

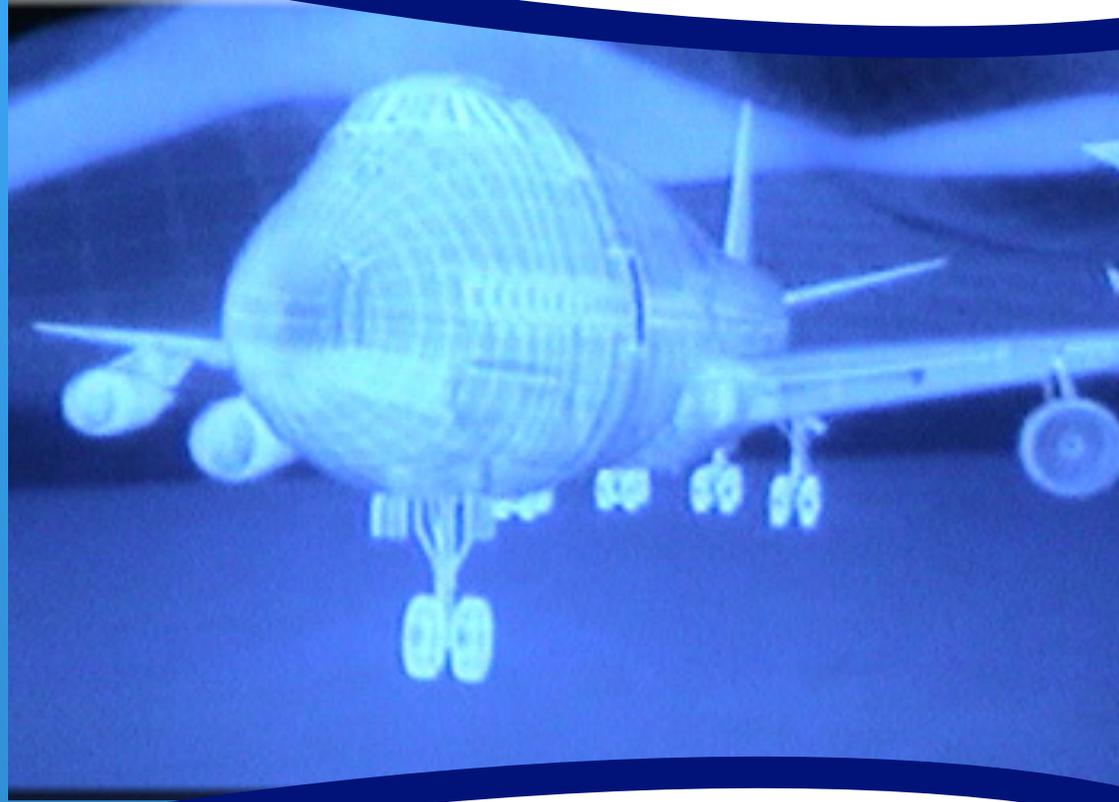
# THEORY OF FLIGHT



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# AIRPLANE

A power-driven heavier-than-air, aircraft deriving its lift in flight from aerodynamic reactions on surfaces...





# ATMOSPHERE

- ✈ The invisible **ocean of air surrounding the earth** is known as atmosphere.
- ✈ The aircraft are navigated through this ocean of air that assist them to fly.
- ✈ The **weather condition** is vital for pilots who navigate the aircraft in the atmosphere.
- ✈ The **properties** of the atmosphere is **mobility, capacity to compression and expansion**



# ATMOSPHERE

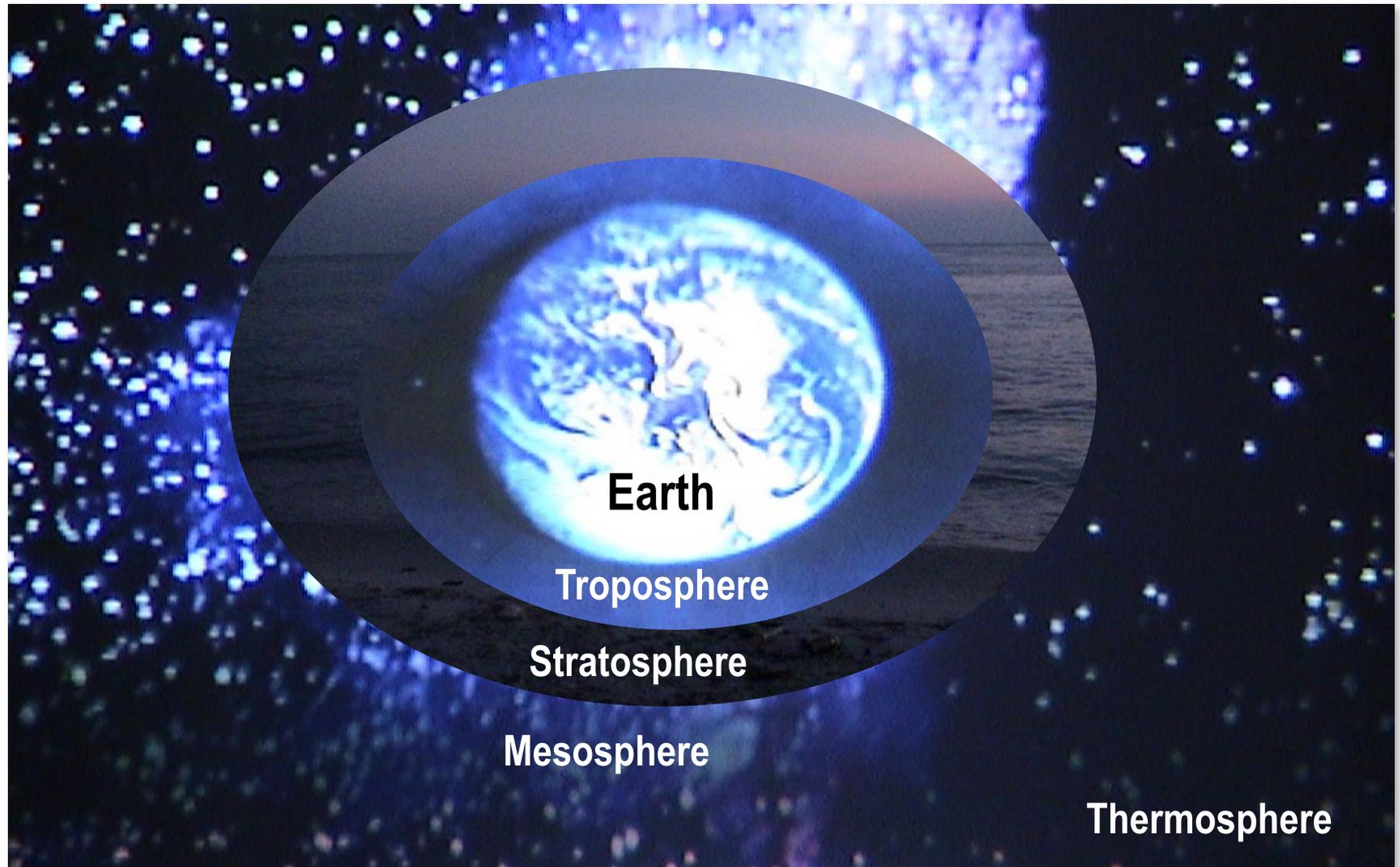
✈ The atmosphere is composed of mixture of gases

☐ Nitrogen (78%)

☐ Oxygen (21 %)

☐ Other Gases (1 %) such as argon, CO<sub>2</sub>

# LAYERS SURROUNDING EARTH





# THE TROPOSPHERE

- The lowest layer of the atmosphere is known as *troposphere*
- Troposphere's height at *poles* are around 28000 feet above sea level and around 54000 feet above sea level at the *equator*
- *Temperature, Pressure* and *Density* all **decrease** with height in this region



# TROPOSPHERE Cont..1

- Lower level of troposphere **contains water** and most of the weather pattern changes in this region.
- At the upper region; **strong winds** and fast moving jet streams occur
- Top layer of troposphere is known as ***tropopause***
- Tropopause; The **temperature remains same** and maintains at (- 56' C)



# STRATOSPHERE

- The distance of about 50000 feet above the **tropopause** is known as **stratosphere**.
- In this region
  - the **Pressure** continue to **decrease** with the height, but the **temperature remains** at (-56' C)
  - **No water contents**
  - **Minimum air current**
- The top layer of stratosphere is known as **Stratopause**



# MESOSPHERE

- The region above **Stratopause** is known as mesosphere.
- At mesosphere the **temperature increases** with the height.
- At a height of about 150,000 feet the temperature reaches 10' C
- The ozone layer presence in this region absorbs sun' s radiation and increases the temperature
- The top region of this layer is known as **mesopause**



# THERMOSPHERE

- The space above *mesopause* to indefinite height is known as **thermosphere**.
- In this region lies the *ionosphere* and *exosphere*
- The **Temperature** again **begin to rise** in this region
- Almost to **3000' C at 400 miles** but
- The only heat the space ship would experience would be what it would receive from the radiation of the sun.

# I C A O STANDARD ATMOSPHERE

- The air is a perfectly dry gas
- A mean sea level pressure of **29.92** inches of mercury
- A mean sea level temperature of **15' C**
- The rate of decrease of temperature with height is **1.98' C per 1000 feet**

# STANDARD ATMOSPHERE CHART

Altitude in feet	Pressure in inches of Mercury	Temperature in Celsius	Relative Density
Sea Level	29.92	+15	1.00
5000	24.89	+ 5.1	0.86
10000	20.58	-4.8	0.74
15000	16.88	-14.7	0.63
20000	13.75	-24.6	0.53
30000	8.88	-44.4	0.37
40000	5.54	-56.5	0.24
50000	3.44	-56.5	0.15

# AIRCRAFT FLYING REGION

- The **unpressurized** aircraft fly **below 10,000 feet**.
- The **pressurized aircraft** normally fly at the height of **35000 to 40000** feet above sea level
- Troposphere is the atmospheric region where pressurized aircraft fly.
- As the altitude increases, The ***Pressure, Density and Temperature***, all ***decrease*** .

# ATMOSPHERIC PRESSURE

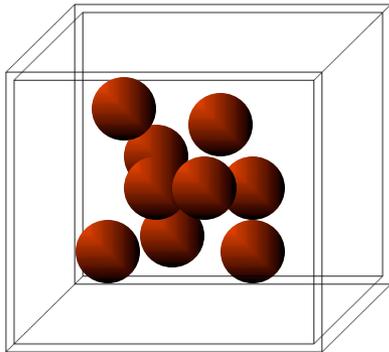
- The **air molecules** which surrounds the earth have **weight**.
- The **force exerted by the weight** of these air molecules is known as **air pressure**.
- The air is a **compressible fluid**.
- **Air pressure** can be **measured with a barometer**.
- At sea level, air pressure is **29.92 inches of mercury**, or **14.7 p.s.i.**
- As the **altitude increases** the **pressure decreases**.



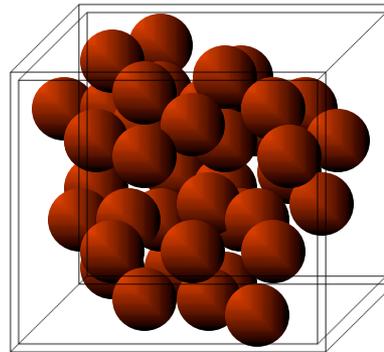
# DENSITY

- The **density** of a substance is its **mass per unit volume**.
- Density of the air **depends** on atmospheric **temperature and pressure**.
- Formula to calculate density :

$$\text{Density} = \text{Mass} / \text{Volume}$$



Low density



High density

- As the altitude increases the density decreases.



# HUMIDITY

- The **water on earth** (oceans, rivers, lakes) **evaporates** and becomes **moisture content** in the atmosphere.
- This water vapour content in the air is called **humidity**.
- The water vapour **changes into water droplets** by a process called **condensation** and **changes into ice crystals** by a process called **sublimation**.



# HUMIDITY Cont..1

- In its visible form (water droplets/ ice crystals), moisture forms **clouds** and **fog**.
- The **temperature governs** the **amount of water vapour** that a unit volume of air can contain.
- Warm air holds more moisture than cold air.
- Humidity affects the **performance of the aircraft** in the air.

# *TEMPERATURE*



# TEMPERATURE

- **Temperature** is the measure of the average **kinetic energy** of the molecules of a substance.
- Kinetic energy is the **energy associated with motion**.
- **Hot** molecules **move faster** than cold molecules.
- The atmosphere is **heated from below** and **not** from above.

# TEMPERATURE Cont..1

- The scales used to measure the temperature is **Celsius, Fahrenheit, and absolute Scales.**
- At sea level, temperature is **15 degree Celsius** or **59 degree Fahrenheit**
- As the **altitude increases**, the **temperature decreases**

# VISCOSITY

- The **internal resistance** to the **flow of fluid** is known as **viscosity**.
- This means the tendency of one layer of air to **resist** the motion of the layer next to it, and try to move with it.
- The viscosity is the property of air that **affects the flight** performance