Solar Radiation

Energy and Radiation

Radiation: The transfer of energy via electromagnetic waves that travel at the speed of light. The velocity of light in a vacuum is approximately 3 x 10^8 m/s. The time it takes light from the sun to reach the Earth is 8 minutes and 20 seconds. Heat transfer by electromagnetic radiation can travel through empty space. The many different types of radiation is defined by its wavelength. The electromagnetic radiation can vary widely.

Solar radiation is the primary source of energy on earth, and life depends on it. Solar radiation is defined as "The flux of radiant energy from the sun".

Thermal Radiation: Radiation emitted by the a body depends on its temperature and is known as thermal radiation.

Transfer of Heat

- Any body, which has a temperature, transfer heat in different forms.
- Three process:

1. Conduction 2. Convection 3. Radiation

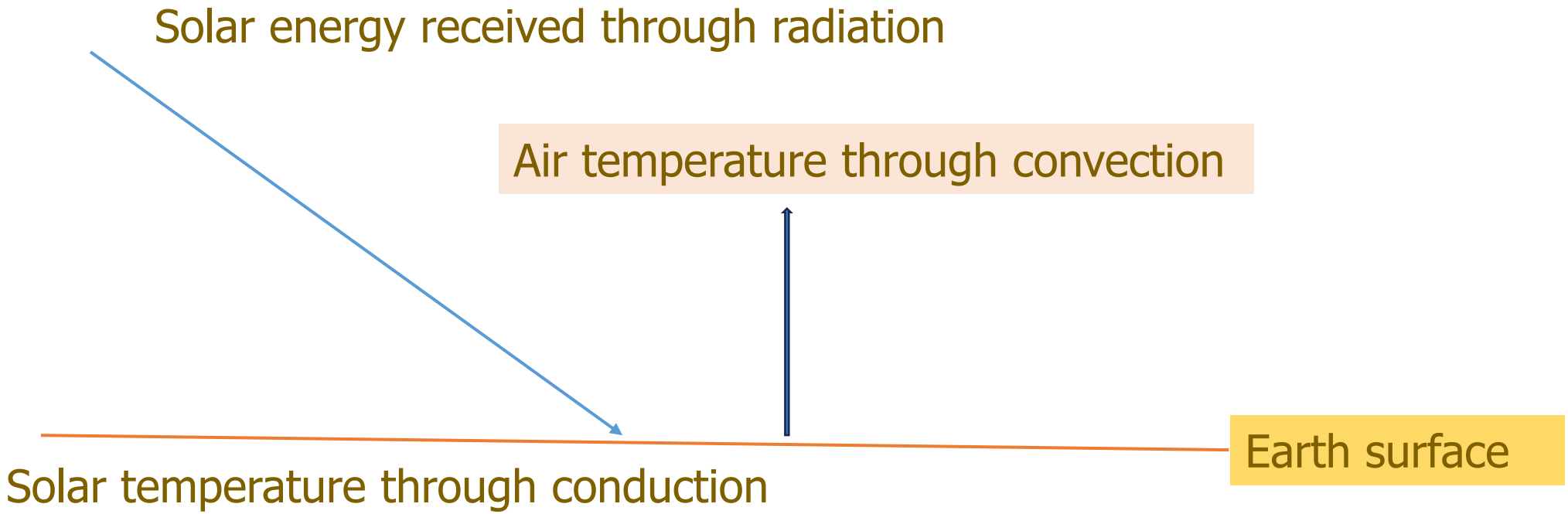
Heat flow or Heat Transfer

Transfer of heat by matter through its adjacent layers from its hotter to colder parts, without any motion of the matter itself, is called **conduction. Ex. Iron**

Transfer of heat through the mass movement of hot fluid matter, ether liquid or gas, is called **convection. Ex. Stem flow from hot water**

The direct transfer of heat from a hot body to a cold body without the aid of any material medium is called **radiation.**

Radiation is not heat. Radiation is absorbed by surface of a body, heat is produced

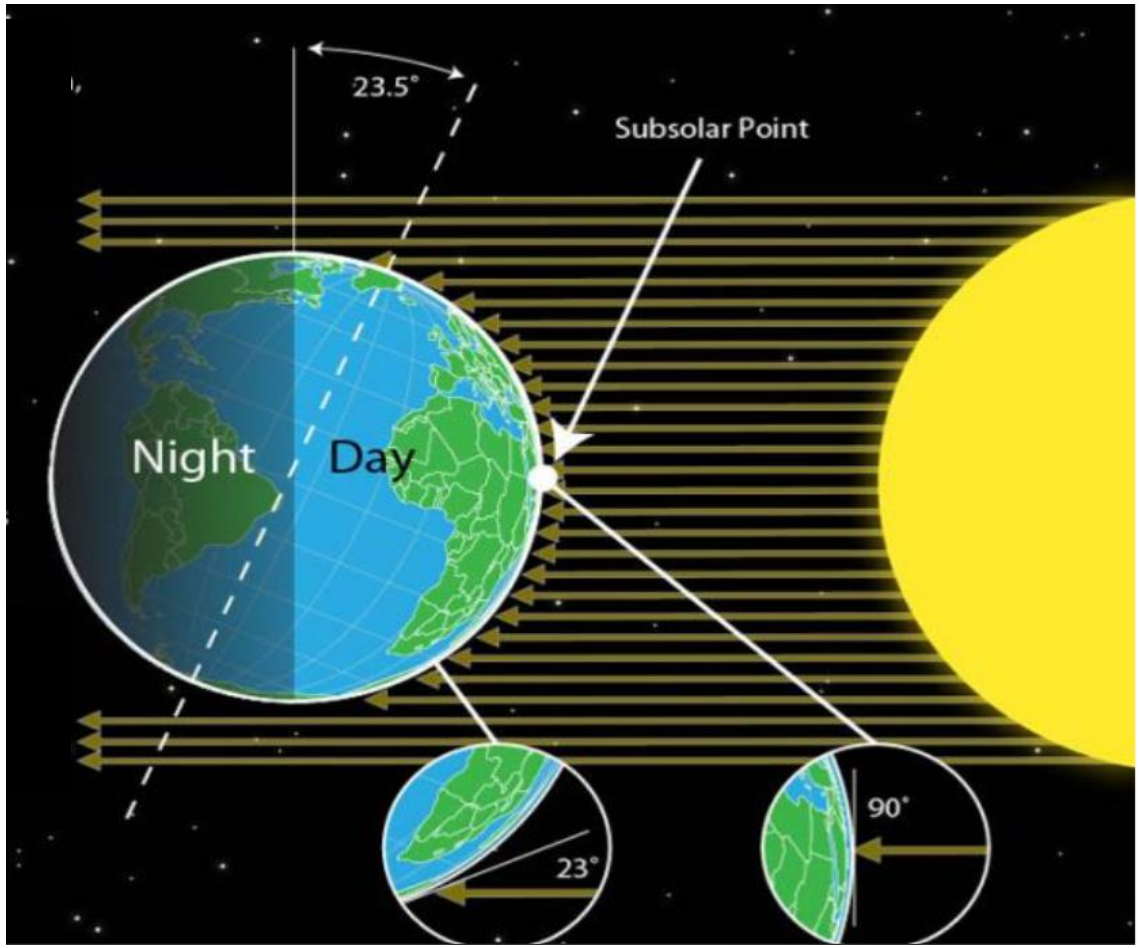


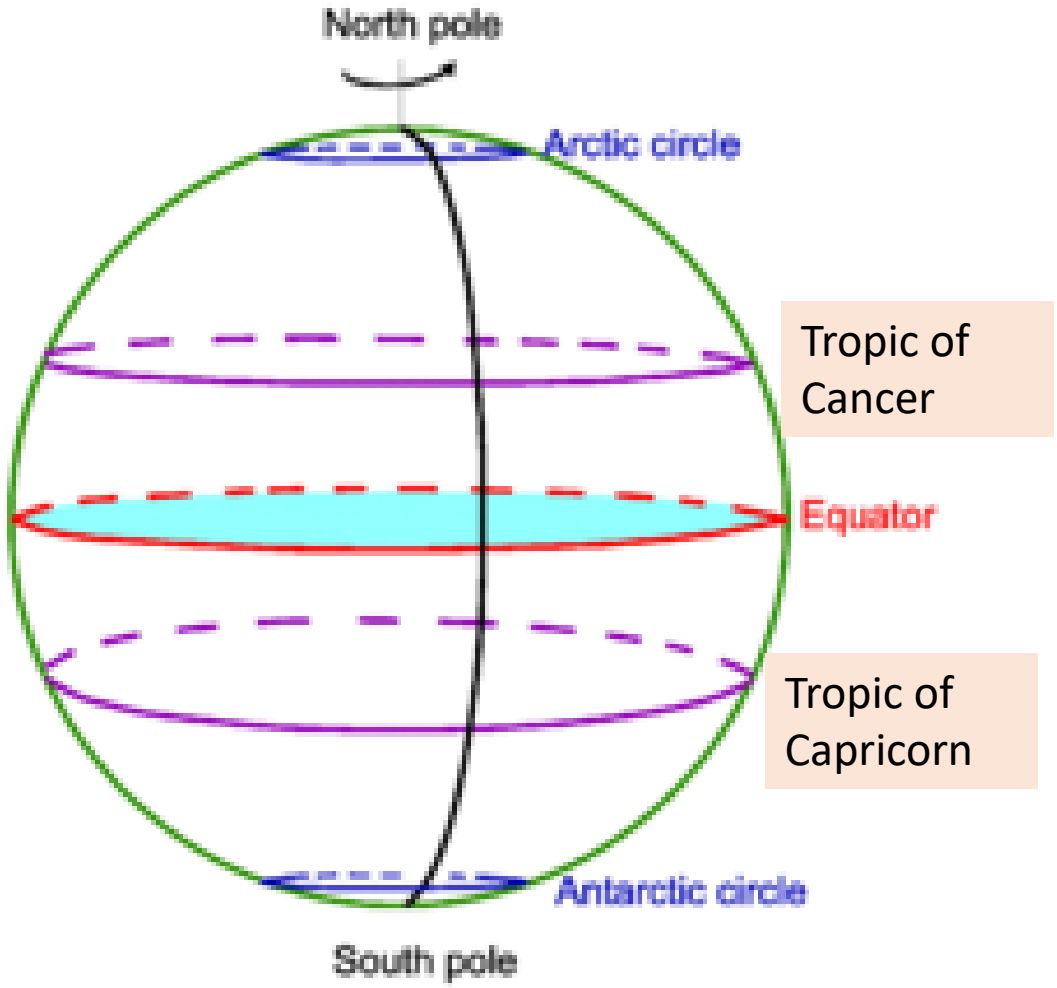
Heat processes between the earth and the atmosphere

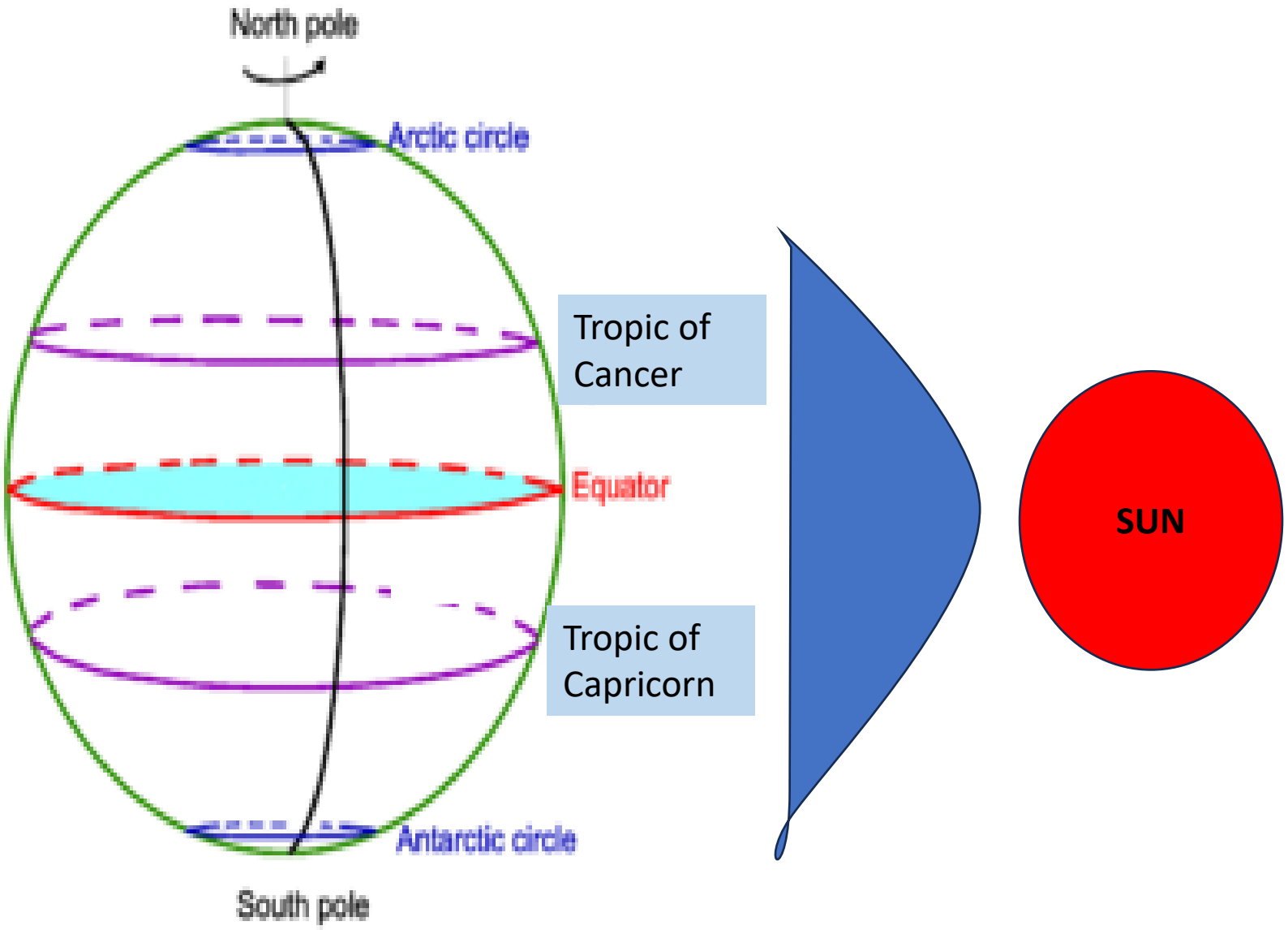
Season

- Periods into which years can be divided, as a result of climate conditions.

- Northern Hemispheres experiences **six months summer**, the southern hemisphere experiences **winter**







Summer: Directly overhead the Tropic of Cancer. **(21 June)**

Spring: Directly overhead the equator **(21 March)**

Autumn: Return to the equator **(23 Sep)**

Winter: Directly overhead the Tropic of Capricorn **(22 Dec)**

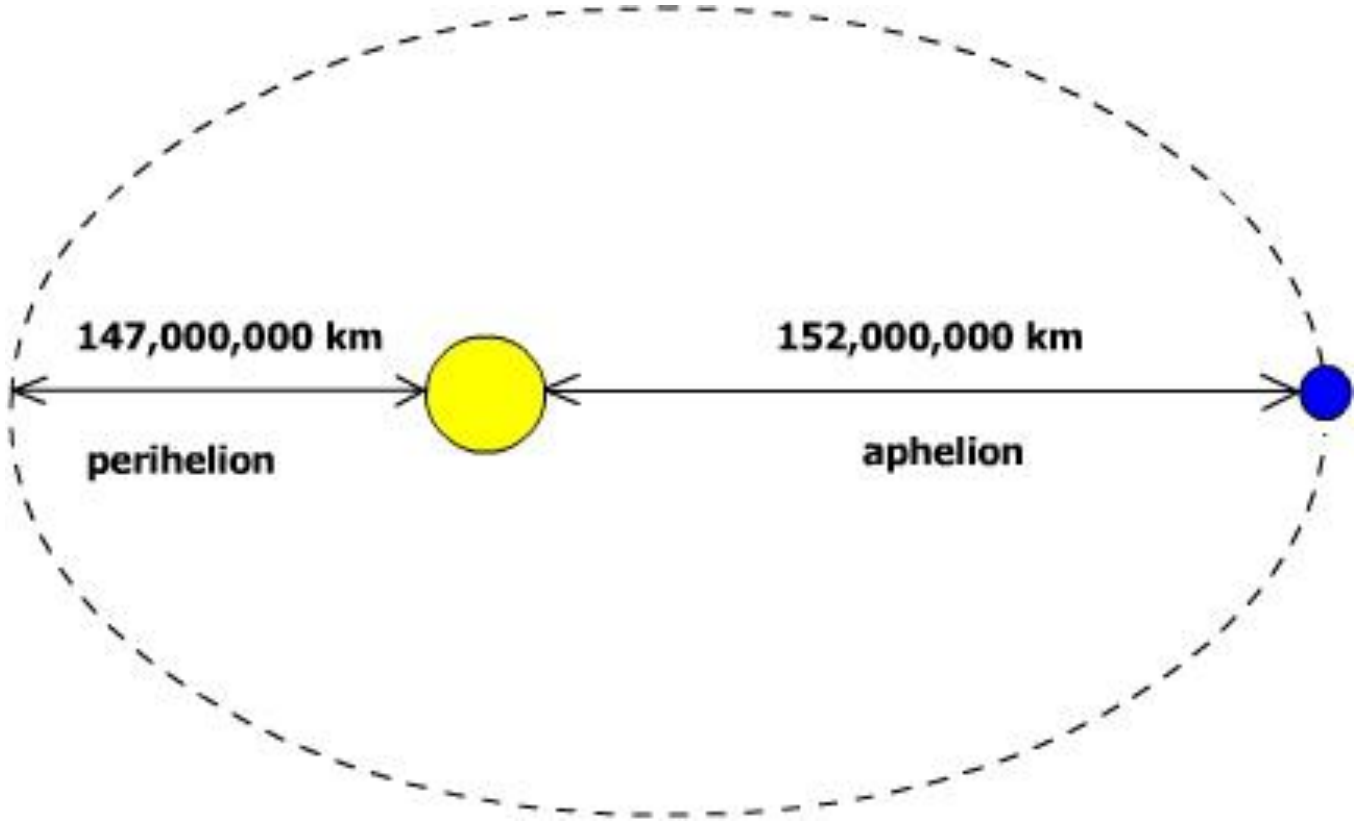
EQUINOXES

- Days when days and night are equal
- During these days the sunshine: directly over the equator.
- Vernal Equinox or spring equinox: 21 March
- Autumnal Equinox: 23 September

Solstice

- Time of the year when the difference b/w the length of days and night the largest.
- Sunshine: Directly overhead the tropics.
- Summer Solstice: 21 June – **Sun overhead at the tropic of cancer/ longest day of the northern hemisphere and the shortest day in the Southern hemisphere.**
- Winter Solstice: 22 Dec- **Sun overhead at the tropic of Capricorn / Longest day of the southern hemisphere and shortest day of the northern hemisphere**

Aphelion and Perihelion



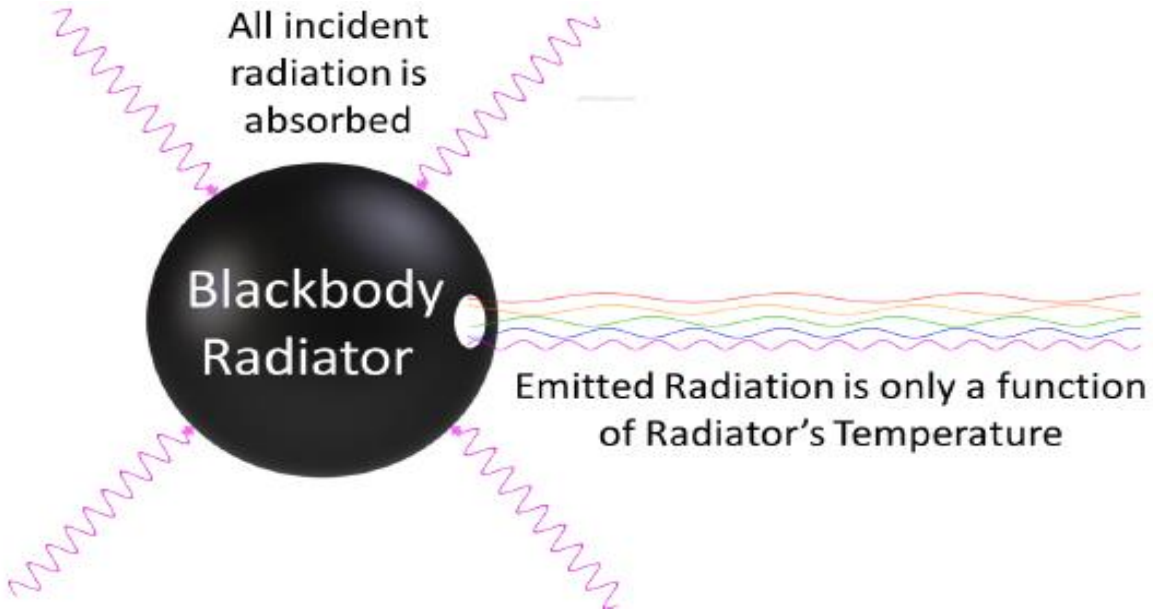
- The elliptical earth's orbit around the sun ensures that the distance between them is not uniform.
- The average distance between the Earth and the sun is 149.5 million km.
- The distance b/w the earth and the sun reaches a maximum of 152 million km, known as aphelion, on July 4.
- The Minimum of 147.6 million km, known as Perihelion, it reached on January 3.

Incident Radiation

- Incident radiation *'I' on the surface is absorbed (A) while a part is reflected (R) and the remaining is transmitted (T).*

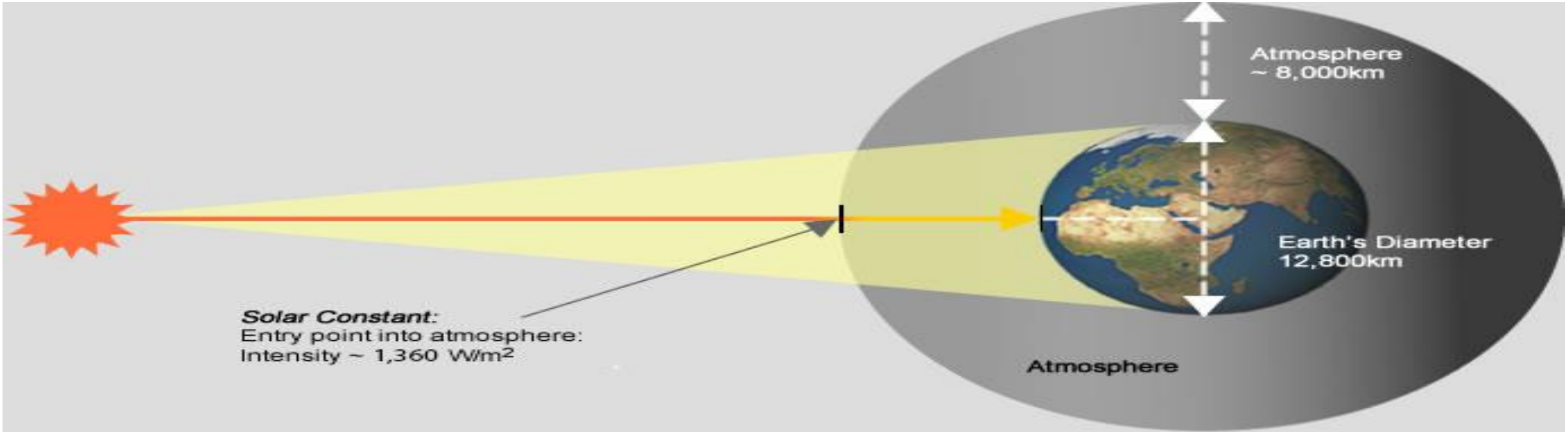
$$I = A+R+T$$

Blackbody Radiation: The black body is an ideal surface or body which completely absorbs all the radiation falling on it without reflection and re-emits the absorbed radiation. Electromagnetic radiation emitted by any heated object is called black body radiation.

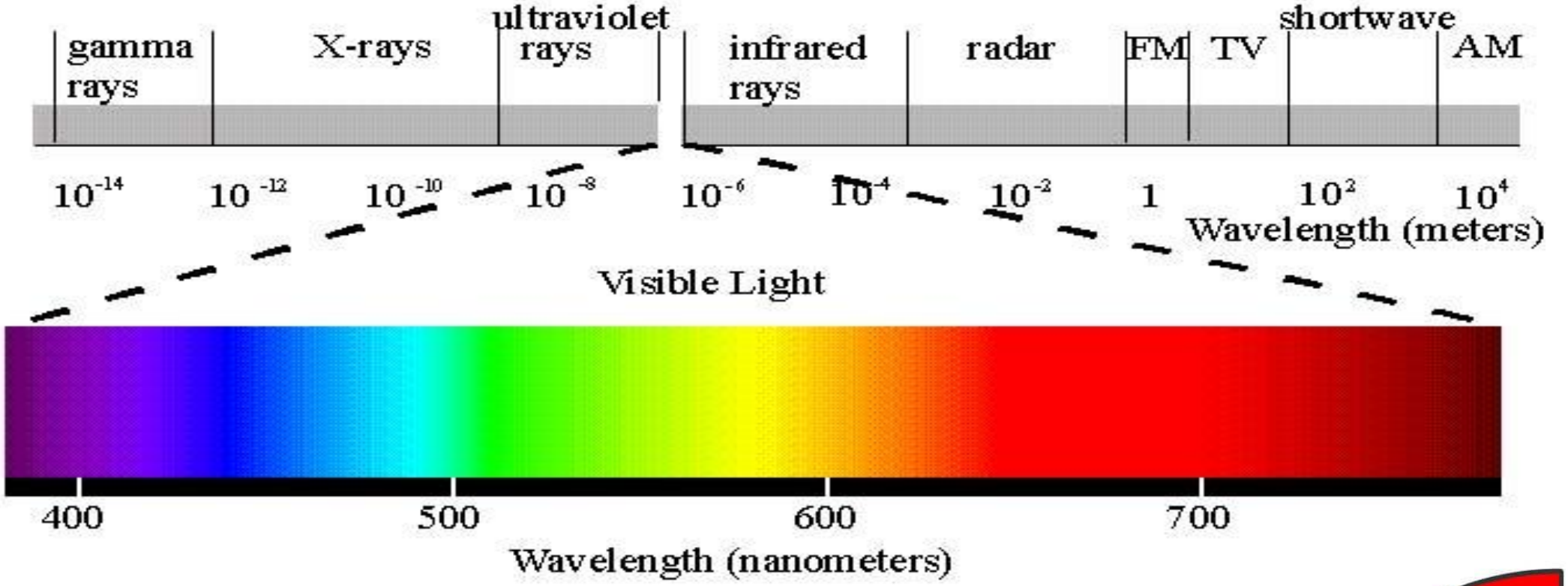


Solar Constant

- The amount of solar radiation that is received a minute, at the top of the atmosphere on a unit area surface, which is held perpendicular to the beam when the earth is at its means distance from the sun, is known as the solar constant.
- The value of solar constant is estimated to be 1.94 cal/cm^2/min or 1.94 ly/min = 1367 +_ 7. Wm^{-2}



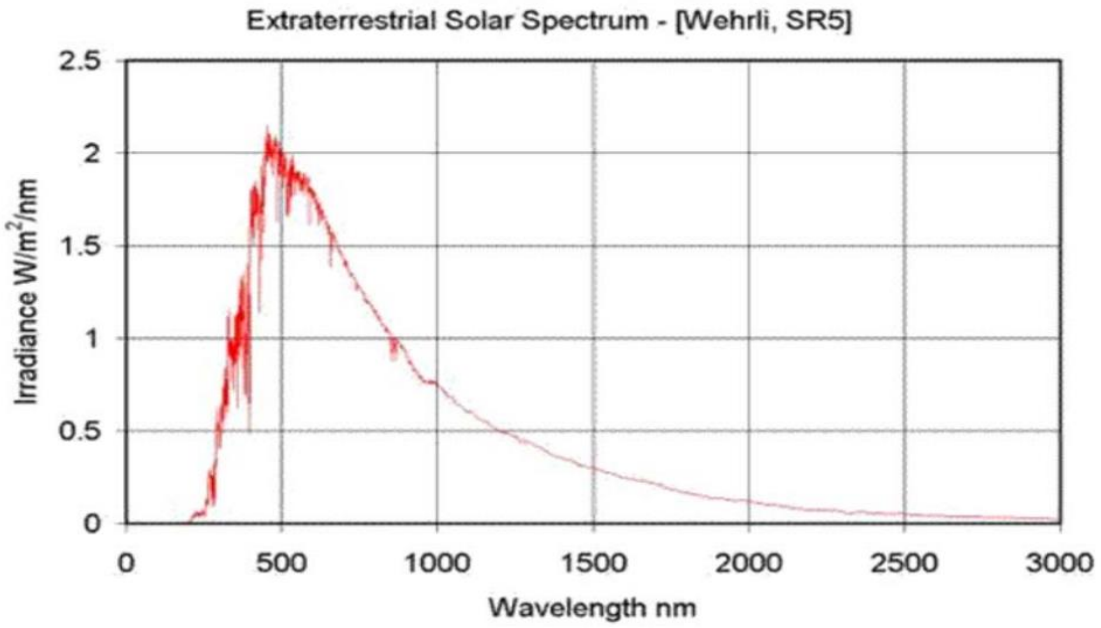
Electromagnetic Spectrum



The visible radiation or PAR (Photosynthetically Active Radiation range b/w 0.4 to 0.76µ is very important to the plants.

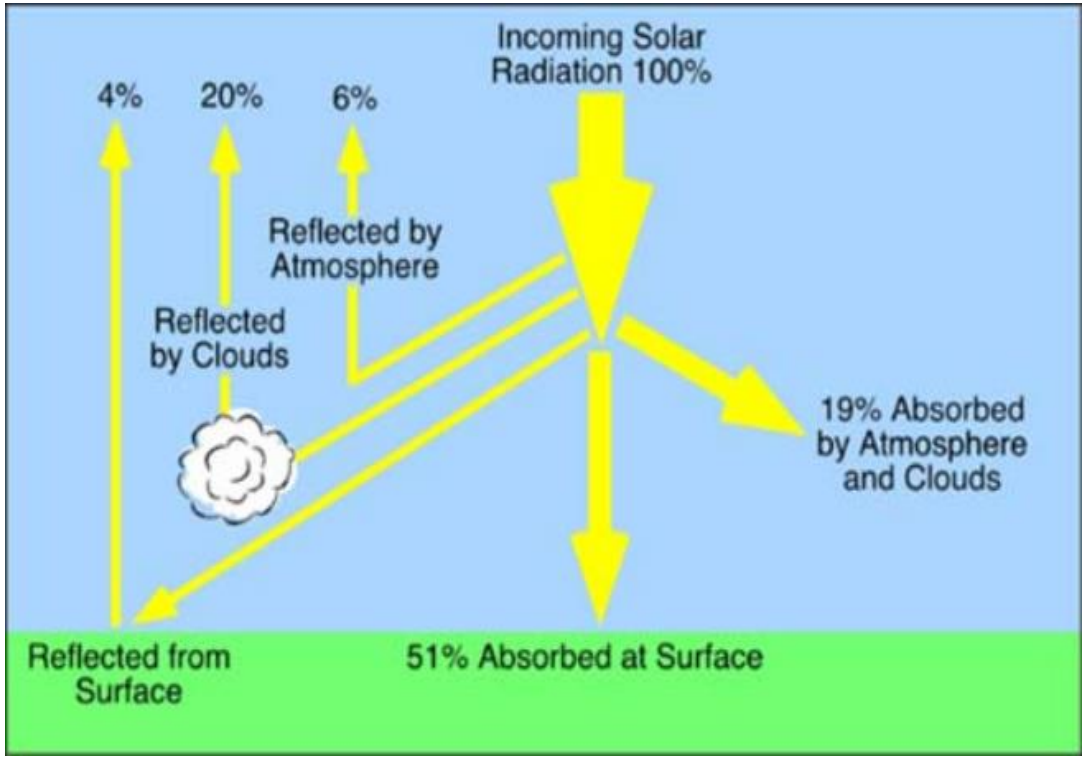
Spectrum

Visible light has a wavelength of between 0.40 to 0.76 micrometers (μm). The sun emits only a portion (44%) of its radiation in this range. Solar radiation spans a spectrum from approximately 0.1 to 4.0 micrometres. About 7% of the sun's emission is in 0.1 to 0.4 micrometers wavelength band (UV). About 48% of the sun's radiation falls in the region between 0.71 to 4.0 micrometers (near infrared : 0.71 to 1.5 micrometers; far infrared: 1.5 to 4.0 micrometers).



Atmospheric Effects on Incoming Solar Radiation

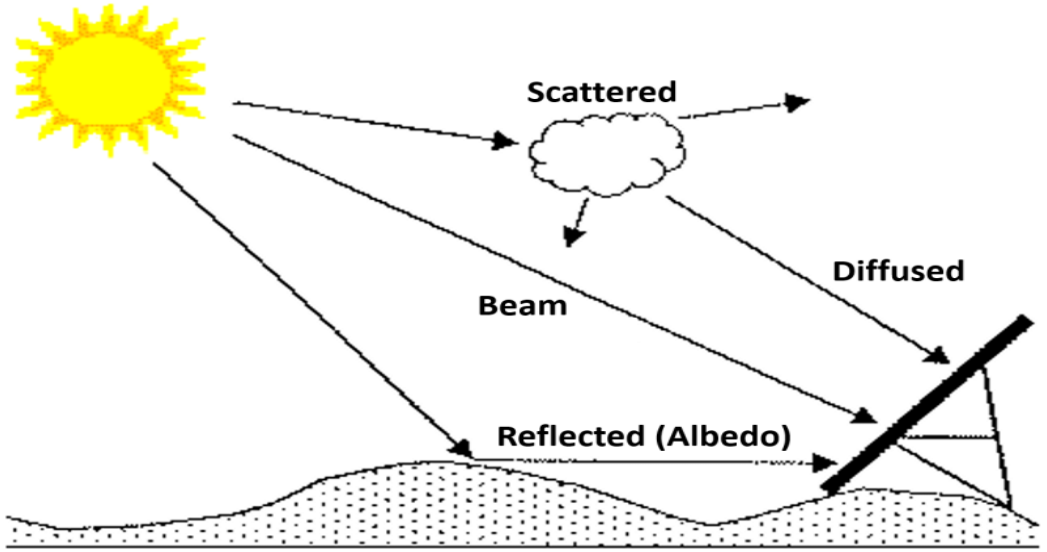
Sunlight reaching the Earth's surface unmodified by any of the atmospheric processes is termed direct solar radiation. Solar radiation that reaches the Earth's surface after it was altered by the process of scattering is called **diffused solar radiation/ Sky or scatter radiation**. Not all of the direct and diffused radiation is available at the Earth's surface. Some of the radiation received at the Earth's surface is redirected back to space by reflection.



The proportion of incident solar energy that is reflected or the reflection coefficient for incoming solar radiation is called **Albedo or Reflecting Radiation.**

It is depends on angle of incidence of the radiation.

Remote sensing work due to reflecting radiation.



Cambell-Stoke Sunshine Recorder: recording the no of hours of sunshine..

Pyranometer: To measure solar radiation at all wavelengths coming from the entire hemisphere.

Pyreheliometers: Direct solar radiation incidence on a collector.

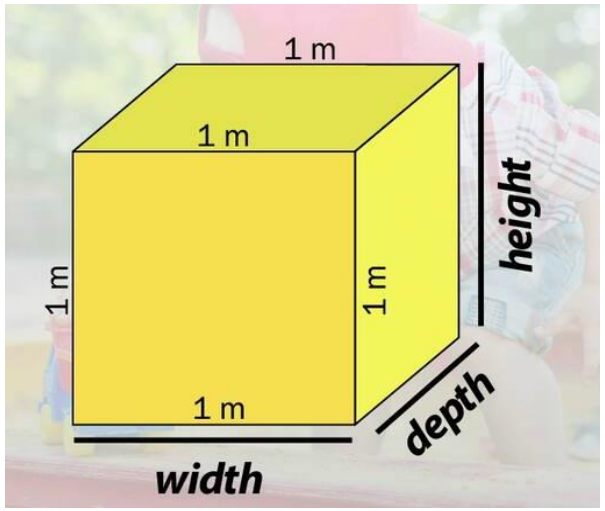
Diffusographs: Radiation from sky.

Radiometer: Net radiation meter

Spectroradiometer: solar radiation in narrow wave bands

Humidity

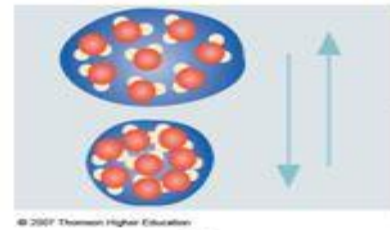
Humidity is the concentration of water vapor present in the air



Humidity

- **Humidity**: the amount of water in the air.
- **Absolute humidity**: the mass of water vapor in a unit volume of air.

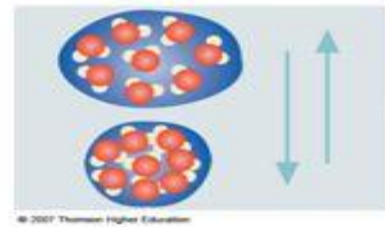
$$AH = \frac{mass\ of\ water\ vapor}{volume\ of\ air}$$



Parcel Size	Mass of H_2O Vapor	Absolute Humidity
2 m^3	10 g	5 g/m^3
1 m^3	10 g	10 g/m^3

- **Specific humidity**: the mass of the water vapor compared to the total mass of the air parcel.

$$SH = \frac{mass\ of\ water\ vapor}{total\ mass\ of\ air}$$



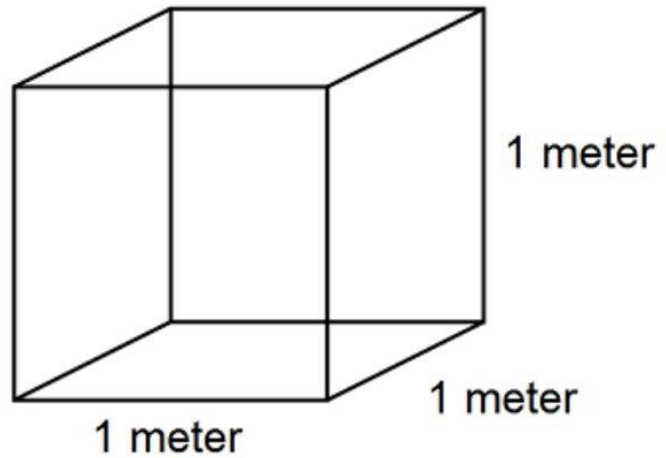
Mass of Parcel	Mass of H_2O Vapor	Specific Humidity
1 kg	1 g	1 g/kg
1 kg	1 g	1 g/kg

RELATIVE HUMIDITY

Relative humidity is a measure of how much water vapor the air actually could "hold" at a certain temperature.

The relative humidity represents how close the air is to saturation.

Saturated air will have an RH of 100 %. You need the RH of 100% to have rain form in clouds.



Psychrometer or Hygrometer: Direct measurement of actual amount of water in the air is not feasible for ordinary observation. A psychrometer is used for indirect measurement. The

RH can be directly measured with **Hair Hygrometer**