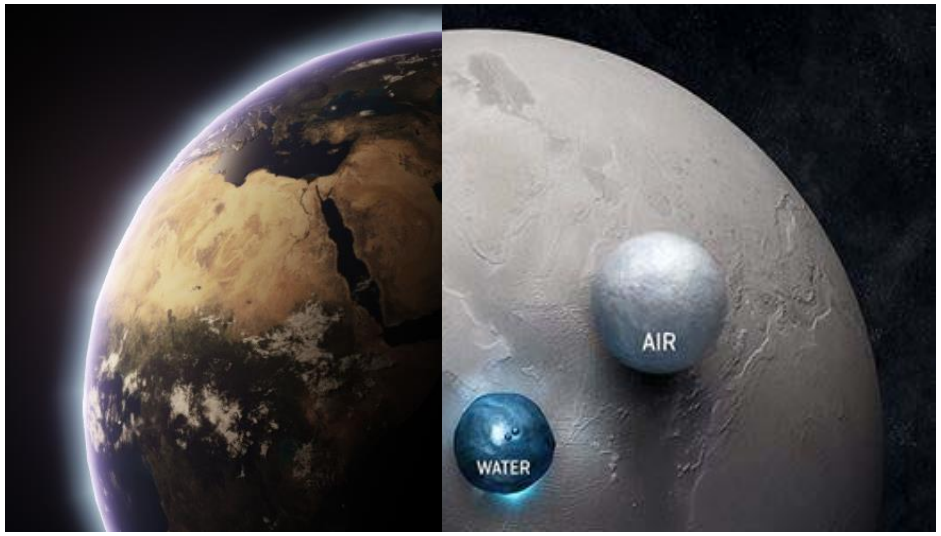
THE ATMOSPHERE

Atmosphere

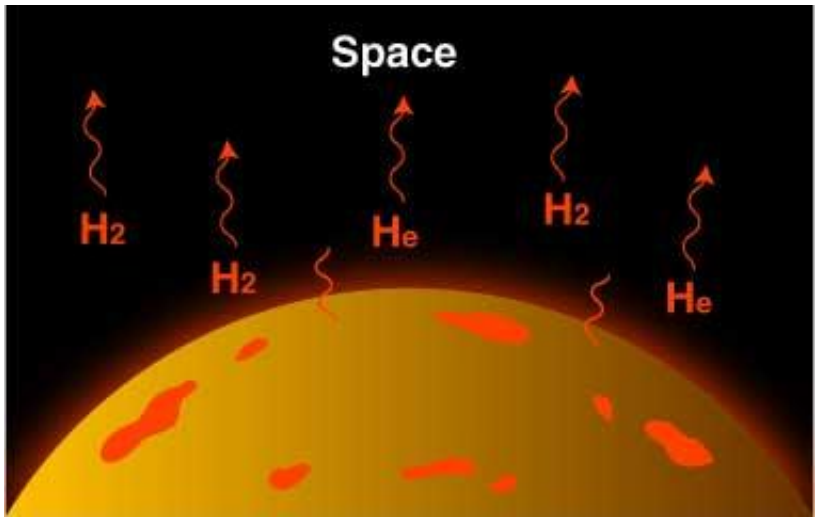
from Greek ἀτμός [*atmos*] "vapor"and σφαῖρα [*sphaira*] "sphere"

- **An <u>atmosphere</u> is a layer of gases surrounding a material body of sufficient mass that is held in place by the gravity of the body.**
- **The Earth's atmosphere protects life on Earth by absorbing ultraviolet solar radiation, warming the surface through heat retention (*greenhouse effect*), and reducing temperature extremes between day and night.**



- The atmosphere is a **gas**.
- The atmosphere is a **fluid**.
- The atmosphere has a **mass of about 5.15×10^{18} kg** (~1-millionth of the Earth's mass!)

Evolution of the Early Atmosphere

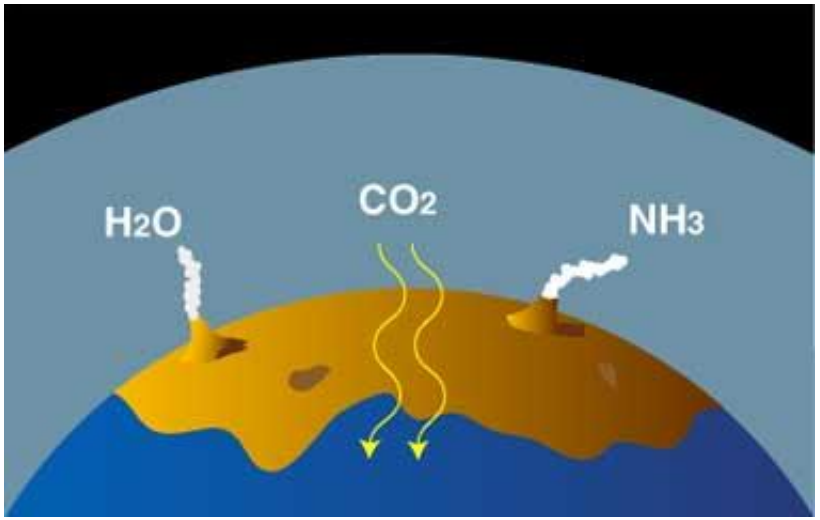


- **Primitive <u>first</u> atmosphere**

(*stellar gas* composition: H, He, CH_4 – hot and light, able to quickly escape to space)

- ***Outgassing*** **and the <u>second</u> atmosphere**

(volcanoes released H_2O, NH_3, Ar, CO_2 – <u>still no oxygen</u>!)

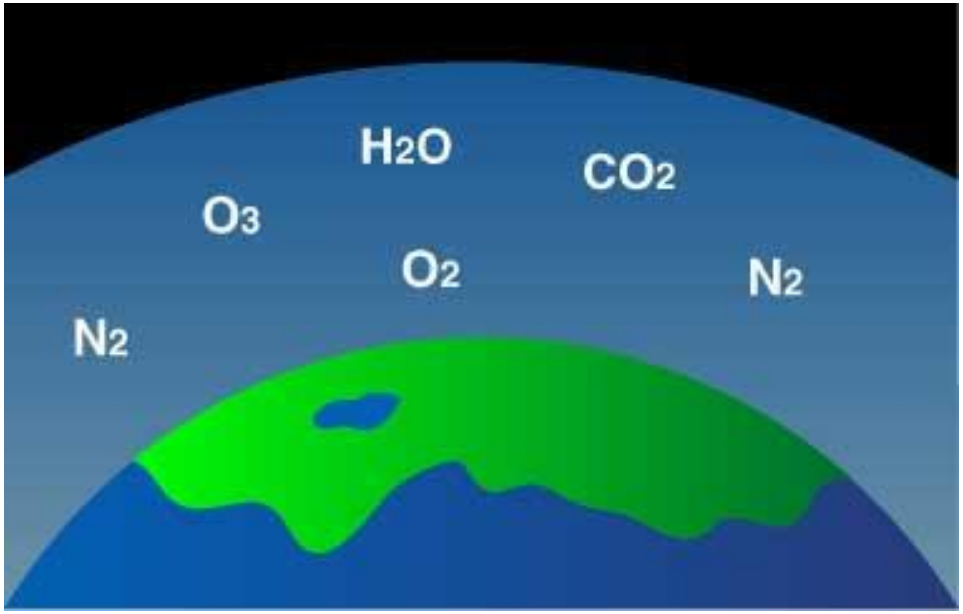


The Modern Atmosphere
upon which life depends was created by life itself!

The evolution of life and atmosphere are closely linked – life produces free oxygen (photosynthesis) and cycles carbon (limestone formation).

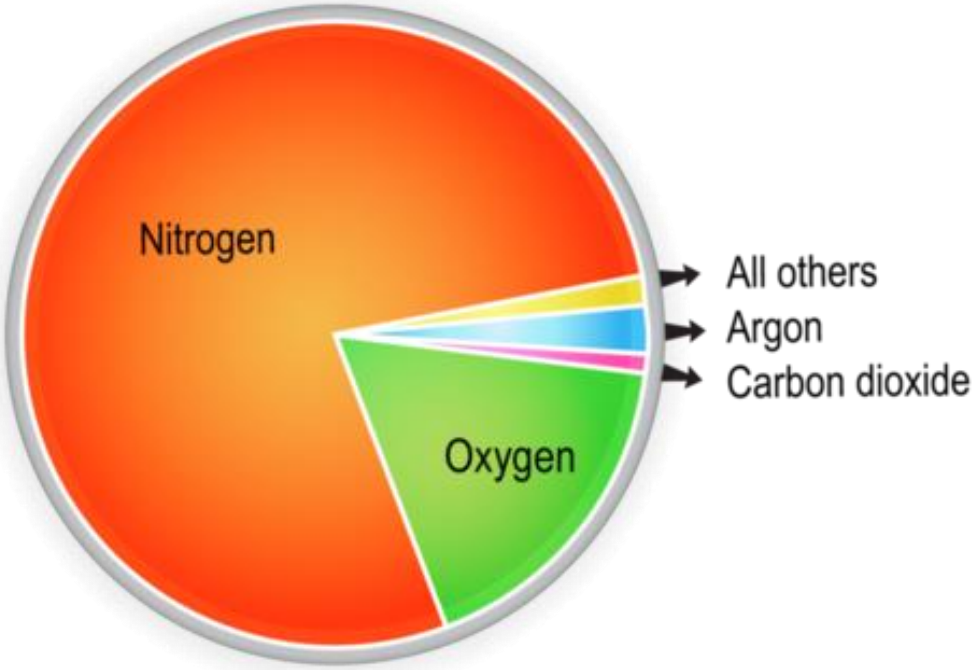
- ***Free oxygen is very reactive!***
- ***Oxidized*** **modern atmosphere**

(mostly N_2, O_2,
and very little H_2O and CO_2… **playing a *very important role*!)**



Atmospheric Gases

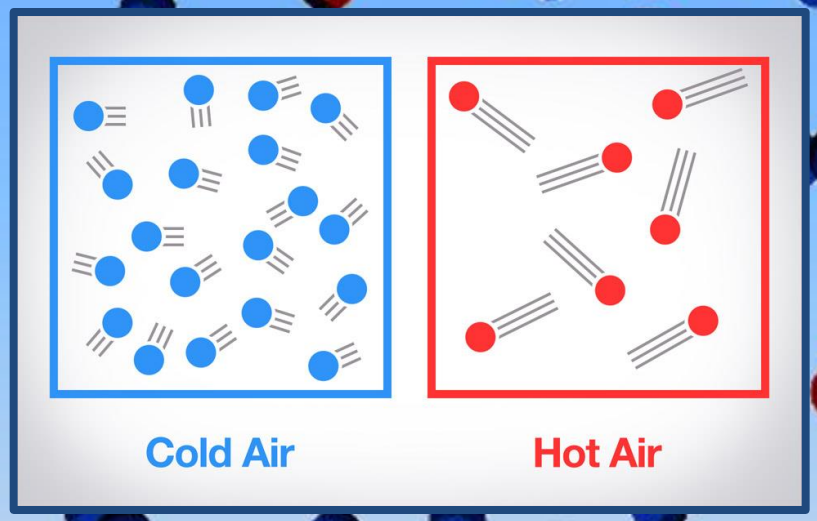
- **Nitrogen - 78%**
- **Oxygen - 21%**
- **Argon - .93%**
- **Water vapor – 0 to 4%**

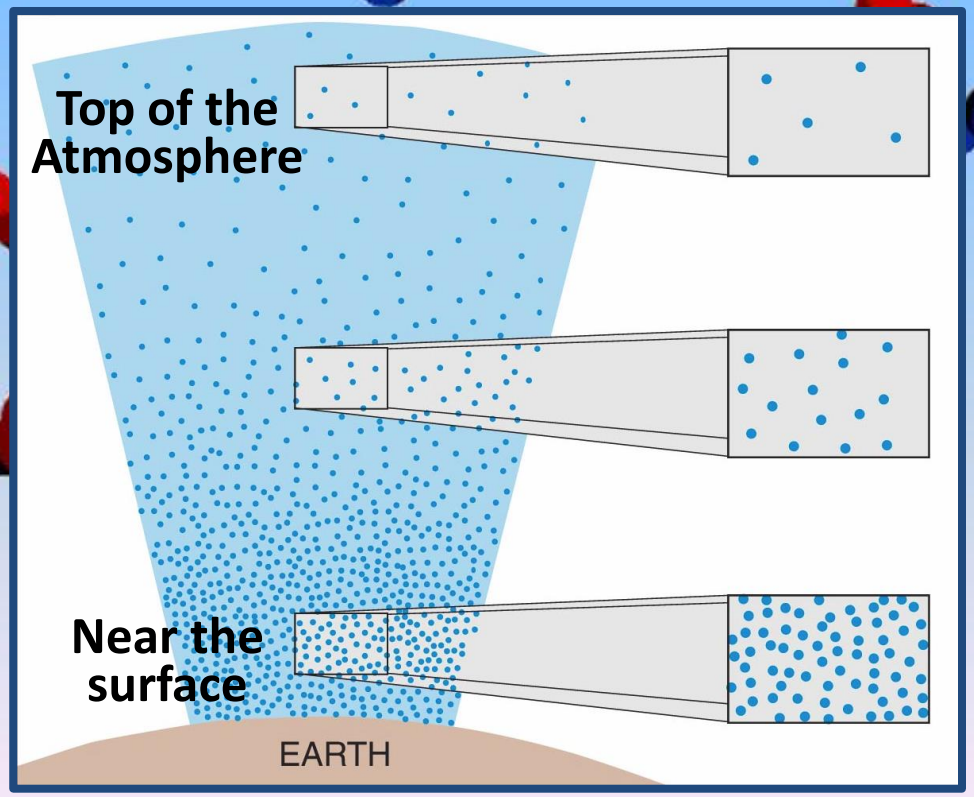


- ***Traces*** **of neon, helium, methane, krypton, xenon, hydrogen, ozone, and…**
- **…carbon dioxide - .0415% (end of year 2020)**
  - **keeps Earth warm and is used by plants to make food**

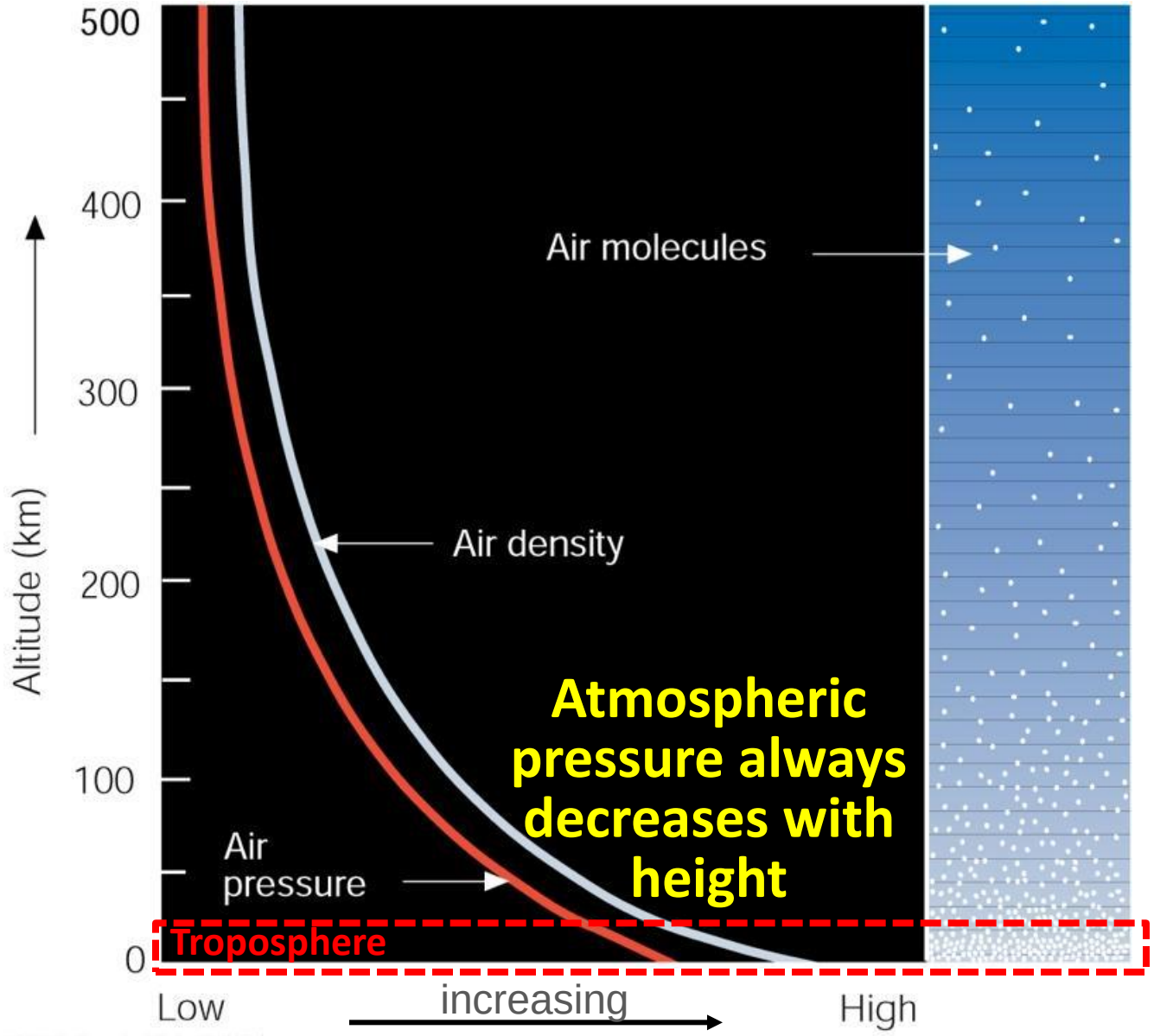
The air is made up of *molecules*:

particles that are in constant motion.





Air Density and Pressure



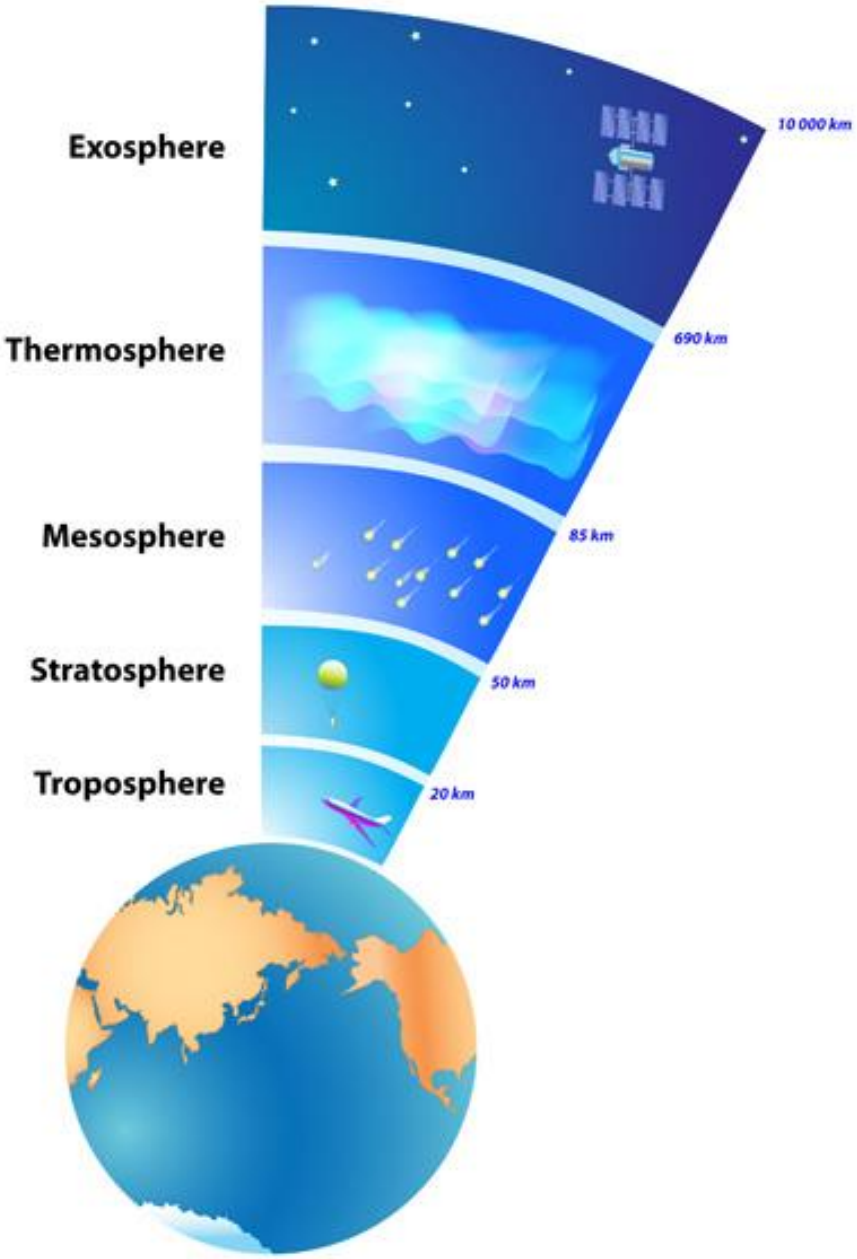
- **Air density is the amount of air (*mass* of air molecules) in a given space (*volume*).**
- **The amount of *force* exerted over an *area* of surface is called pressure.**

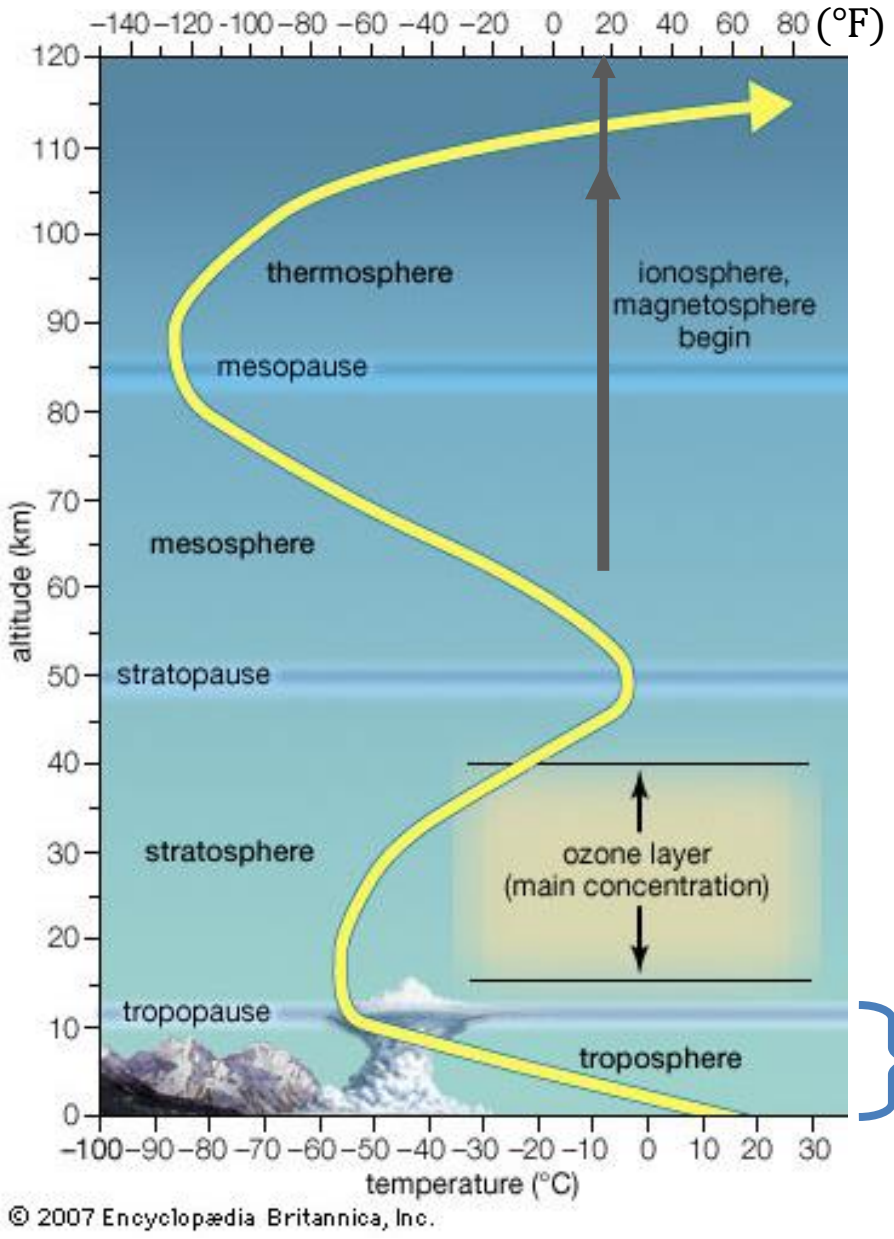
Gravity pulls gases toward the surface creating air pressure!

Layers of the Atmosphere

- **5 main layers (based on temperature and composition):**
  - **Troposphere**
  - **Stratosphere**
  - **Mesosphere**
  - **Thermosphere**
  - **Exosphere**

- **There is a bottom but no "top" – the atmosphere gradually thins out with increasing altitude.**
- **Atmospheric effects become noticeable during atmospheric reentry of spacecraft at an altitude of around 120 km (75 mi).**





Atmospheric Temperature

has a complex profile governed by many factors including:

- **incoming solar radiation**
- **humidity**
- **ozone presence**
- **altitude**

Troposphere, the lowest atmospheric layer, plays the role of a "planetary comforter" thanks to the *greenhouse effect*.

What is Greenhouse Effect?

The warming of the atmosphere by absorbing and emitting infrared radiation while allowing shortwave radiation to pass through.

The gases mainly responsible for the Earth's atmospheric greenhouse effect are water vapor and carbon dioxide.