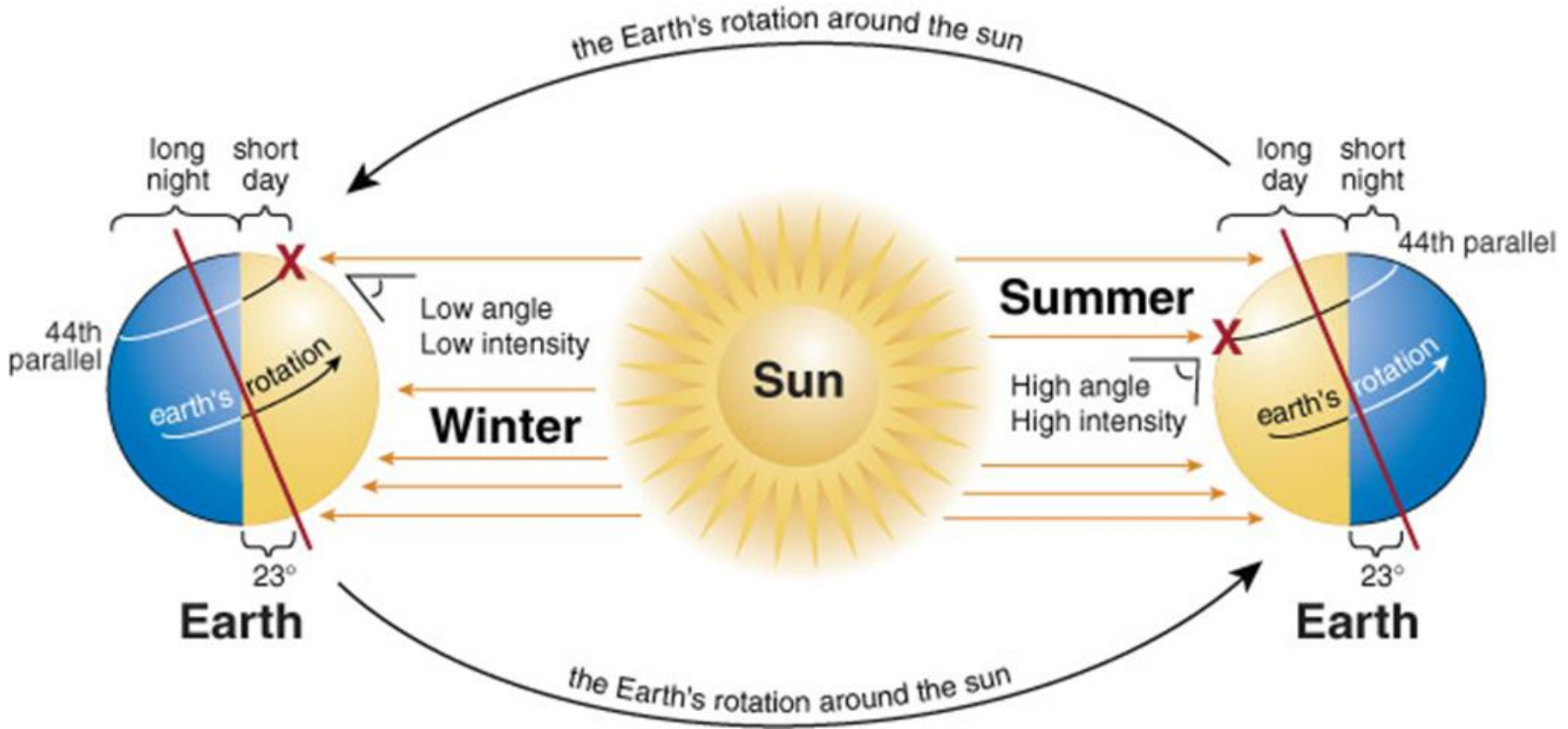


Change of Seasons

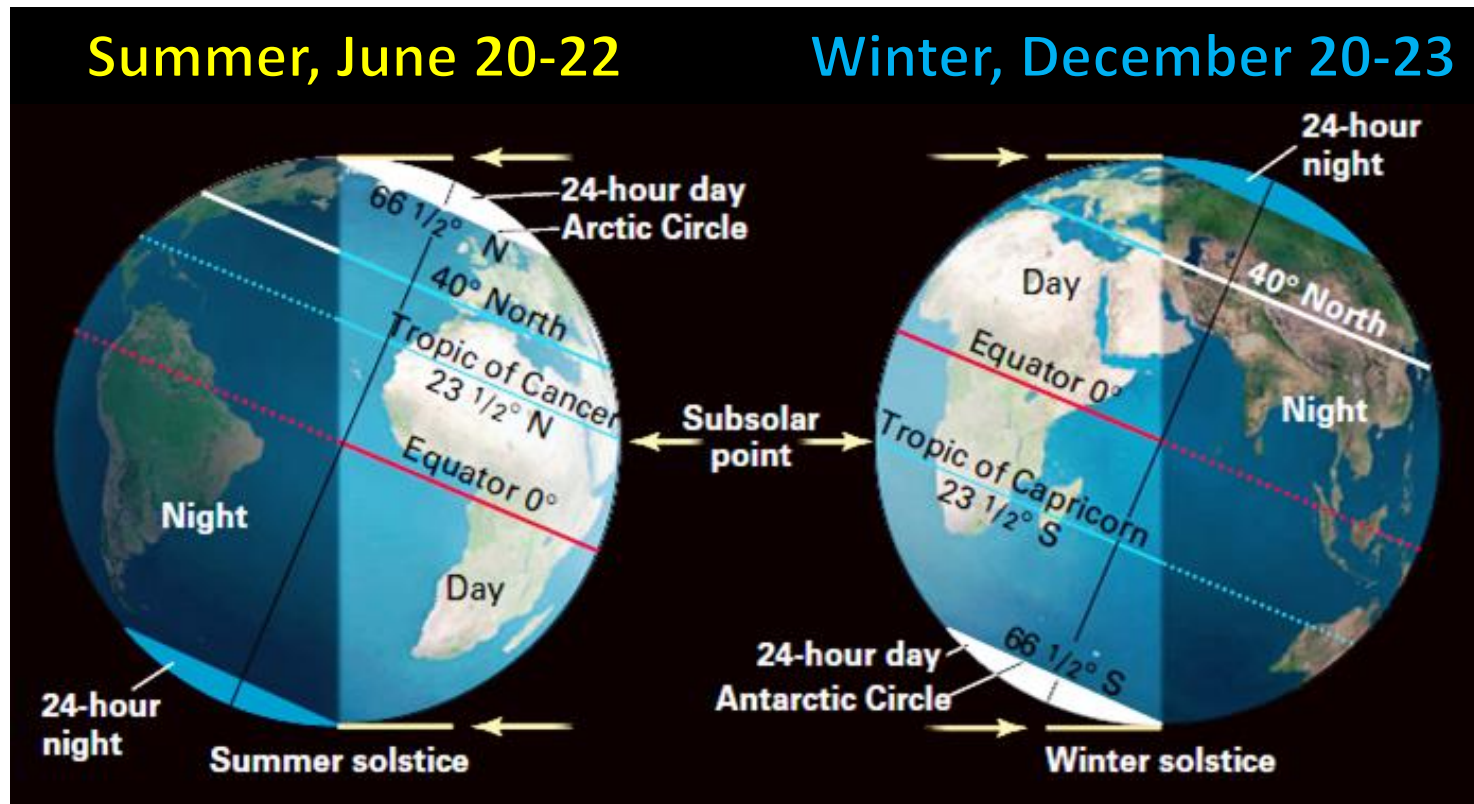
Video:

http://www.youtube.com/watch?v=DD_8Jm5pTLk



Astronomers and scientists use the dates of **equinoxes** and **solstices** to mark the change of seasons.

Solstice conditions (Northern Hemisphere)



- At **solstice** (Latin: “sun”+”stand still”), the Earth’s **axis of rotation is fully tilted either toward or away** from the Sun.
- Polar regions experience either 24-hour day or 24-hour night.
- The Sun is directly overhead at noon on one of the tropics.

December Solstice

Seasons in the Southern Hemisphere are opposite to those in the Northern Hemisphere.

Fairbanks, Alaska



← On December solstice, **1st day of Winter**, daylight length in Fairbanks, Alaska is just **3 hr 41 min 48 sec!**

At the same time, on the **1st day of Summer**, the Sun in Antarctica dips to the horizon but doesn't set! →

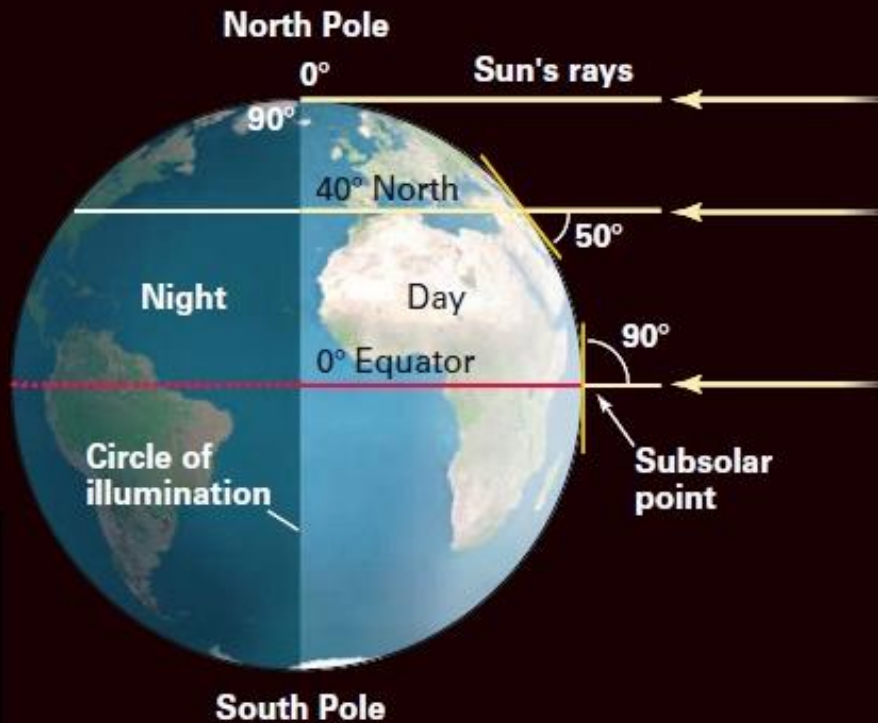


Midnight Sun in Antarctica

Equinox conditions

Autumnal (Fall), September 21-24

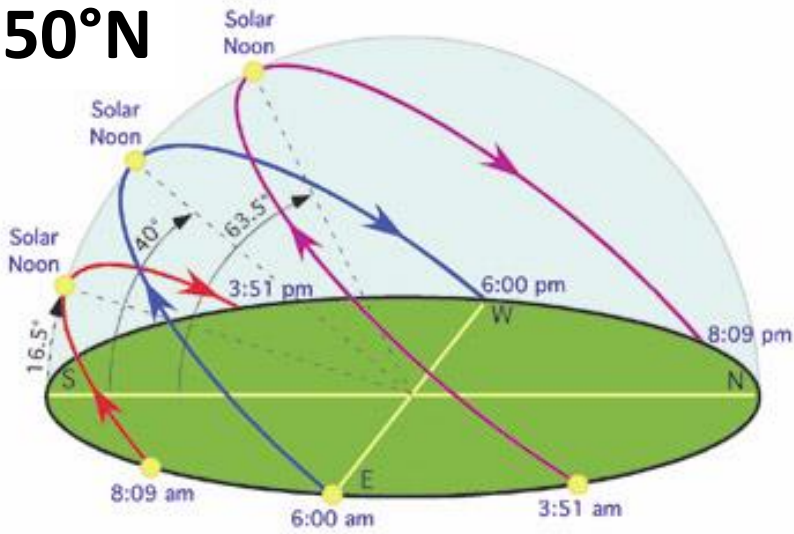
Vernal (Spring), March 20-23



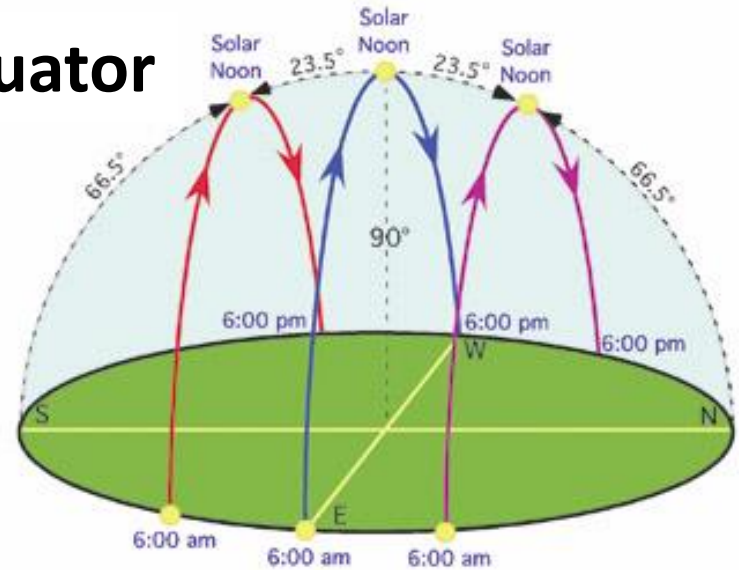
- At **equinox** (*Latin: "equal" + "night"*), the Earth's **axis of rotation is exactly at right angle** to the direction of solar illumination.
- The circle of illumination passes through the North and South Poles.
- At noon, the Sun is directly overhead on the Equator.
- At both poles the Sun is seen at the horizon.
- Both hemispheres are equally illuminated.

Observed path of the Sun

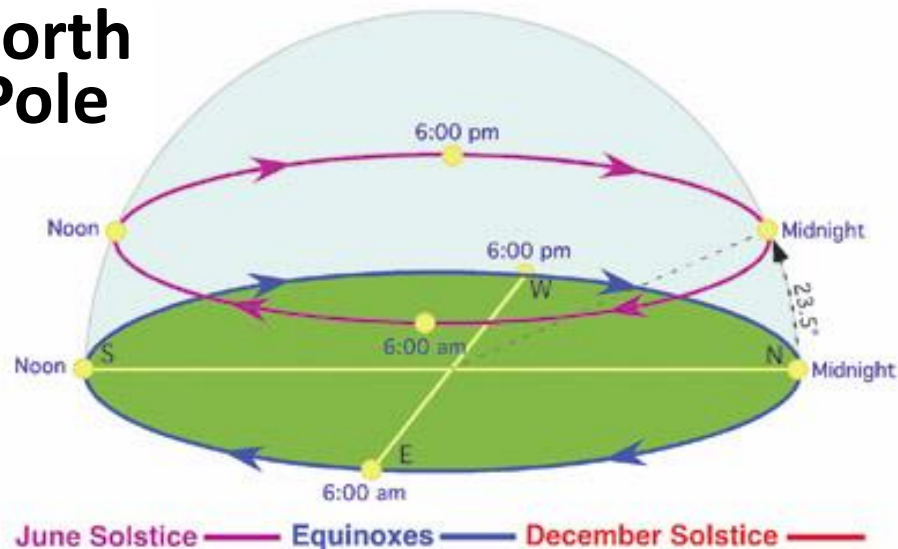
50°N



Equator

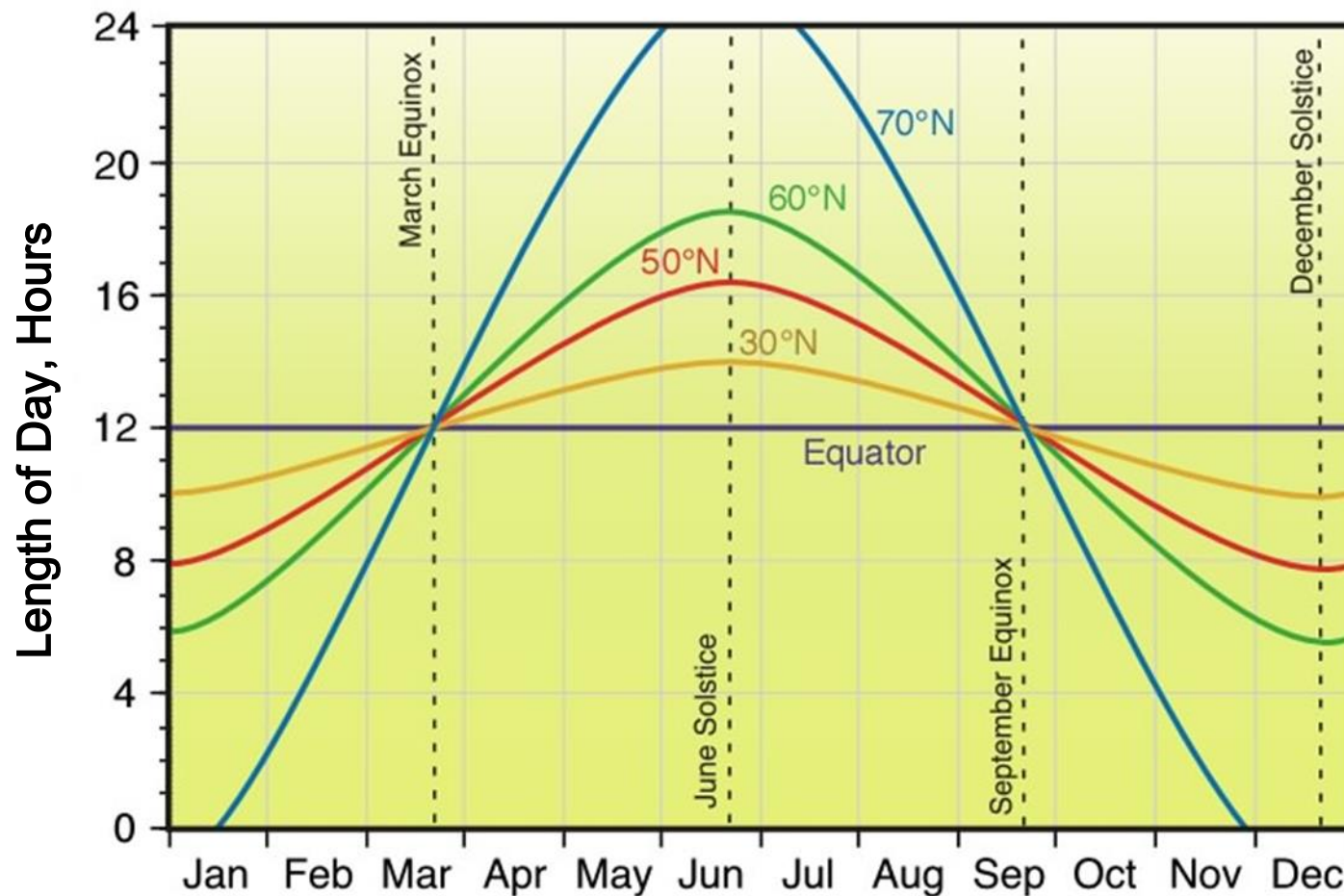


North Pole



Length of Day and Night

- Graph shows variation of day length over the course of the year.
- Variation over latitude is shown by different color curves.



THE ATMOSPHERE



Atmosphere

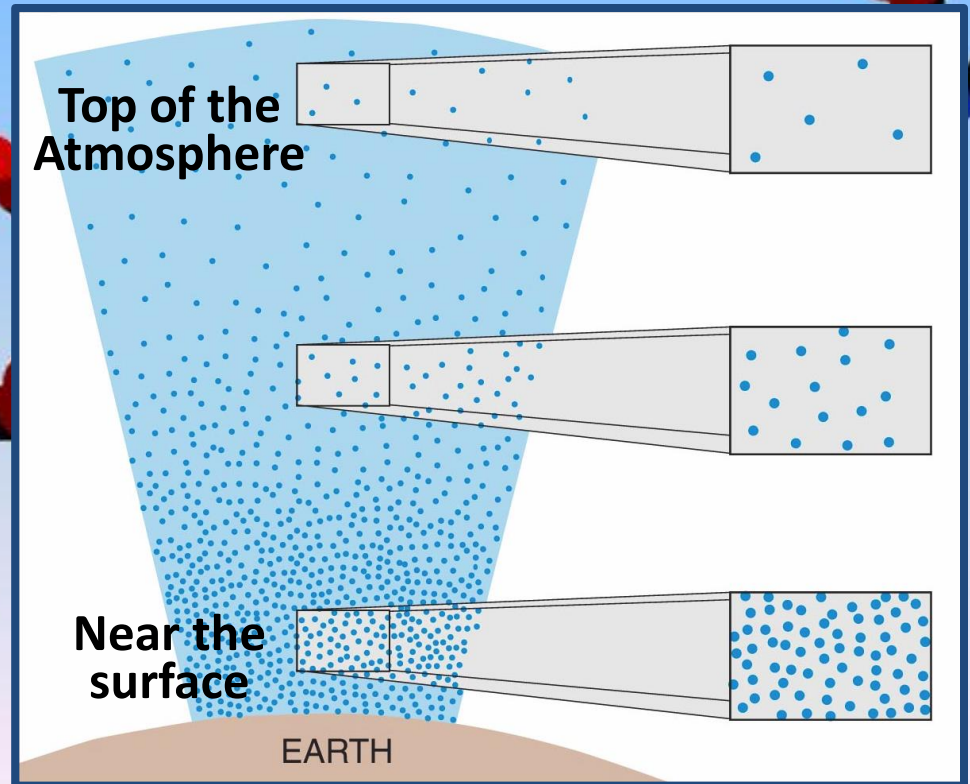
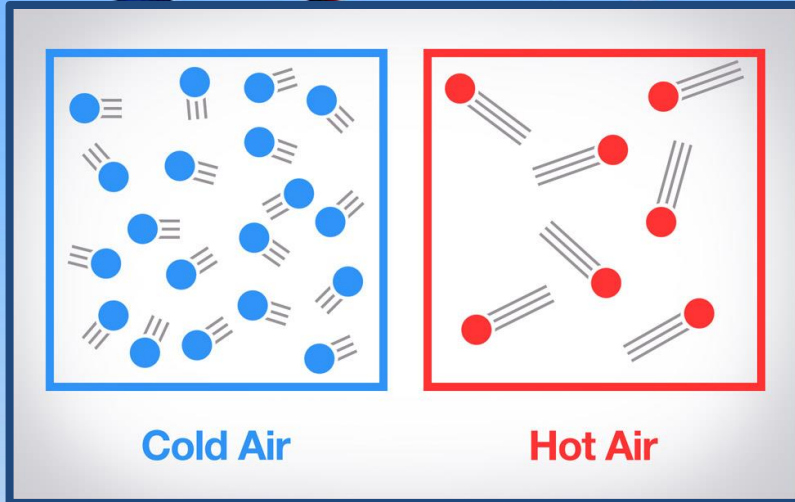
from Greek ἀτμός [*atmos*] "**vapor**" and σφαῖρα [*sphaira*] "**sphere**"

- 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**.

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



Evolution of the Atmosphere

- **Reduced primitive atmosphere**
(*stellar gas* composition: H, He, CH₄, NH₃)
- **Outgassing and the second atmosphere**
(mostly N₂, Ar, CO₂ – still no oxygen!)

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

- **Oxidized modern atmosphere**
(mostly N₂, O₂, and *very little* CO₂...)

Atmospheric Gases

- **Nitrogen** - 78%
- **Oxygen** - 21%
- **Argon** - .93%
- **Water vapor** – 0 to 4%
 - clouds and precipitation
- **Traces** of neon, helium, methane, krypton, xenon, hydrogen, ozone, and...
- ...carbon dioxide - .04% (year 2015)
 - keeps Earth warm and is used by plants to make food

