

THE ATMOSPHERE



Atmosphere

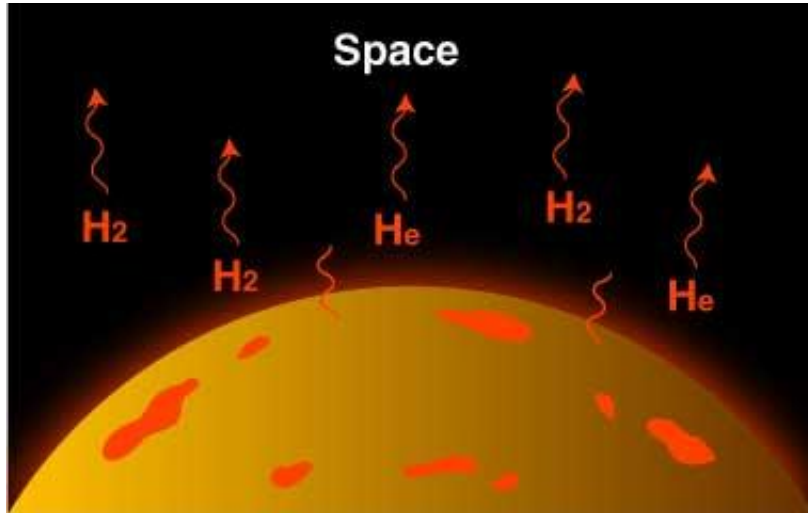
from Greek ἀτμός [*atmos*] "**vapor**" and σφαῖρα [*sphaira*] "**sphere**"

- An atmosphere 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

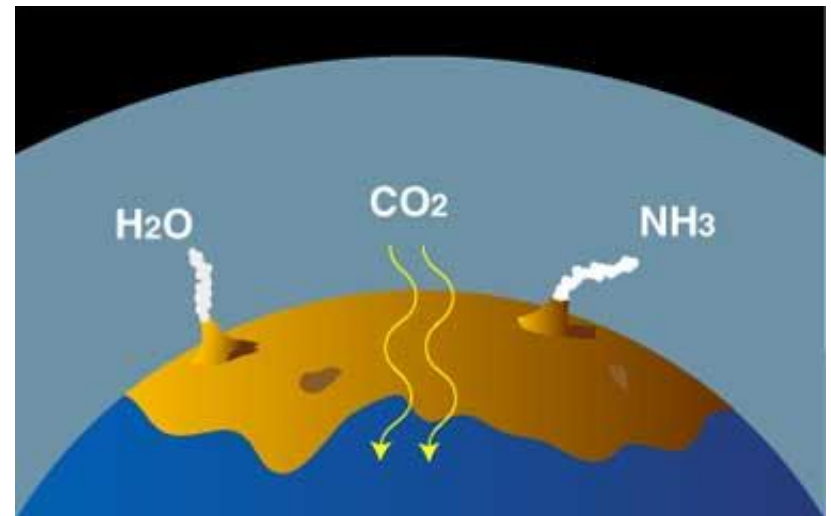


- Primitive first atmosphere

(*stellar gas* composition: H, He, CH₄ – hot and light, able to quickly escape to space)

- Outgassing and the second atmosphere

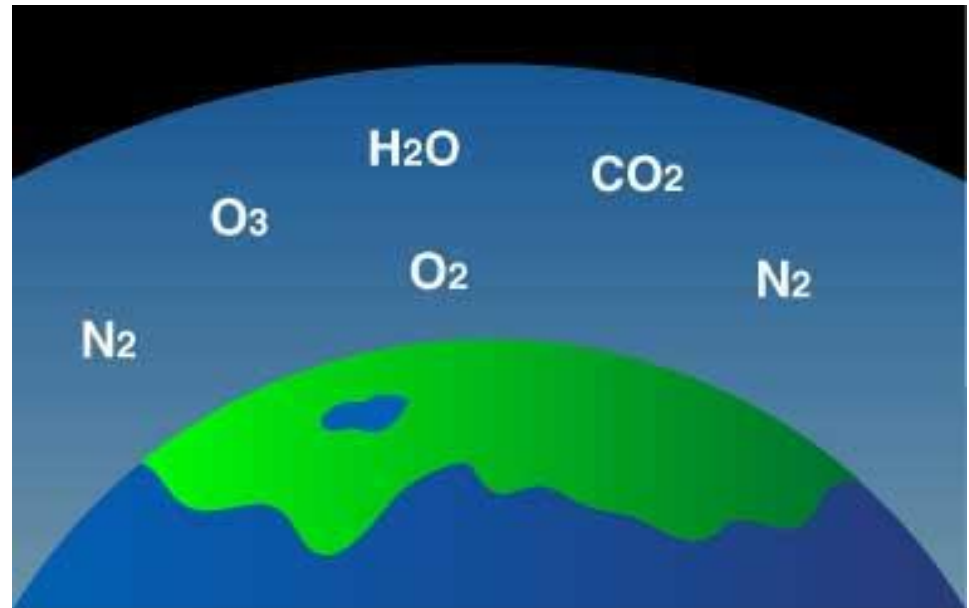
(volcanoes released H₂O, NH₃, Ar, CO₂ – still no oxygen!)



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

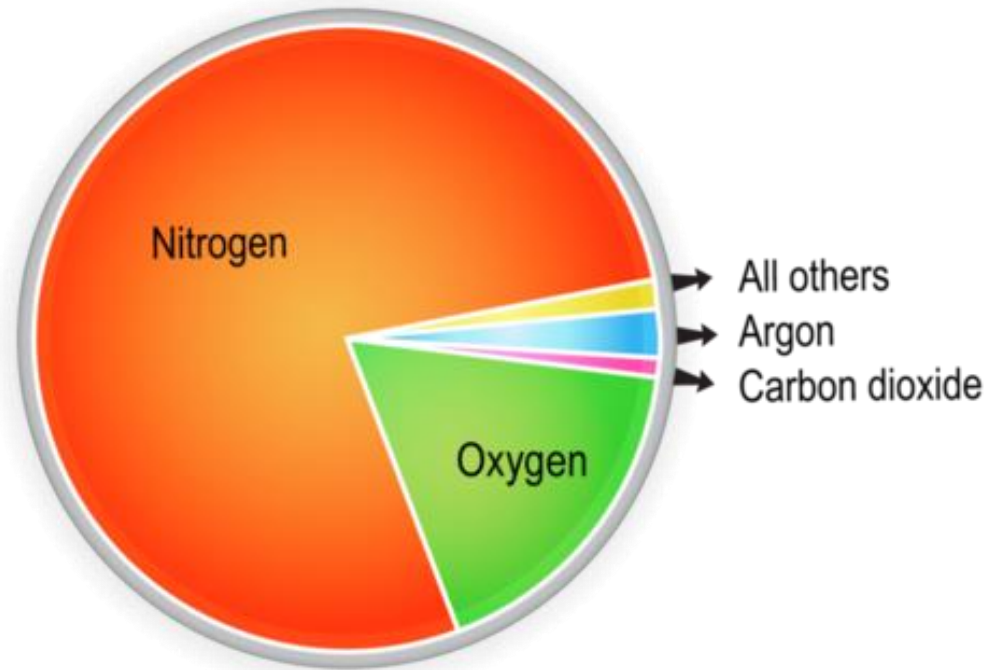
The **evolution of life** and **atmosphere** are closely linked – life produces **free oxygen** (photosynthesis) and **cycles carbon** (limestone formation).

- *Free oxygen is very reactive!*
- *Oxidized modern atmosphere*
(mostly **N₂**, **O₂**,
and very little H₂O and CO₂... playing a very important role!)



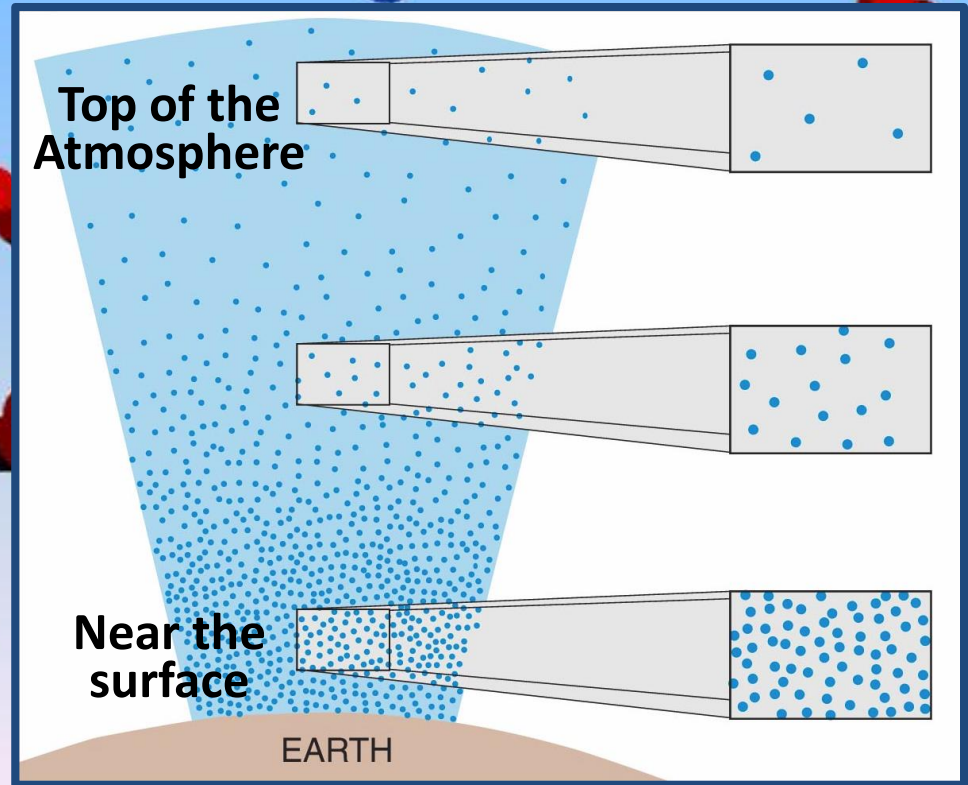
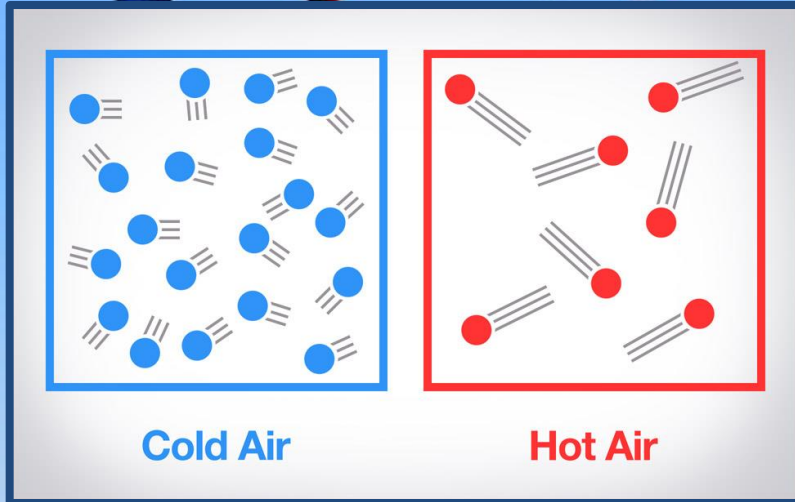
Atmospheric Gases

- **Nitrogen - 78%**
- **Oxygen - 21%**
- **Argon - 0.93%**
- **Water vapor – 0 to 4%**

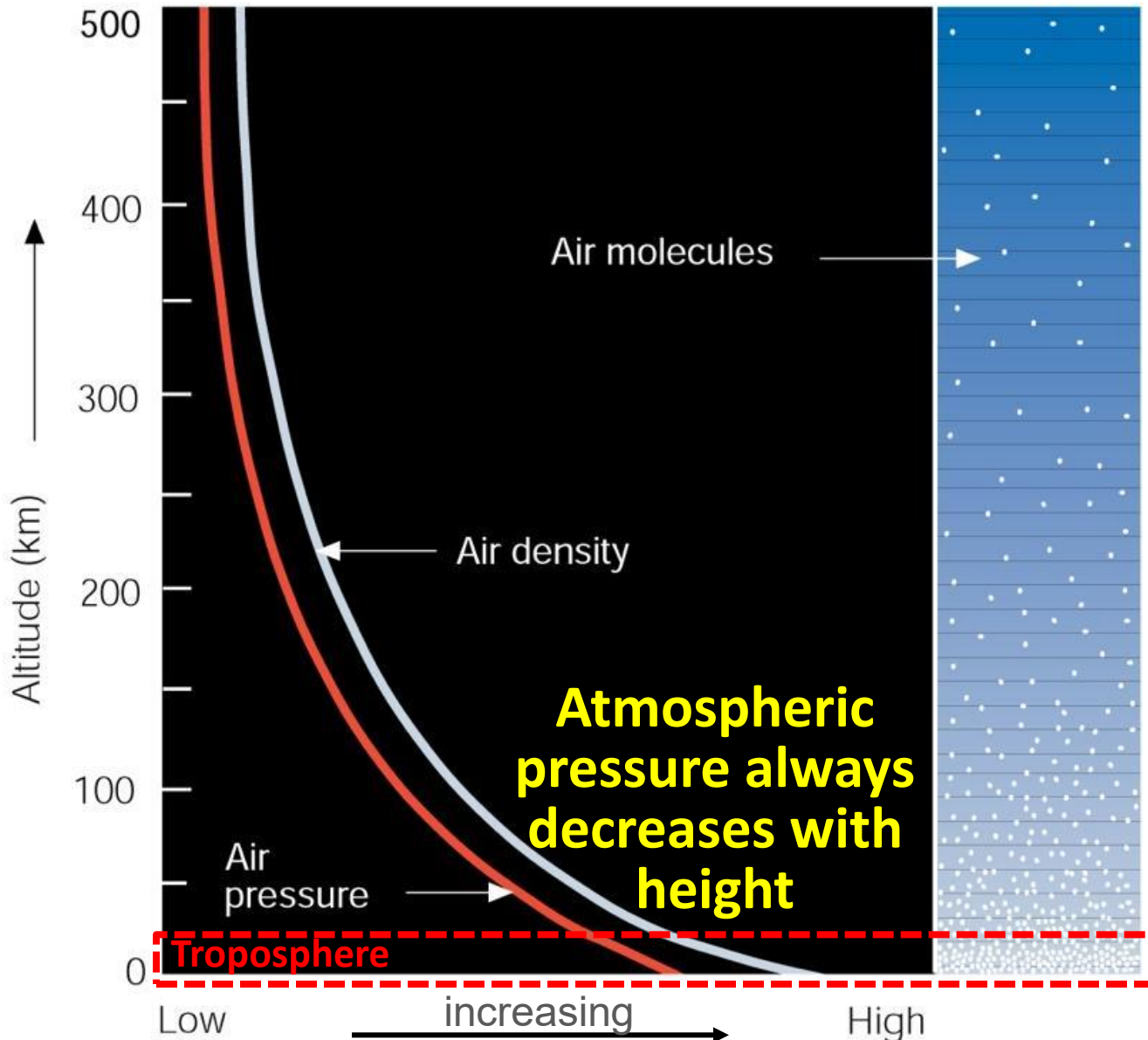


- ***Traces*** of neon, helium, methane, krypton, xenon, hydrogen, ozone, and...
- **...carbon dioxide - 0.043%** (end of year 2025)
 - keeps Earth warm and is used by plants to make food

The air is made up of *molecules*: particles that are in constant motion.



Air Density and Pressure

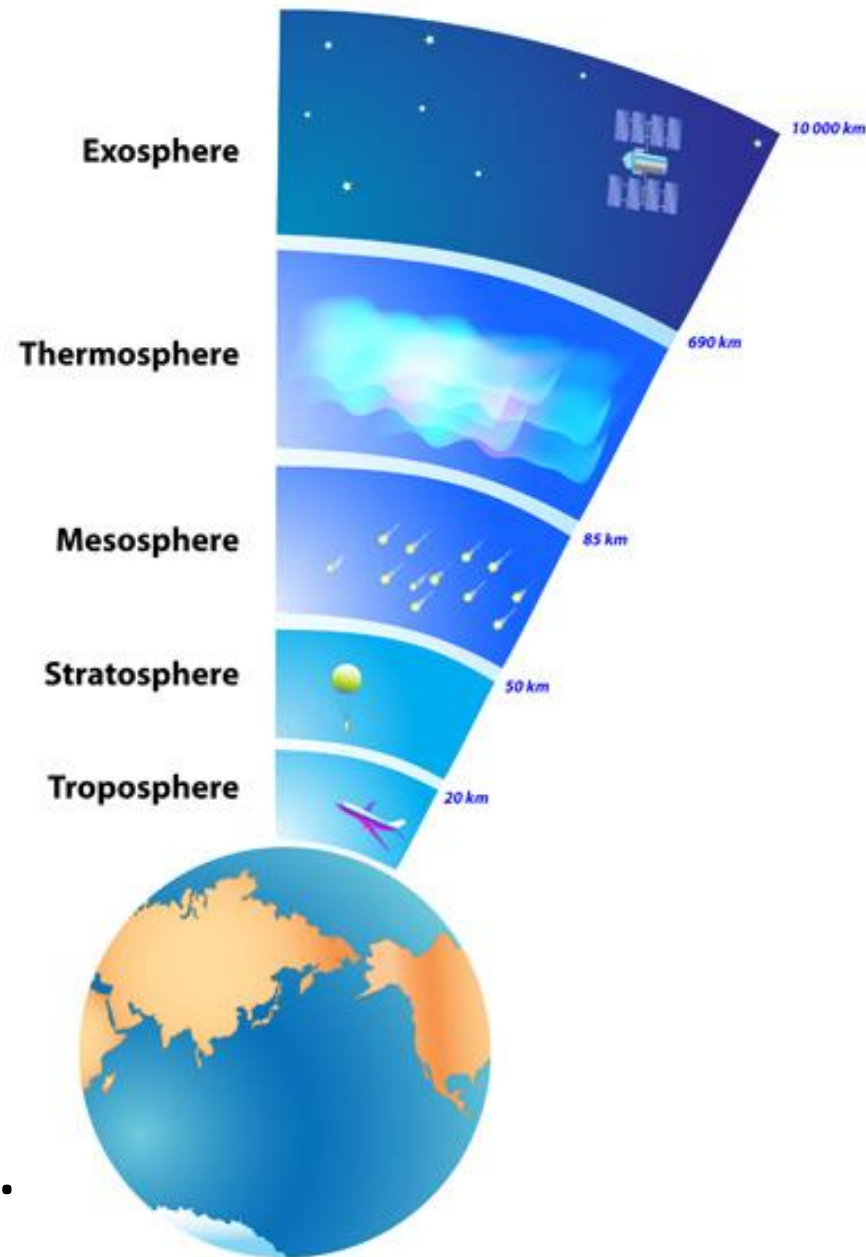


- Air **density** is the amount of air (*mass* of air molecules) in a given space (*volume*).
- The amount of *force* exerted over an *area* of surface is called **pressure**.

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).

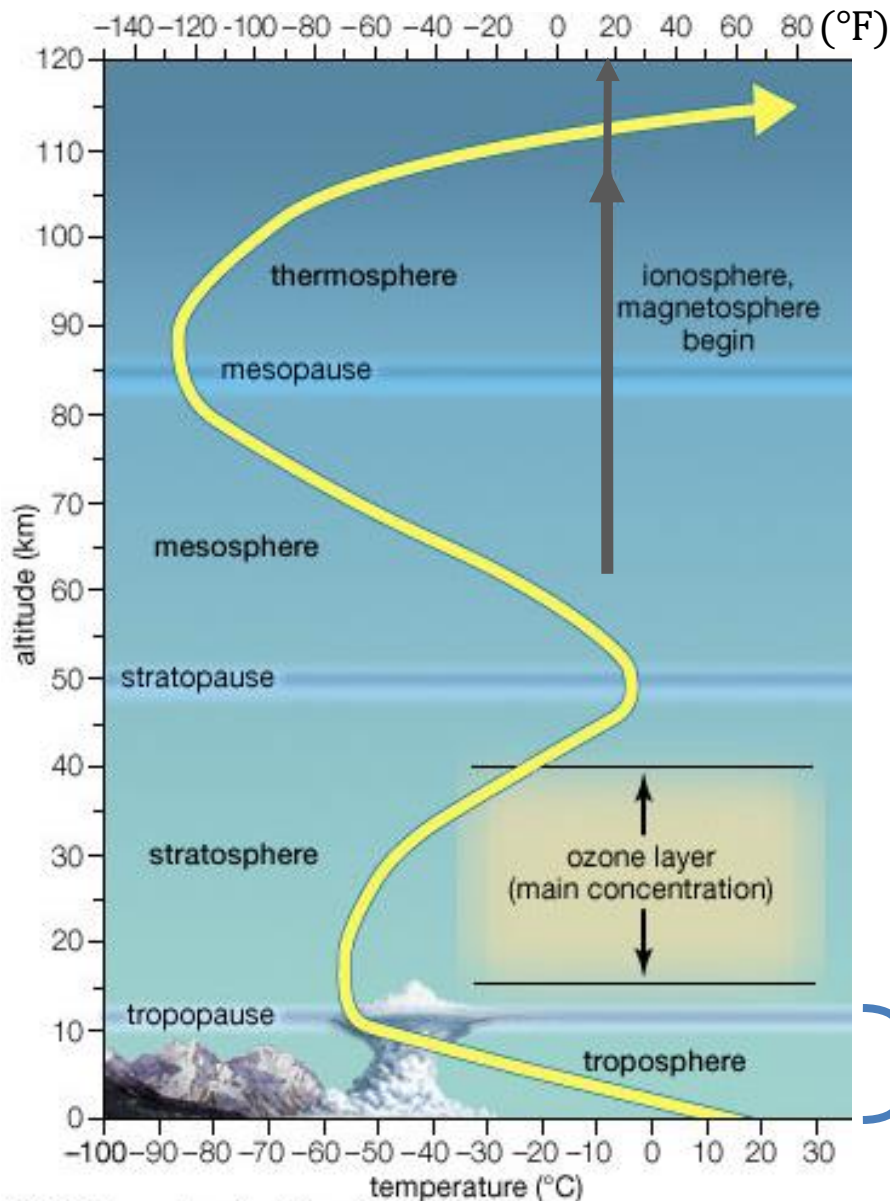


Atmospheric Temperature

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**.

