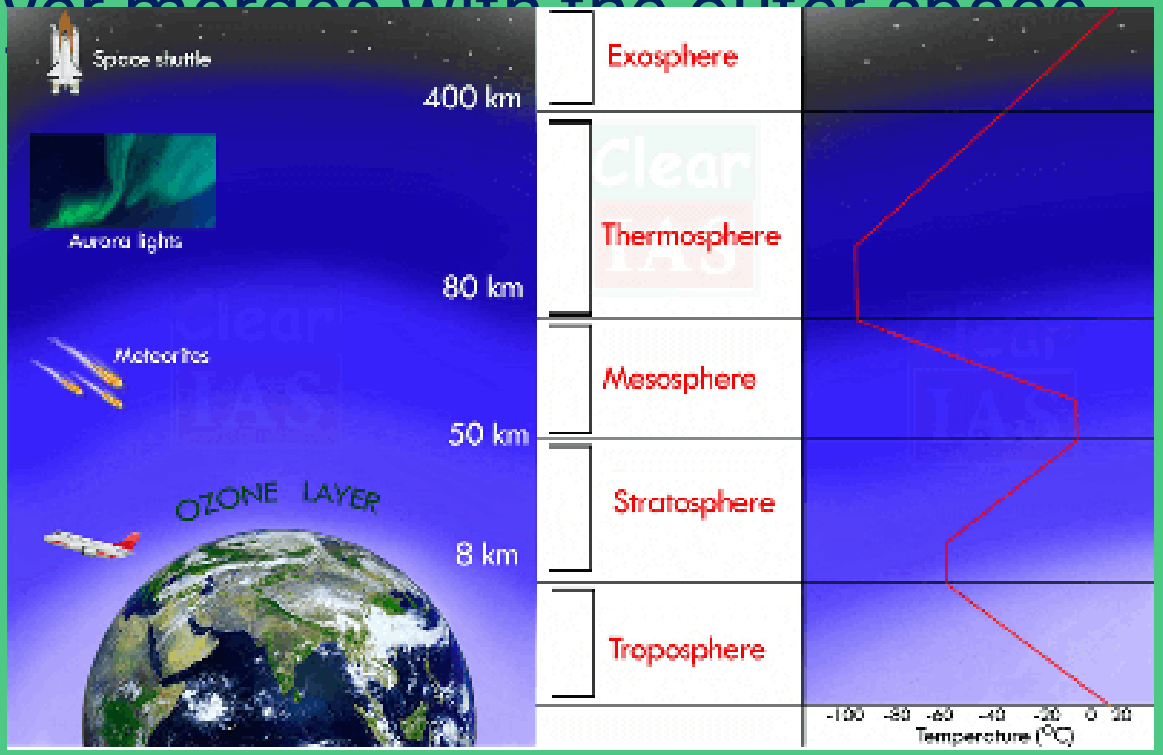


LAYERS OF IONOSPHERE

LAYER	HEIGHT	FREQUENCY	PRESENCE	FORMATION
D	60-90 KM	LF	DAY TIME	SOLAR RADIATION
E	99-130KM	MF, HF	DAY TIME	UV AND N MOLECULE
F	150-380KM	MF, HF	DAY & NIGHT TIME	
G	ABOVE 400	MF, HF	DAY & NIGHT TIME	

EXOSPHERE

- This is the uppermost layer of the atmosphere extending beyond the ionosphere.(above 640km)
- The density is very low & temperature becomes 5568°C.
- This layer merges with the outer space.



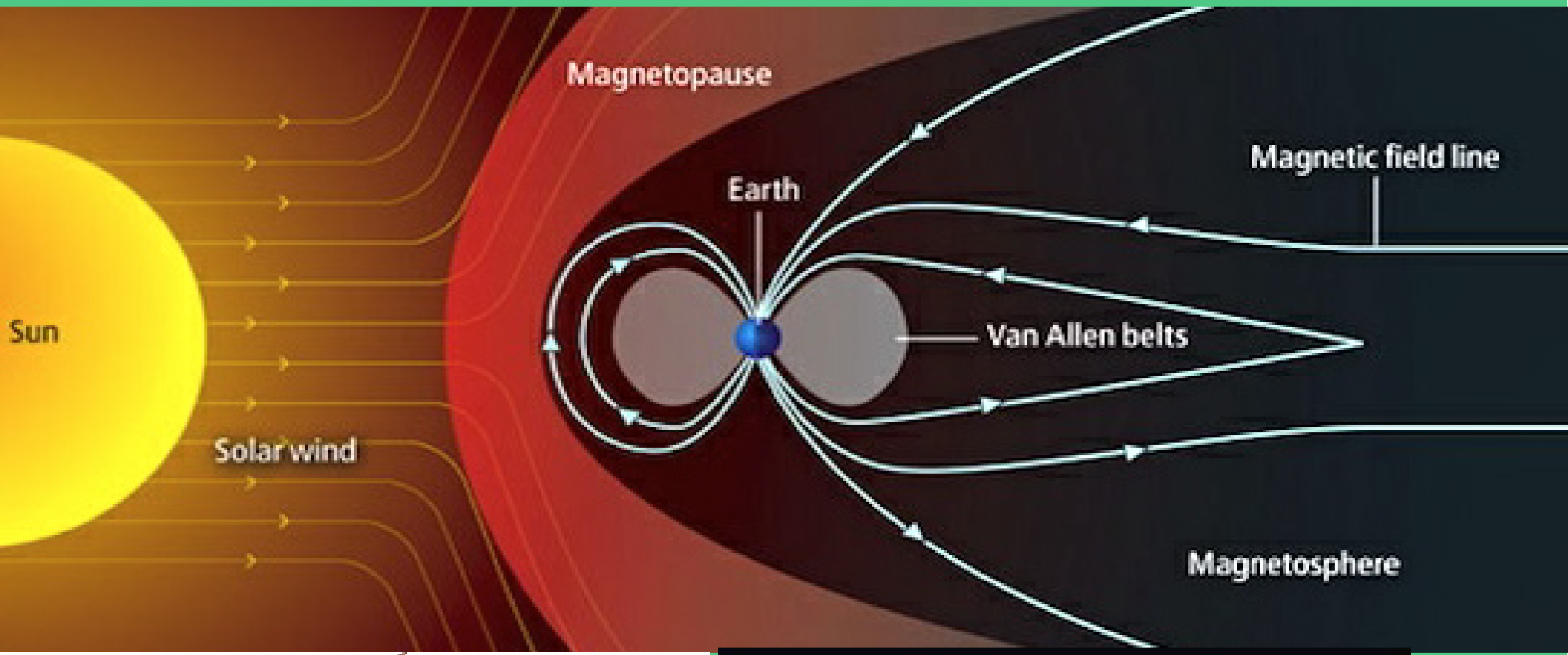
AURORA

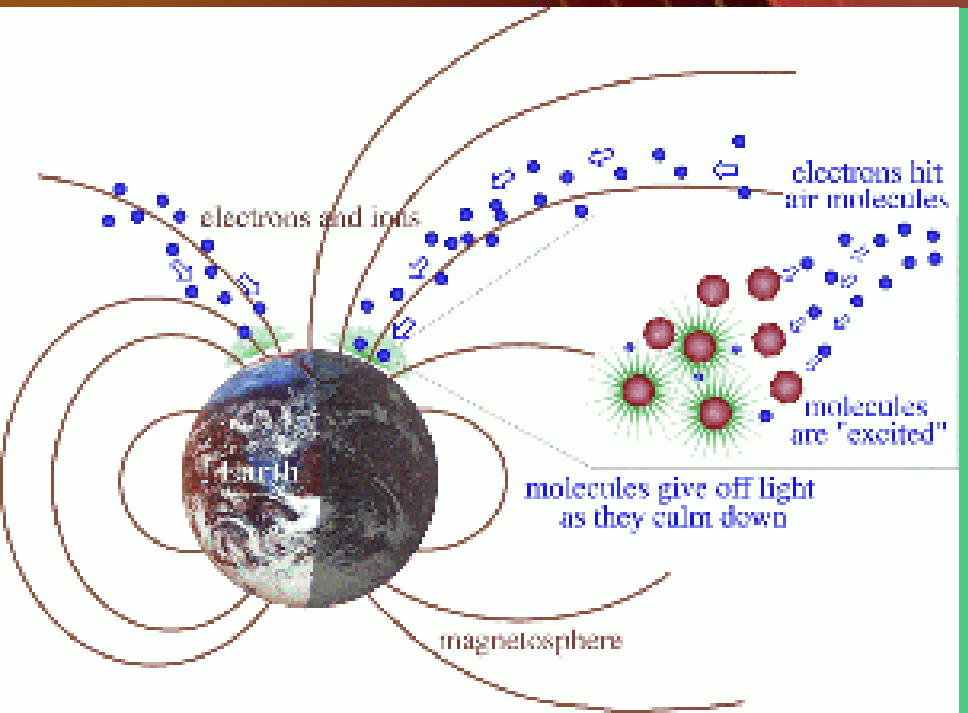
- Glowing light at mid nights at high latitude.
- At height of exosphere and magnetosphere.

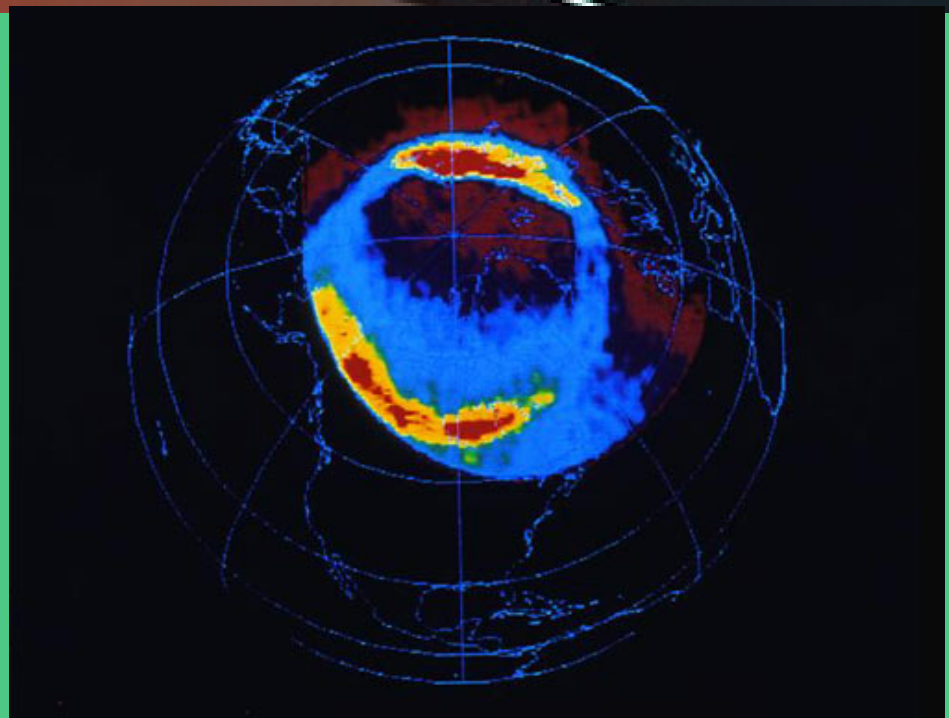
ORIGIN OF AURORA

- Sun emit solar wind/ storm from its corona.
- Solar wind consist of plasma(free electron and +ve ions)
- Interaction of solar wind with earths magnetosphere- disturbance.
- collision of charged particles (isonisation)
- Ionised particles emit lights- release energy.
- Charged particles interact with geomagnetic field lines.

AURORA


Magnetopause
Magnetic field line
Earth
Sun
Van Allen belts
Solar wind
Magnetosphere


electrons and ions
electrons hit
air molecules
molecules
are "excited"
molecules give off light
as they calm down
magnetosphere



AURORA

THANK YOU