

# **Atmosphere: Composition and Structure**

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# **Structure of the chapter**

- **Origin of Atmosphere**
- **Composition of Atmosphere**
- **Structure of Atmosphere**

# What is 'Atmosphere'?

- The mixture of gases, water droplets, and solid particles above the earth's surface
- Atmosphere is a blanket of gases and suspended liquids (water droplets) and solid particles (dust) that envelops the earth completely and extends upwards several thousands kilometers upto the zone where magnetic fields and ionised particles are more than the air (like near the surface).
- Atmosphere is the part of our earth the same way as lithosphere, hydrosphere and biosphere.
- Atmosphere is attached to the earth due to gravitation force.



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- **Atmosphere** – The mixture of gases, water droplets, and solid particles above the earth's surface
- **Weather** – Day to day atmospheric conditions. Short-term atmospheric phenomena lasting from hours up to about a week (e.g. thunderstorms, hurricanes, periods of high winds, drizzle)
- **Climate** – Long-term atmospheric conditions lasting from weeks to years (30-32 years and more)
- **Meteorology** – The study of weather
- **Climatology** – The study of climate

# The Evolution of the Atmosphere

- Earth's early atmosphere contained mostly hydrogen and helium
- Two hypotheses exist that explain the dispersion of this early atmosphere
  - 1) The gases escaped to space by overcoming gravity with large enough escape velocities
  - 2) Collisions between earth and other large bodies launched the early atmosphere to space
- A modern atmosphere began to form through outgassing by volcanic eruptions, and possibly through collisions of comets with earth (Both supplying mostly carbon dioxide and water vapor)

# The Evolution of the Atmosphere

- Water vapor condensed and precipitated to form oceans
- Carbon dioxide lost to oceans
- Oxygen released first through primitive oceanic bacteria, later through plants (protected by ozone layer)
- Plants further reduced carbon dioxide
- Nitrogen slowly increased over long periods of time through outgassing

# Composition of the Modern Atmosphere

The atmosphere contains:

- Gases (permanent and variable);
- Water droplets (clouds and precipitation);
- Microscopic solid particles: Aerosols (Dust particles);

# The Permanent Gases

- **Permanent gases** form a constant proportion of the atmosphere, and have long residence times (thousands to millions of years)

**TABLE 1-2** Permanent Gases of the Atmosphere

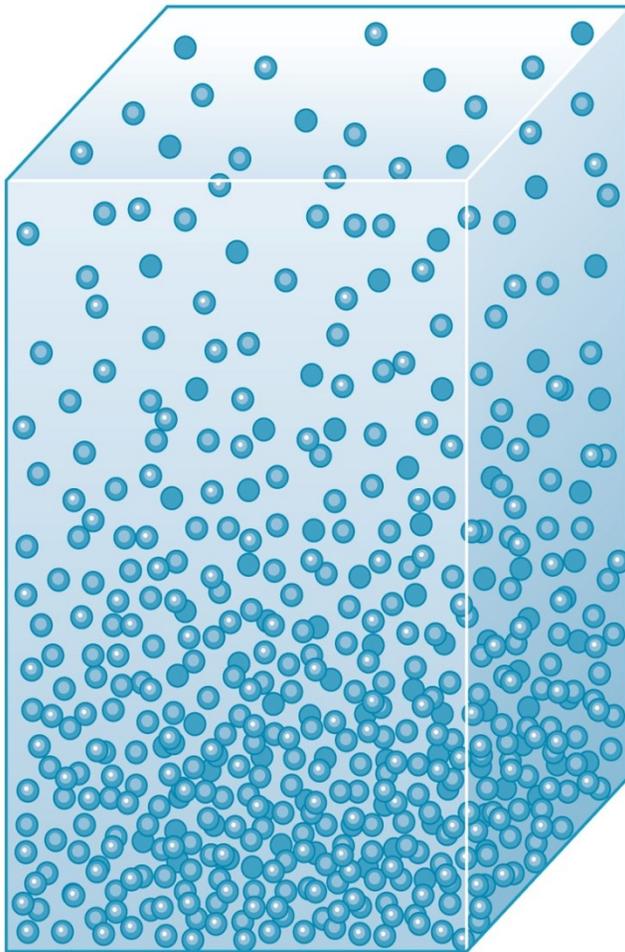
Constituent	Formula	Percent by Volume	Molecular Weight
Nitrogen	N <sub>2</sub>	78.08	28.01
Oxygen	O <sub>2</sub>	20.95	32.00
Argon	Ar	0.93	39.95
Neon	Ne	0.002	20.18
Helium	He	0.0005	4.00
Krypton	Kr	0.0001	83.8
Xenon	Xe	0.00009	131.3
Hydrogen	H <sub>2</sub>	0.00005	2.02

# The Variable Gases

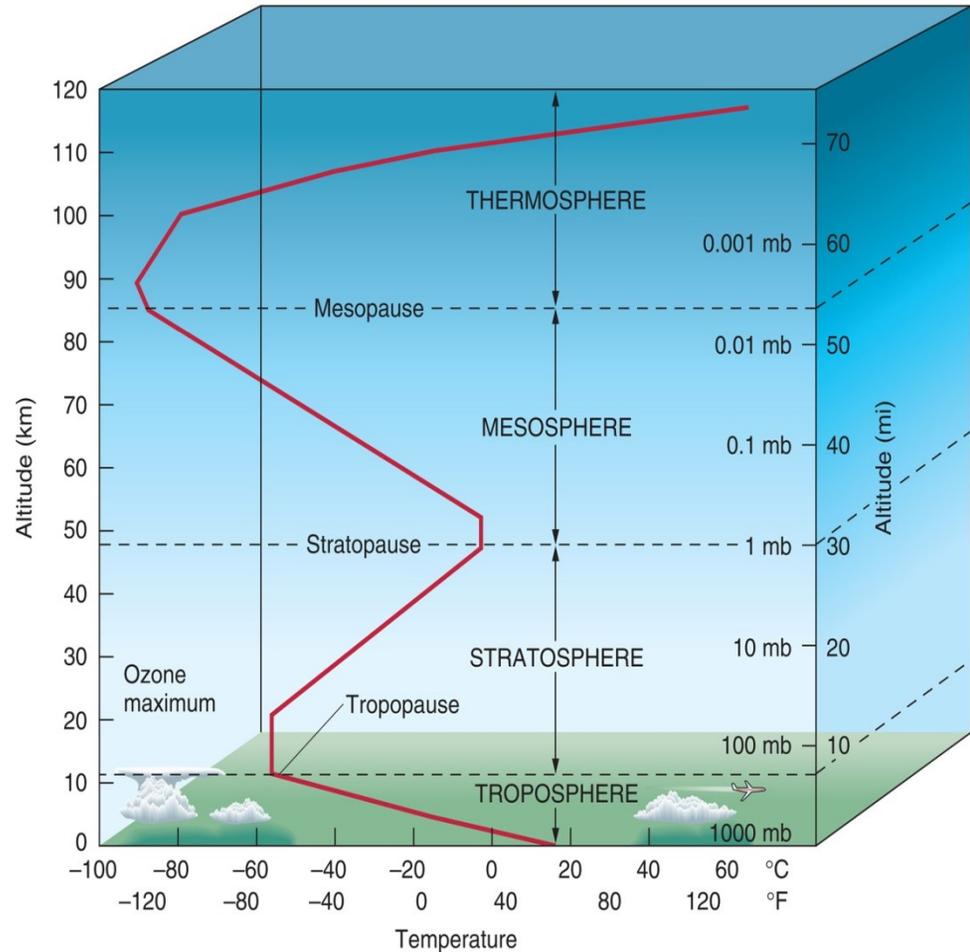
**Variable gases** vary in atmospheric concentration in both time and space.

**TABLE 1-3** Variable Gases of the Atmosphere

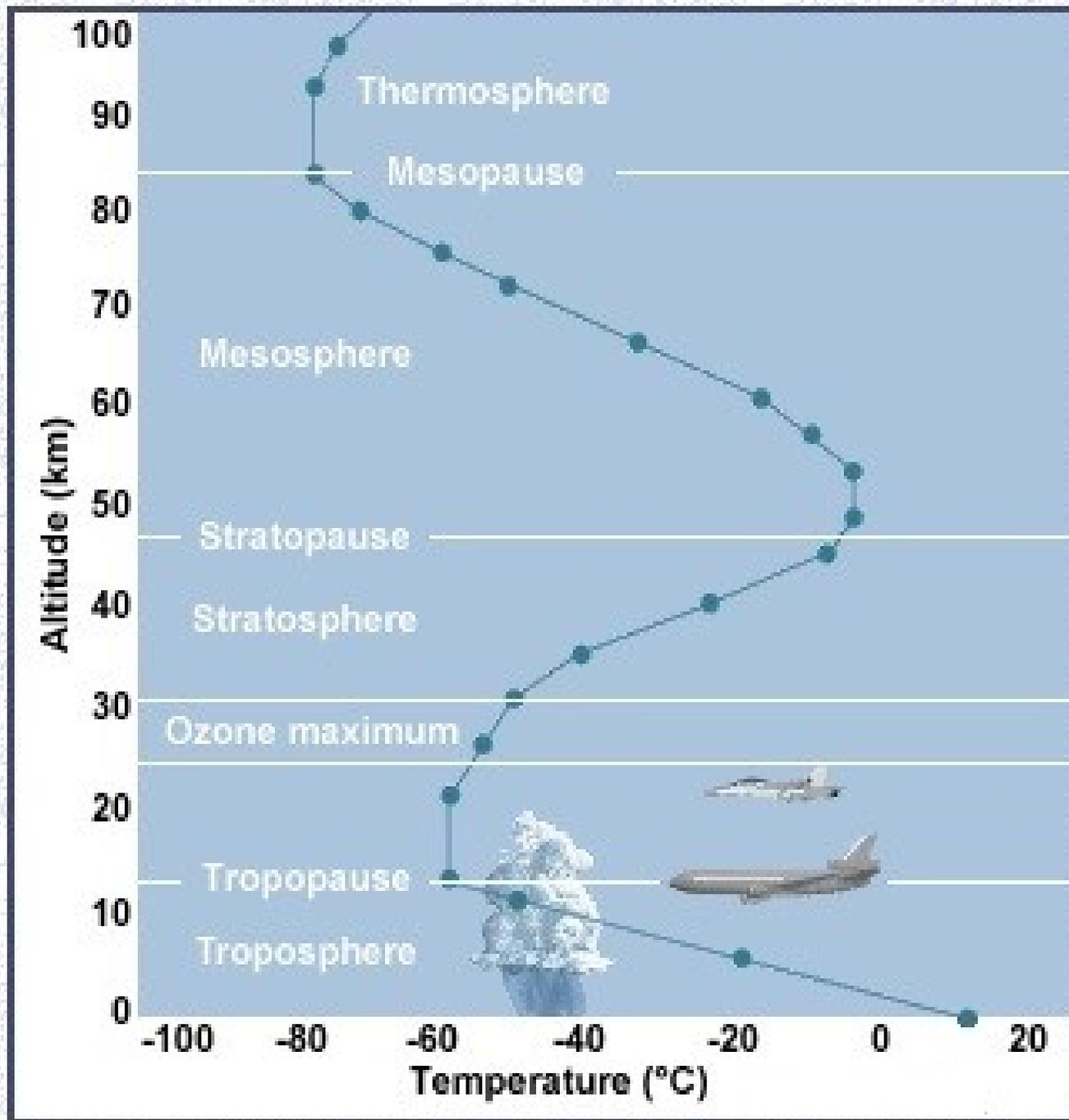
Constituent	Formula	Percent by Volume	Molecular Weight
Water Vapor	H <sub>2</sub> O	0.25	18.01
Carbon Dioxide	CO <sub>2</sub>	0.038	44.01
Ozone	O <sub>3</sub>	0.01	48.00

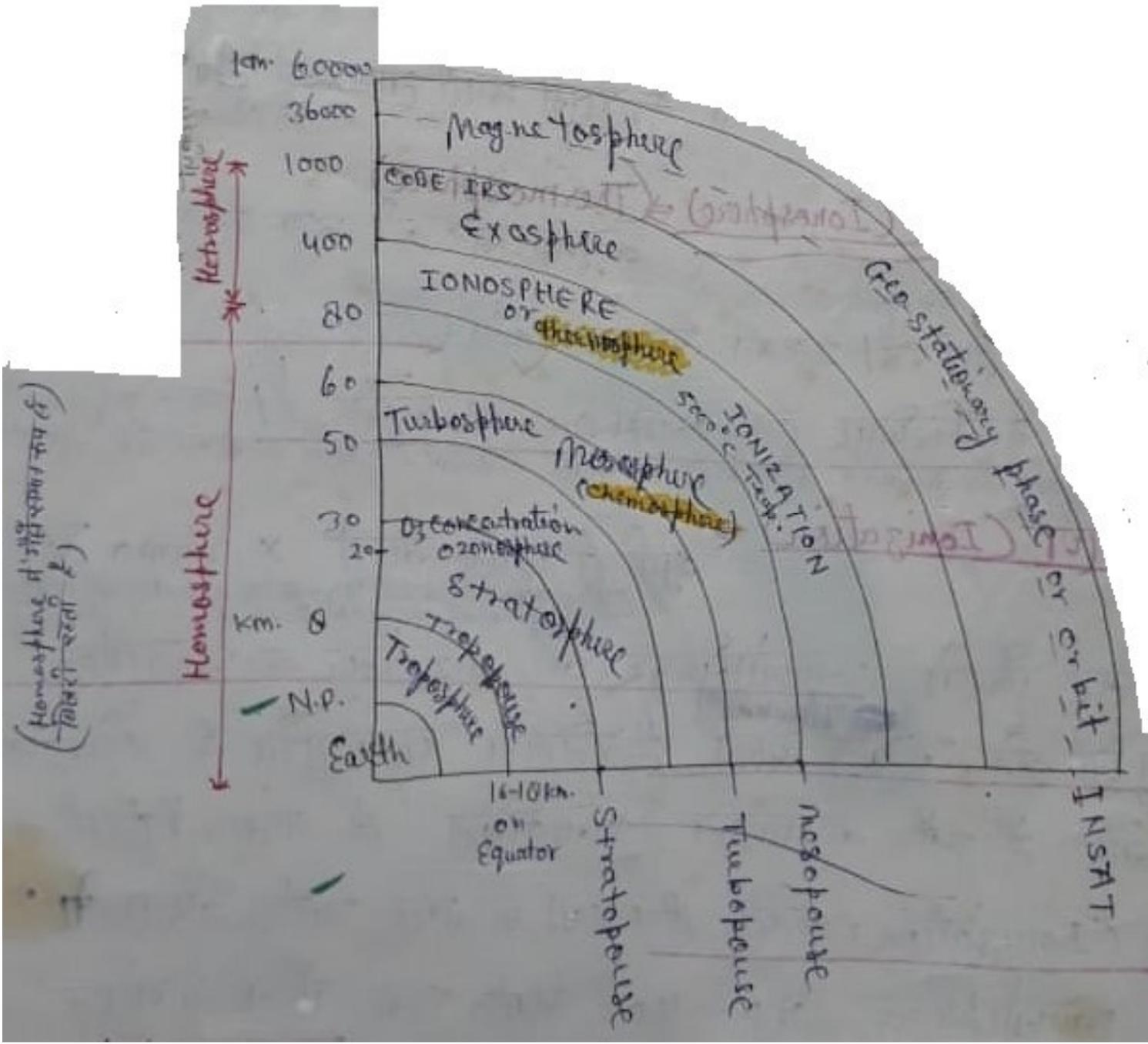


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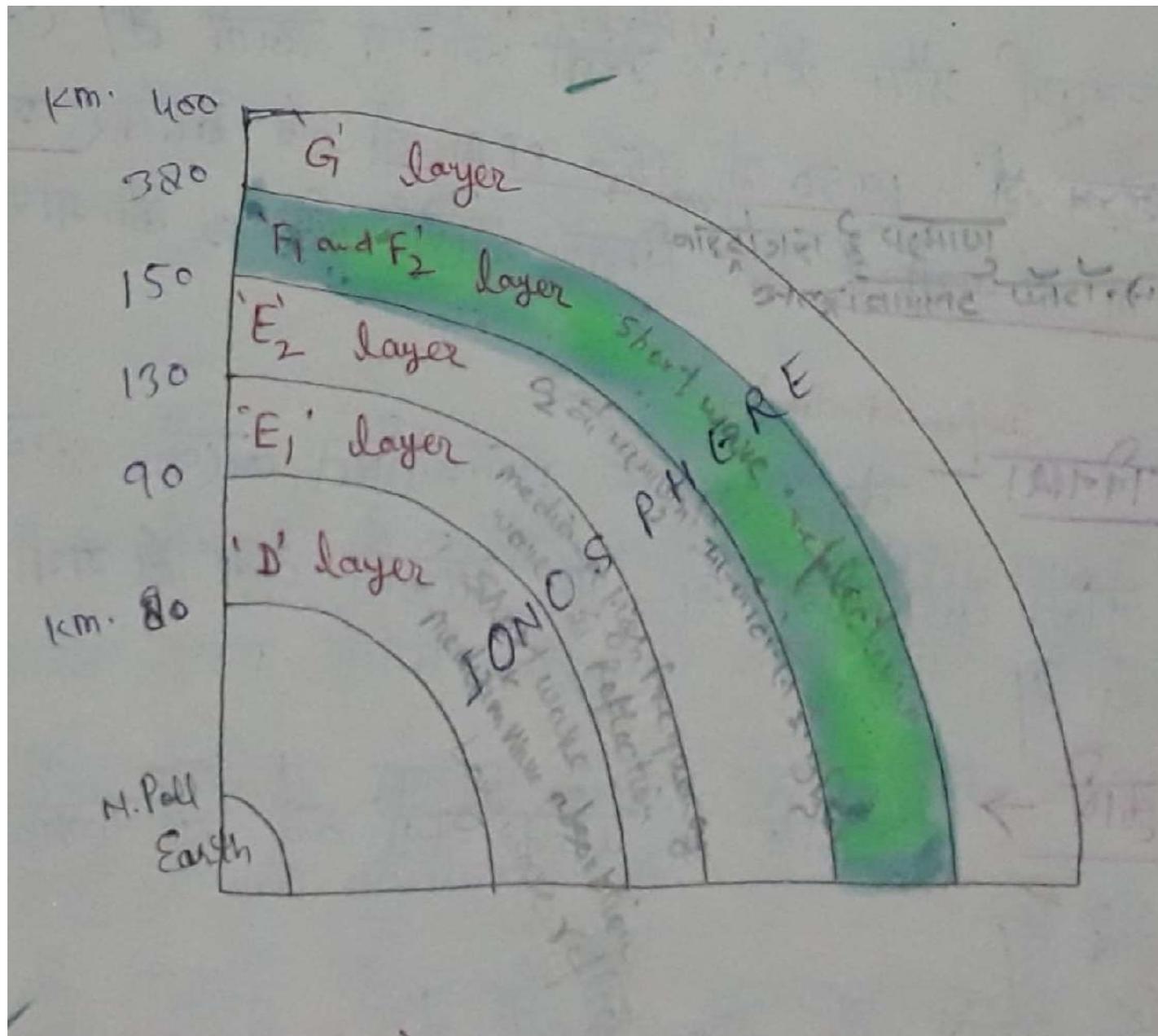


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(Homosphere is the lower part of the atmosphere)  
(Heterosphere is the upper part of the atmosphere)



# Ionosphere

Aurora Borealis and Aurora Australis



