Heat Transfer in Atmosphere

- Conduction
- Convection
- Radiation

$E = \sigma T^4$

as Temp increases, emitted energy increases

$\lambda_{max} = c / T$

as Temp increases, wavelength of maximum emission decreases

Clicker Question

Set Frequency to "AD"

On a hot summer day, you walk across a dry asphalt parking lot with bare feet. Your feet soon get hot due to heat being transferred by:

(A) convection

(B) conduction

(C) latent heating

(D) radiation

Clicker Question

Set Frequency to "AD"

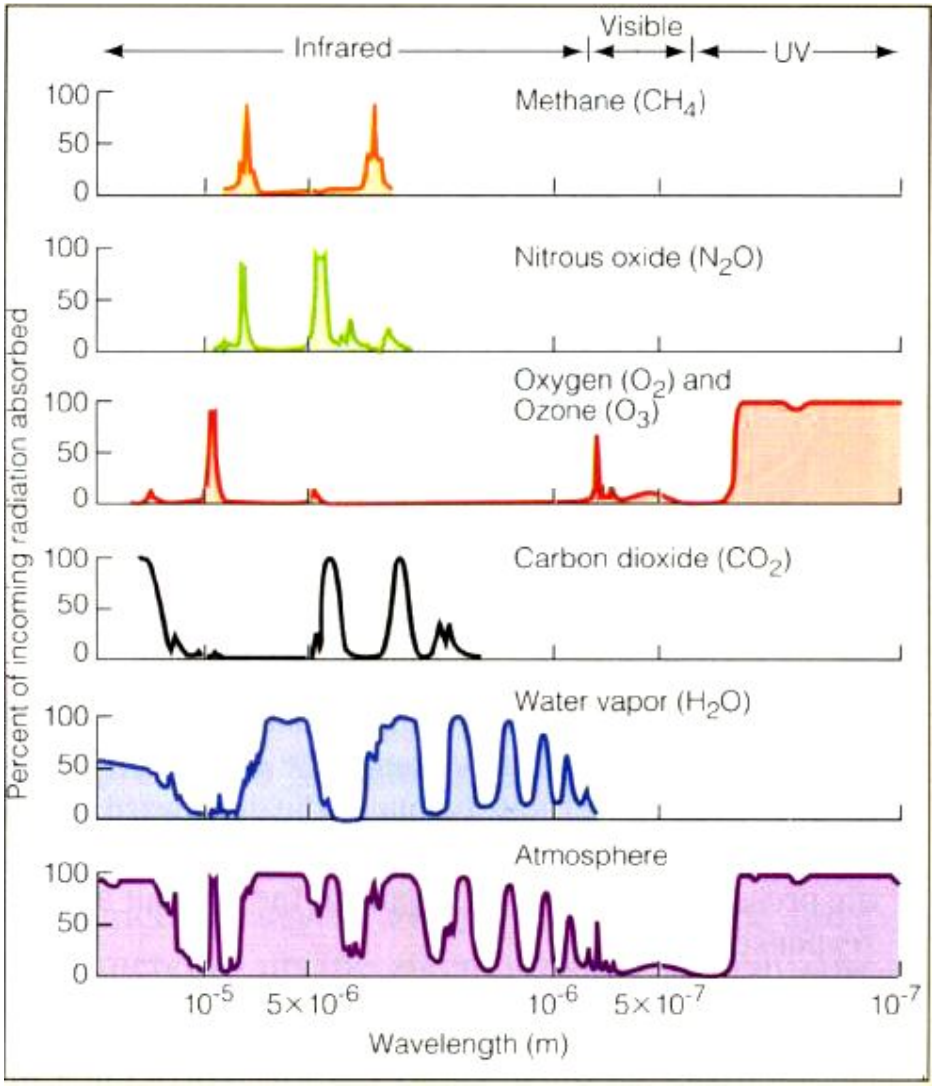
The moon has no atmosphere. As a result, heat transferred away from (or towards) the surface of the moon can only take place by:

(A) convection

(B) conduction

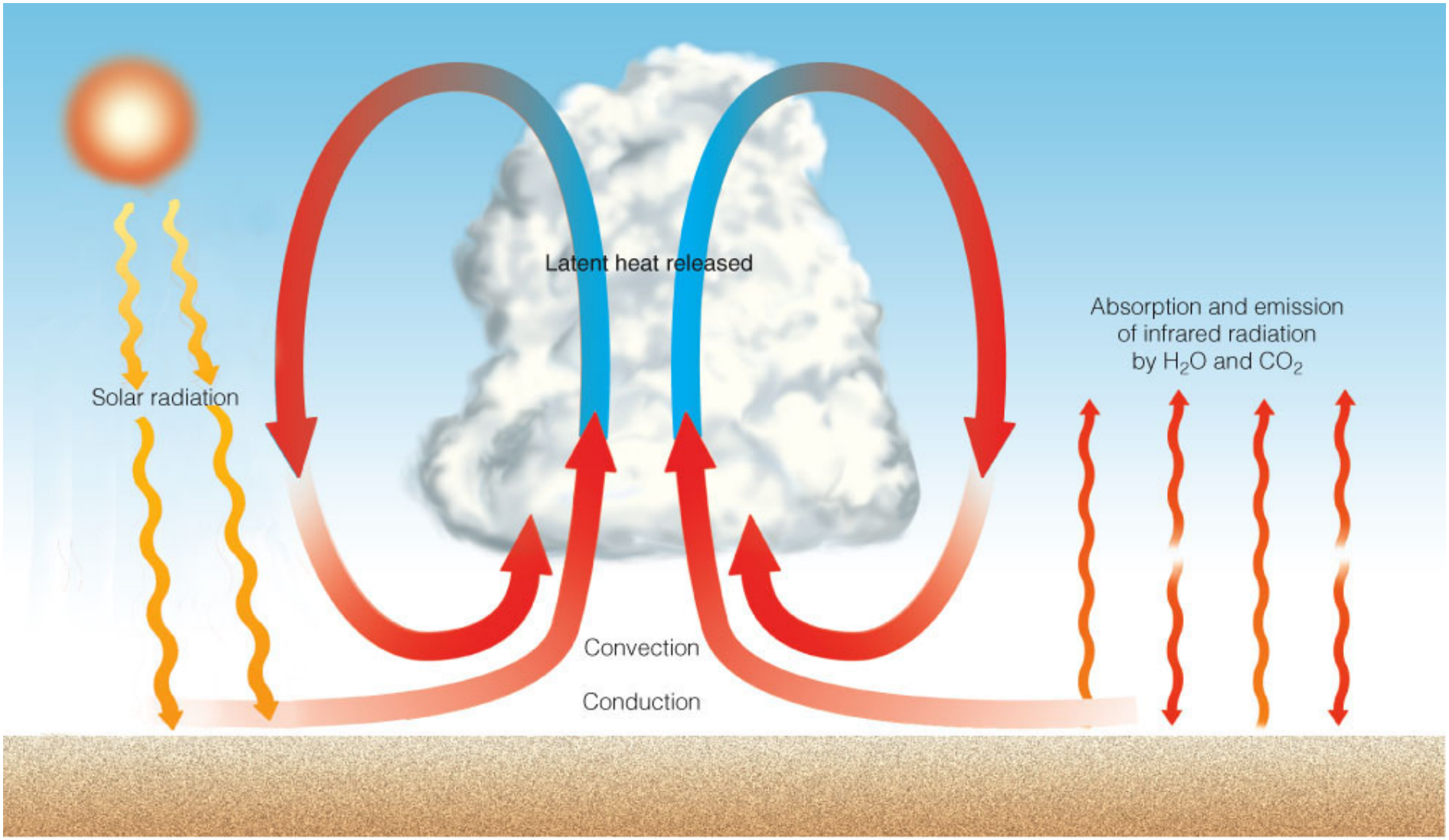
(C) latent heating

(D) radiation



Atmosphere:

- Absorbs most Infrared (IR)
- Absorbs little Visible



© 2007 Thomson Higher Education

Atmosphere is heated from below

- analogy is a pan of water on a stove

However, Earth is not heated evenly

- heating varies in time (Earth has seasons)
- heating varies by location

Clicker Question

Set Frequency to "AD"

What causes the Earth's seasons?

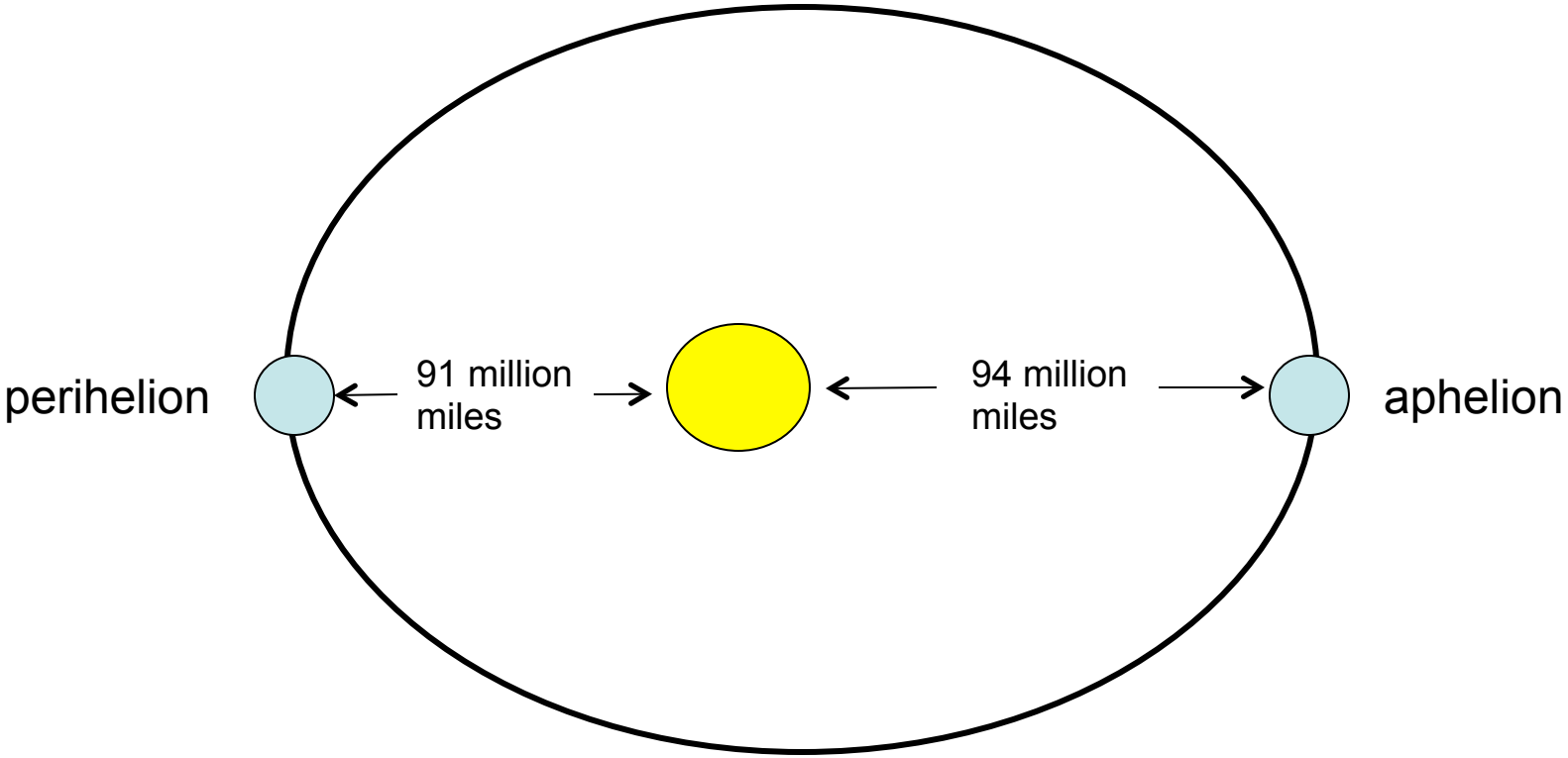
(A) distance from the sun (closer in summer and further in winter)

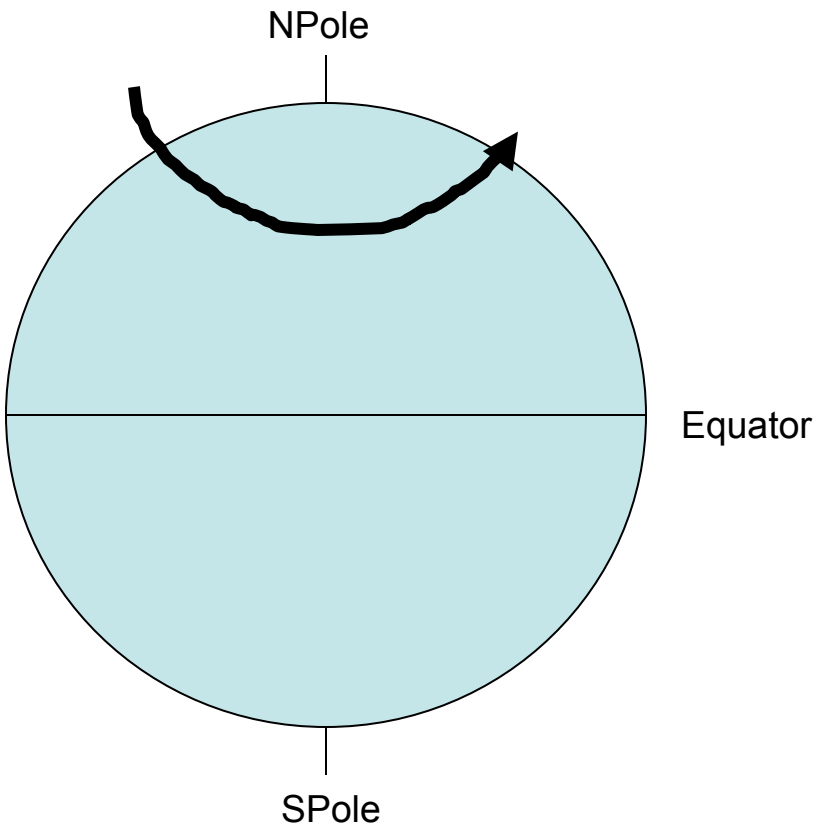
(B) solar output changes during the year

(C) tilt of Earth's axis

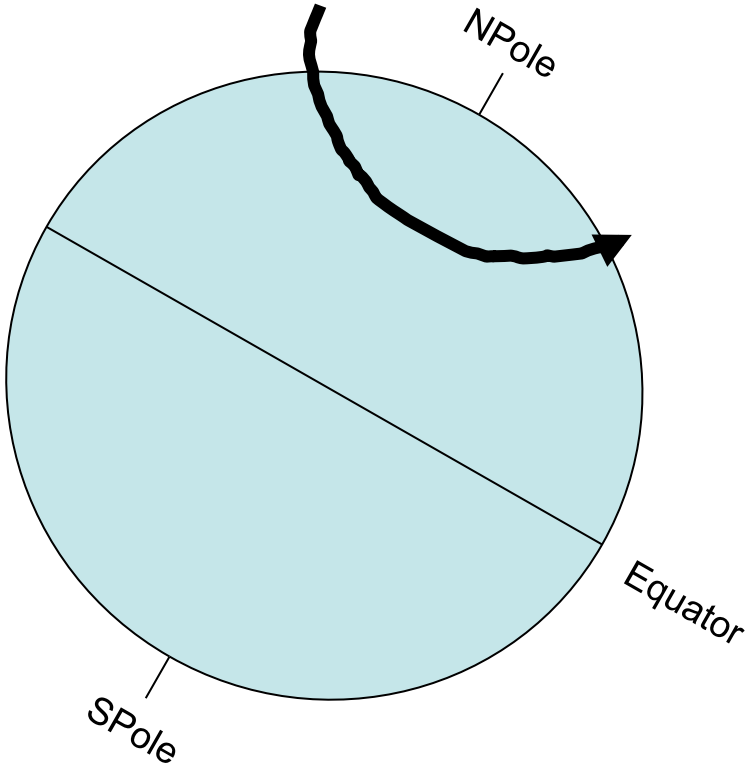
Earth's orbit around sun is an ellipse

Closest to sun on Jan 3 (perihelion)
Furthest from the sun on July 4 (aphelion)



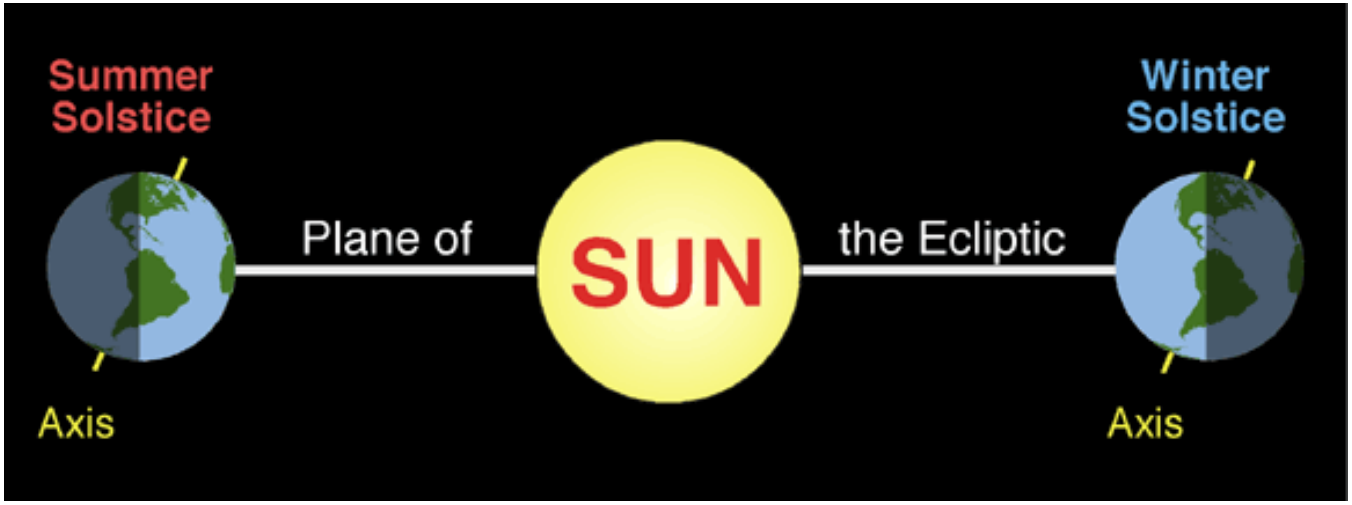


Earth Rotates about it's axis



However, Earth's axis is tilted relative to it's orbit around the Sun.

Seasons are due to tilt of Earth's axis relative to the orbital plane



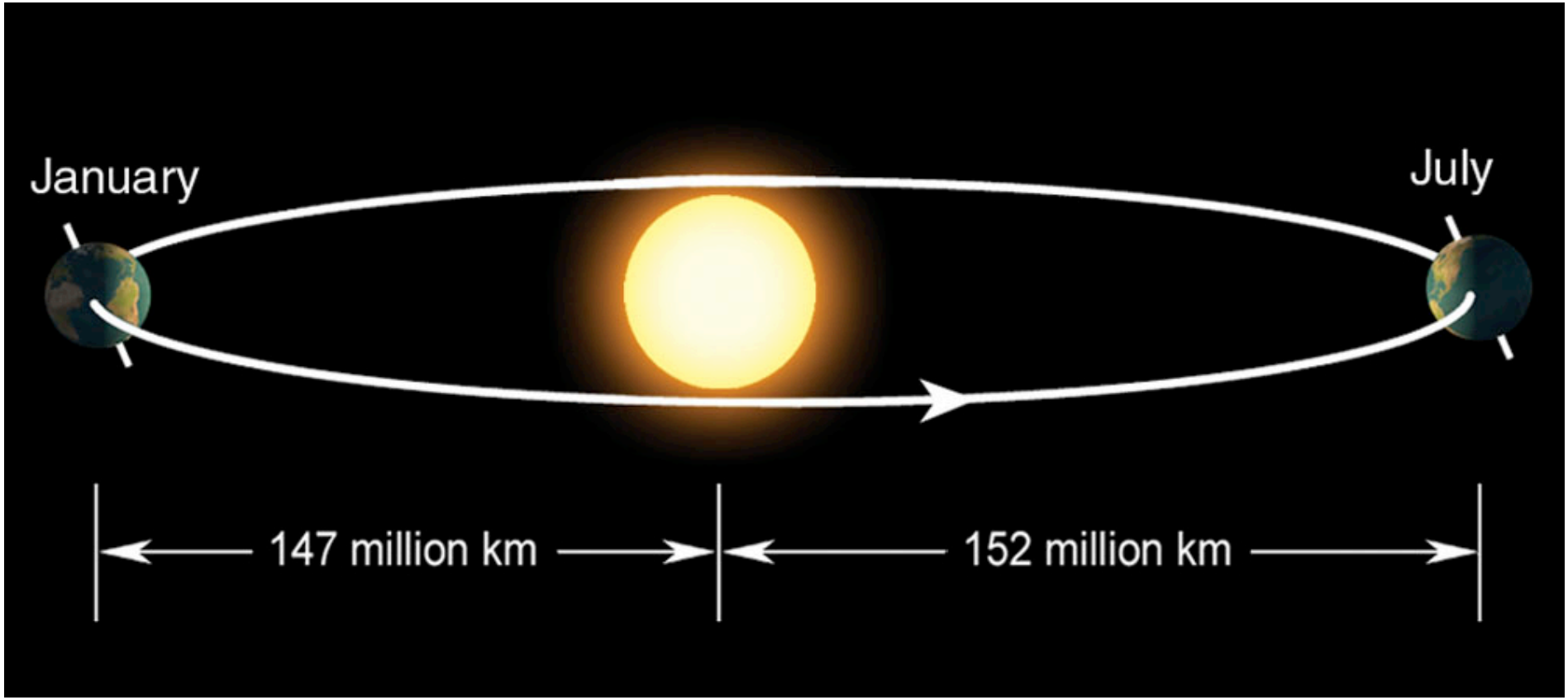
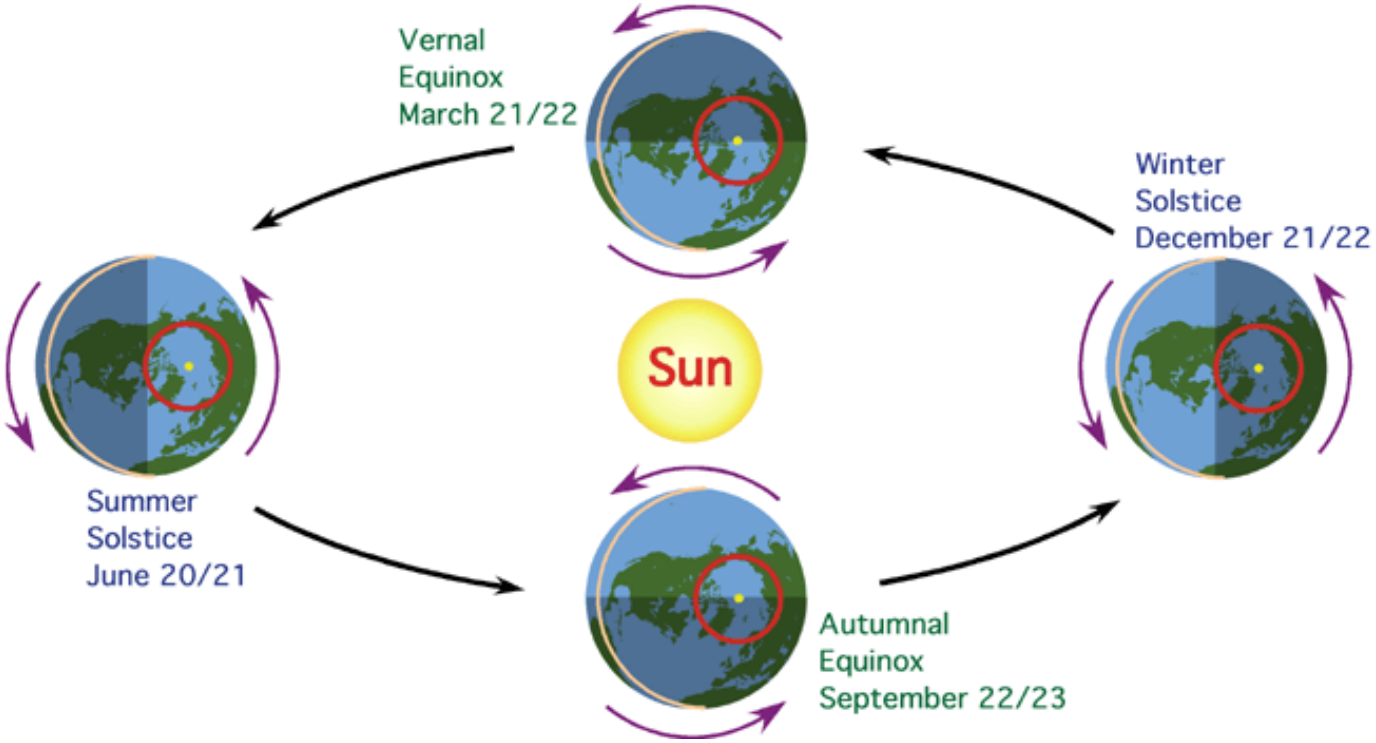
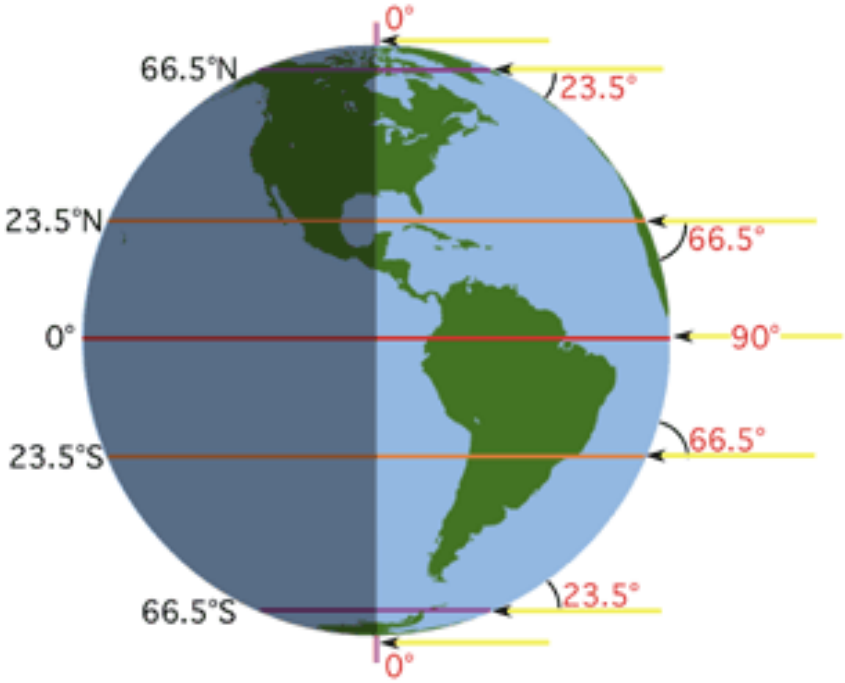


Fig. 2-20, p. 46

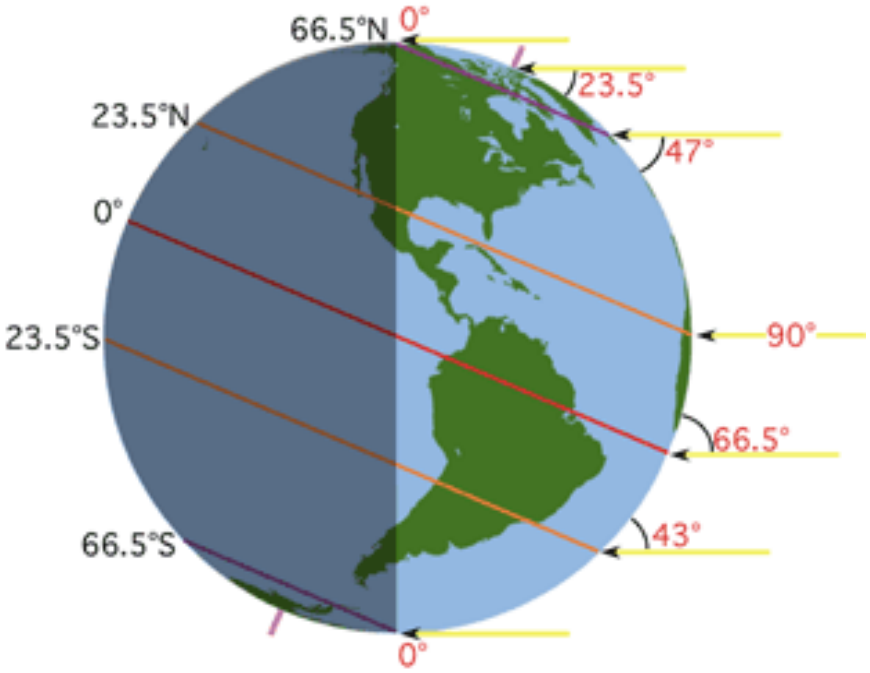
Northern Hemisphere Seasons



Spring and Fall Equinox

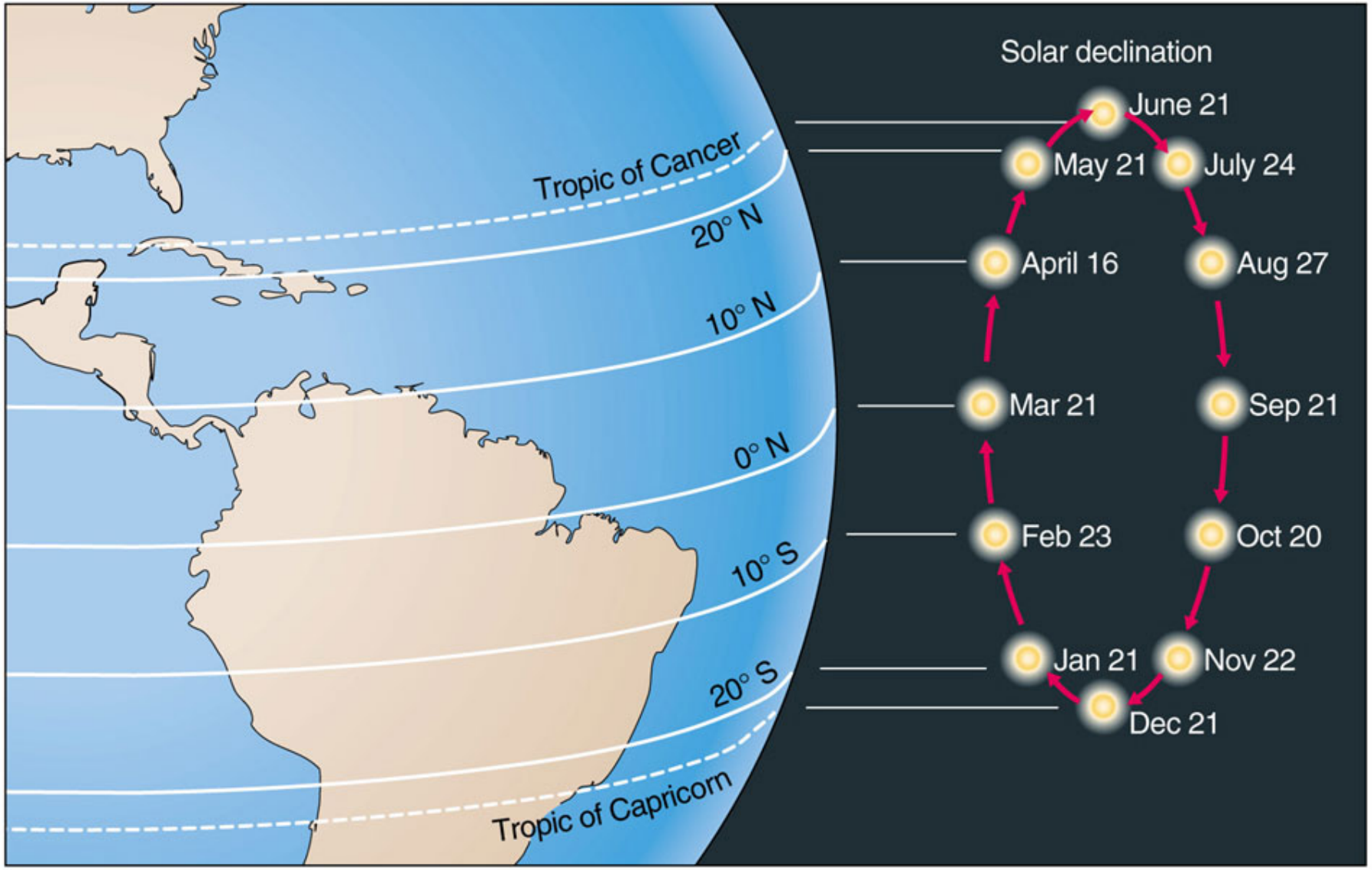


N.Hemisphere Summer Solstice



S.Hemisphere Winter Solstice

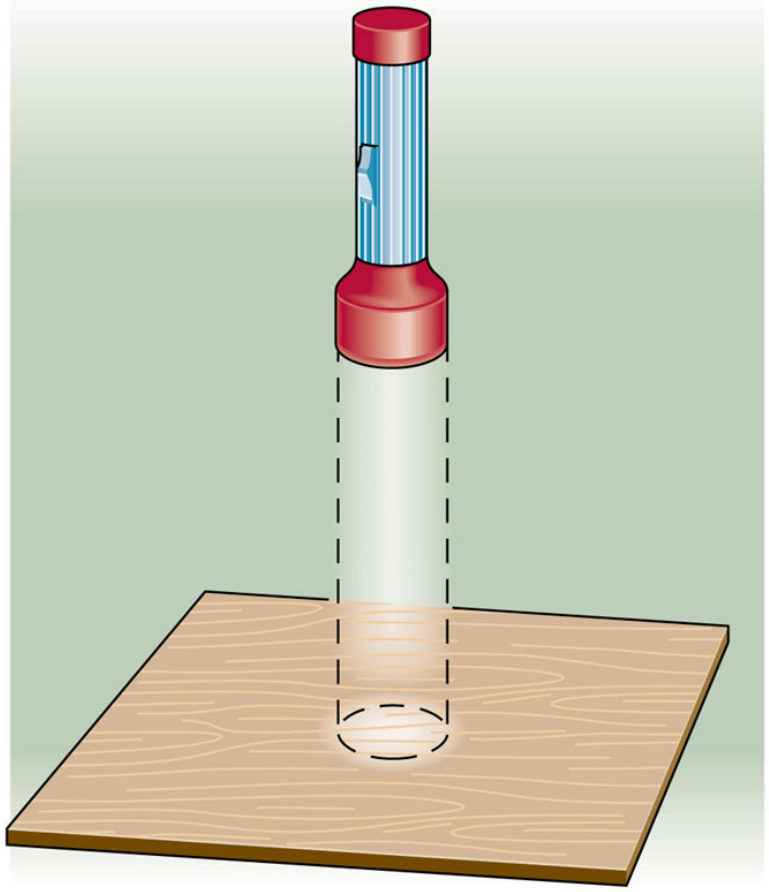
Latitude where sun is directly overhead

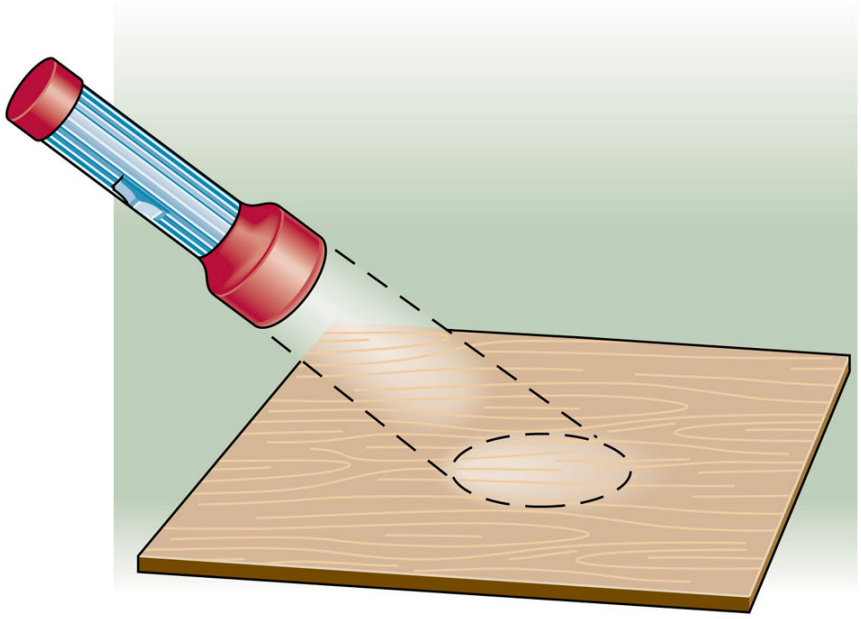


Amount of Incoming Solar Radiation Depends On:

- Angle of incidence
- Length of day
- Depth of atmosphere light must penetrate

Angle Of Incidence



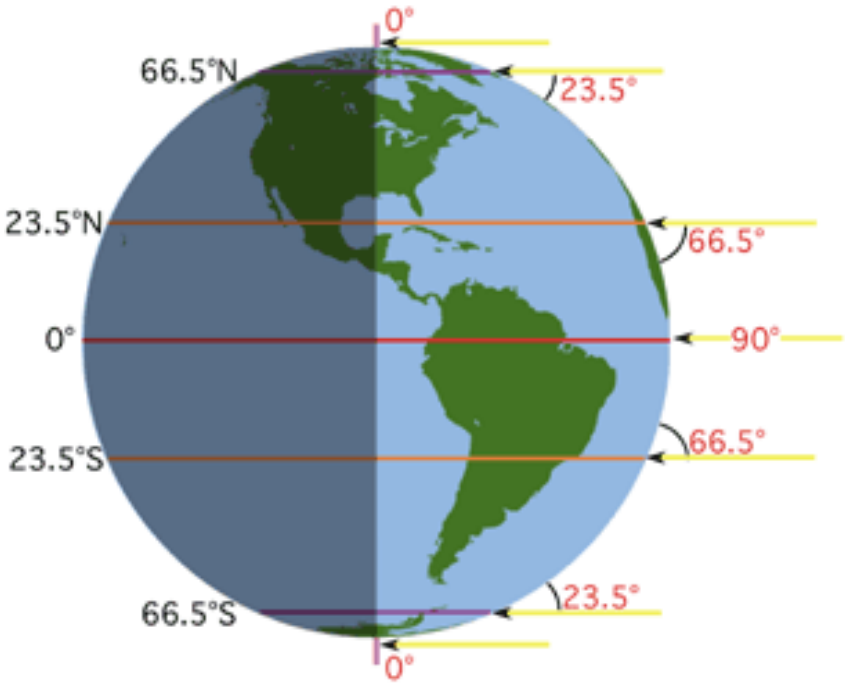


Energy spread out over larger surface area

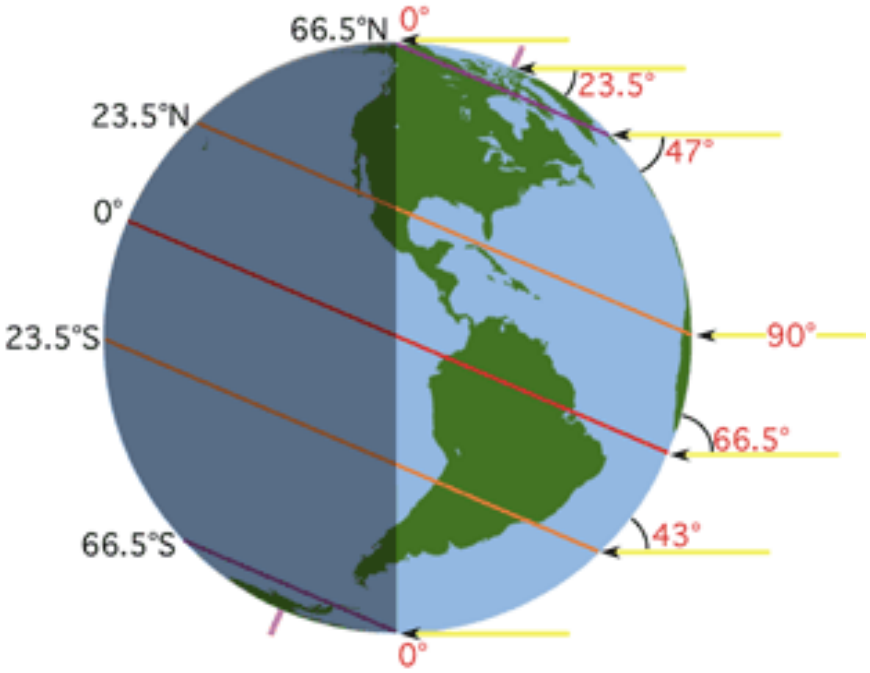
Amount of Incoming Solar Radiation Depends On:

- Angle of incidence
- Length of day
- Depth of atmosphere light must penetrate

Equinox



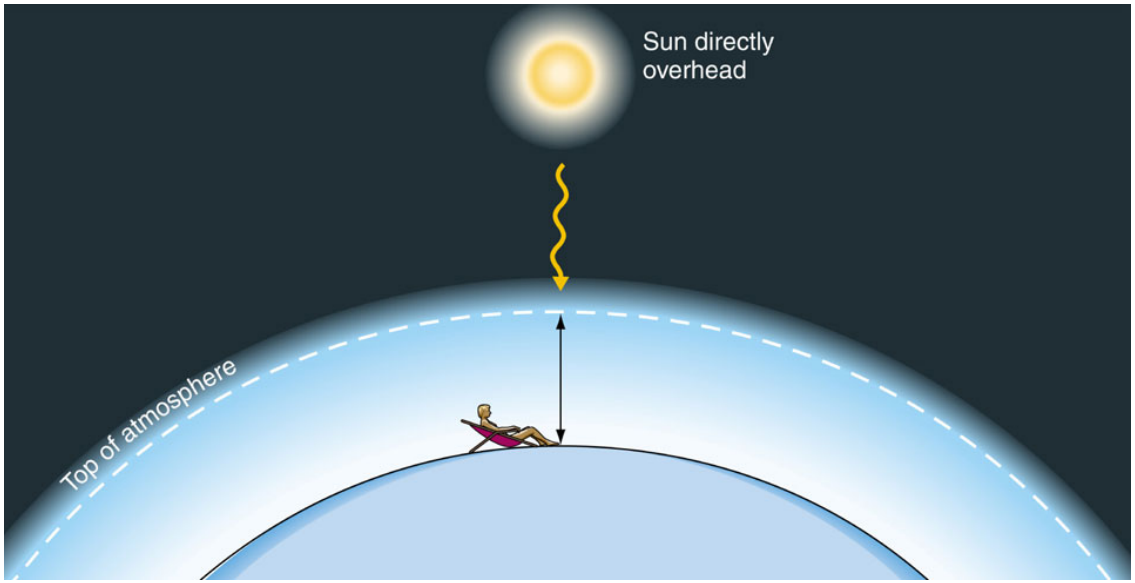
N.H. Summer

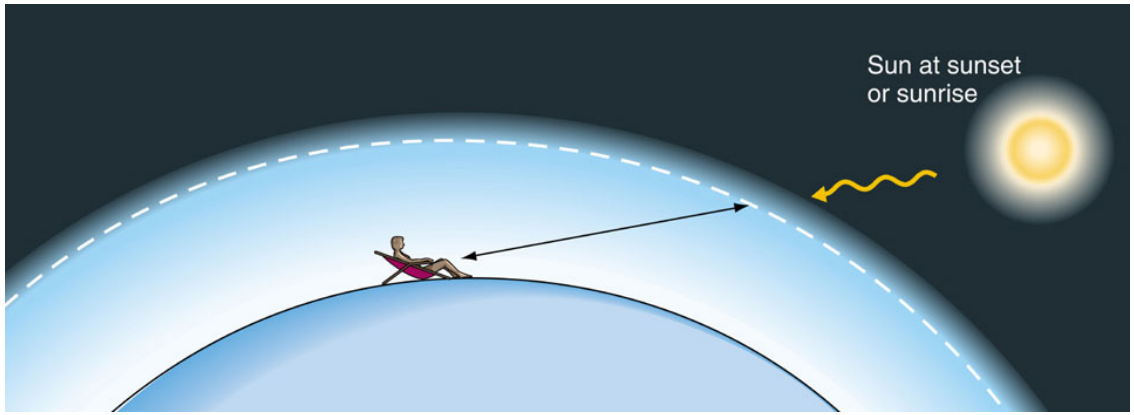


-12 hour day length everywhere on equinoxes
-12 hour day length at all times on equator
- elsewhere, day > 12 hours in summer
day < 12 hours in winter
- variation in day length increases at higher latitudes

Amount of Incoming Solar Radiation Depends On:

- Angle of incidence
- Length of day
- Depth of atmosphere light must penetrate


Sun directly
overhead
Top of atmosphere


Sun at sunset
or sunrise

Amount of Incoming Solar Radiation Depends On:

- Angle of incidence
- Length of day
- Depth of atmosphere light must penetrate

Because Earth is a sphere

=> these factors change with latitude

Because of Earth's tilt

=> these factors also change with time of year

Amount of incoming solar energy varies by

=> latitude AND time of year