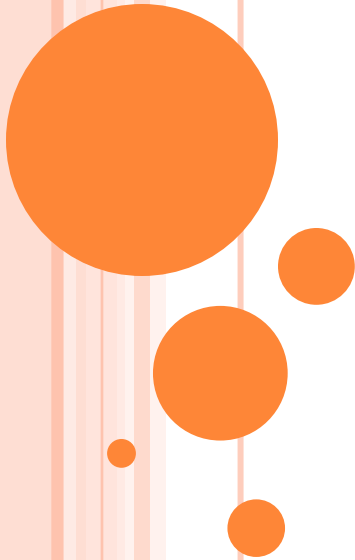
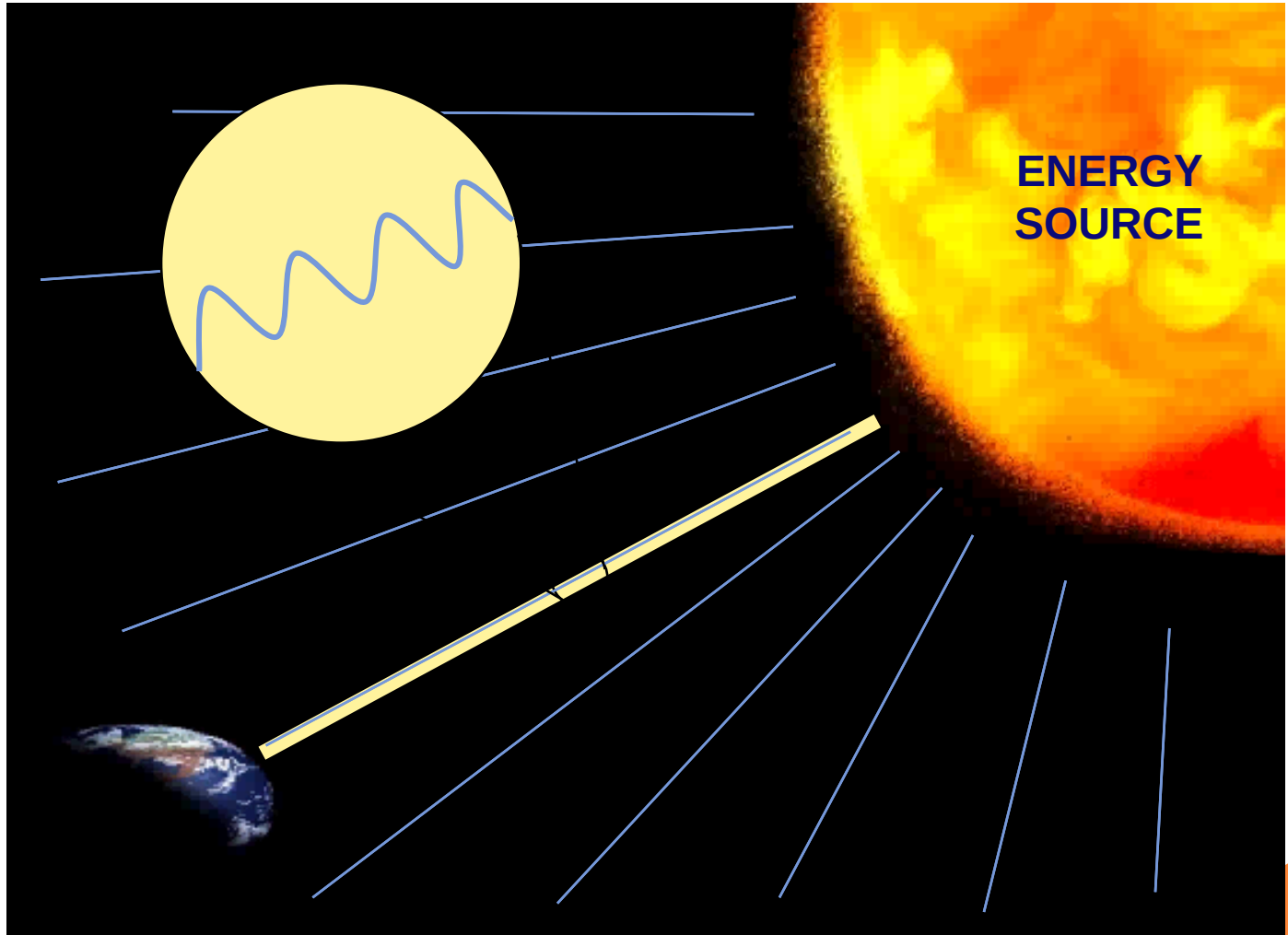


DR.PURNIMA SHUKLA

**HEAD OF THE DEPARTMENT OF
GEOGRAPHY
DURGA COLLEGE RAIPUR**



insolation

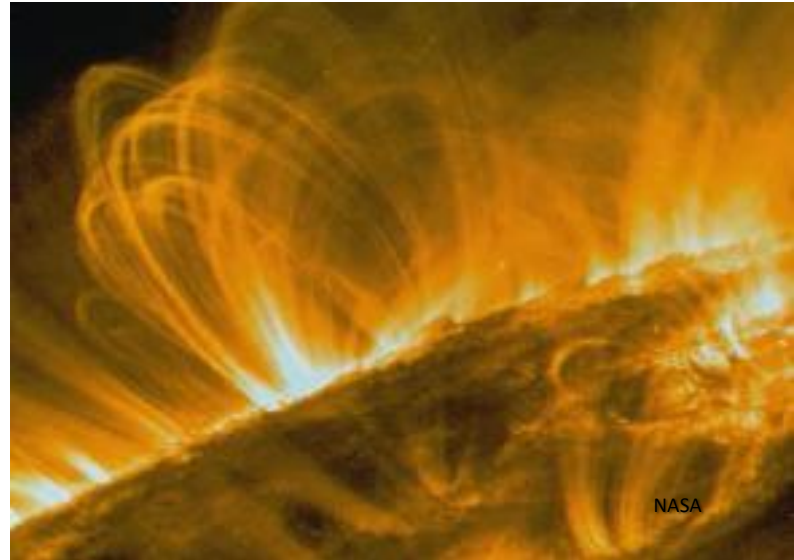


SOLAR RADIATION

SOLAR RADIATION IS ELECTROMAGNETIC RADIATION RANGING FROM ABOUT 0.25 -4.5 μm IN WAVELENGTH, INCLUDING THE NEAR ULTRAVIOLET (UV) VISIBLE LIGHT, AND NEAR INFRARED (IR) RADIATION .

COMMON UNITS OF MEASURE FOR ELECTROMAGNETIC RADIATION WAVELENGTHS

- 1 Angstrom(A)= 10^{-10} meter(m)
- 1 Nanometer(nm)= 10^{-9} meter
- 1 Micrometer(μm) 10^{-6} meter
- 1 Millimeter (mm) 10^{-3} meter
- 1 Kilometer (km) 1000meters



SUN – EARTH RELATIONSHIPS



93 million miles, average (1.5×10^8 km)
1 Astronomical Unit
(Distance traveled in 8.31 minutes at the Speed of Light)



Sun:

Diameter: 865,000 miles (1,392,000 km, 109 times earth)

Mass: 2×10^{30} kg (330,000 times earth)

Density: 1.41 g/cm^3

Gravity: 274 m/s^2 (28 g)

Surface Temperature: 10,000 F (5800 K)

Earth:

Diameter: 7,930 miles (12,756 km)

Mass: 5.97×10^{24} kg

Density: 5.52 kg/cm^3

Gravity: 9.81 m/s^2 (1 g)

Typical Surface Temperature: 68 F (300K)

Earth's Orbit Around Sun: 1 year

Earth's Rotation about its Polar Axis: 1 day

INSOLATION

INCOMING SOLAR RADIATION

THE SUN RADIATES ENERGY AND
EARTH RERADIATES IT AS INFRARED
HEAT ENERGY

EARTH IS HEATED UNEQUALLY



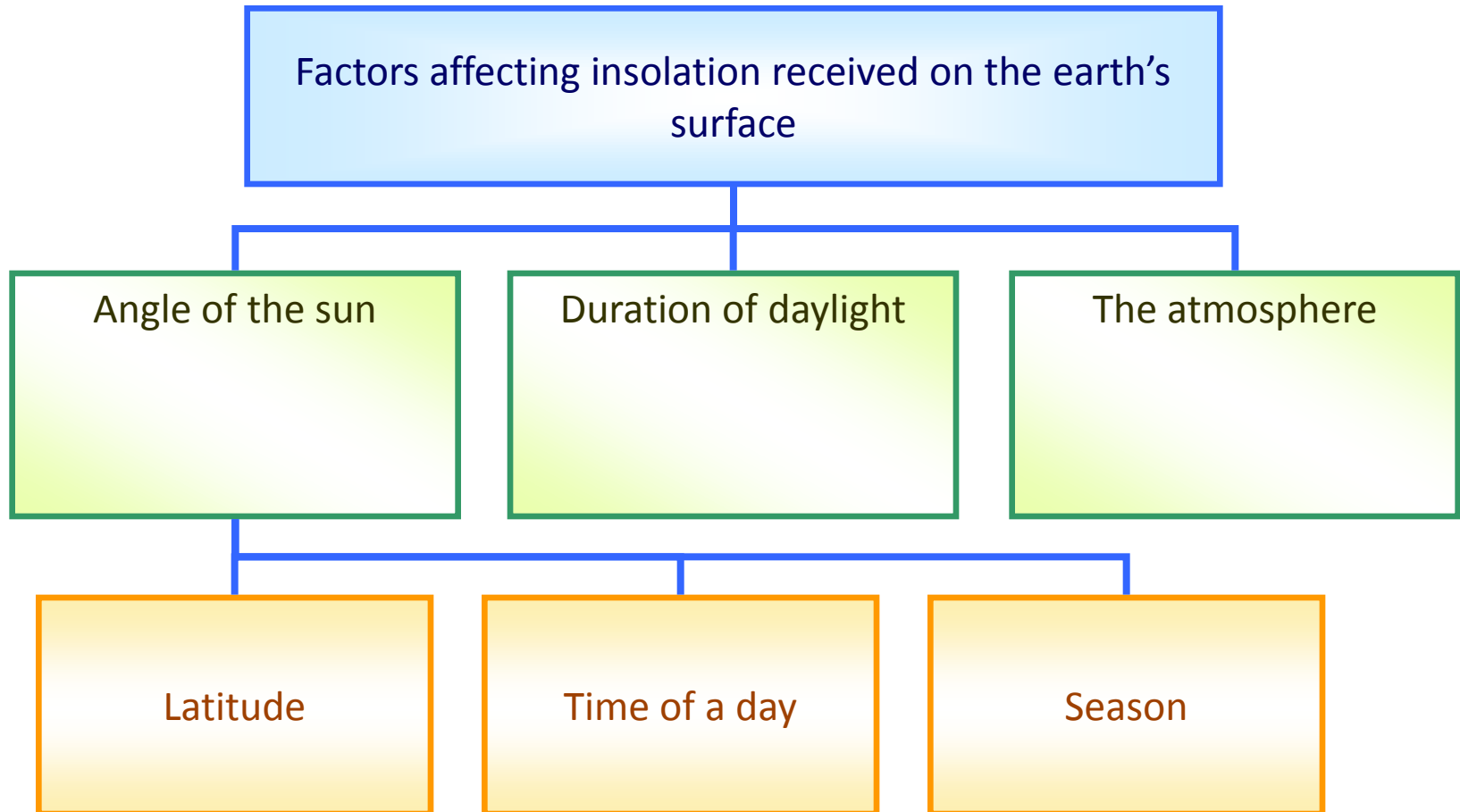
FACTORS THAT AFFECT INSOLATION

- ANGLE
- INTENSITY
- DURATION
- LATITUDE
- SEASONS



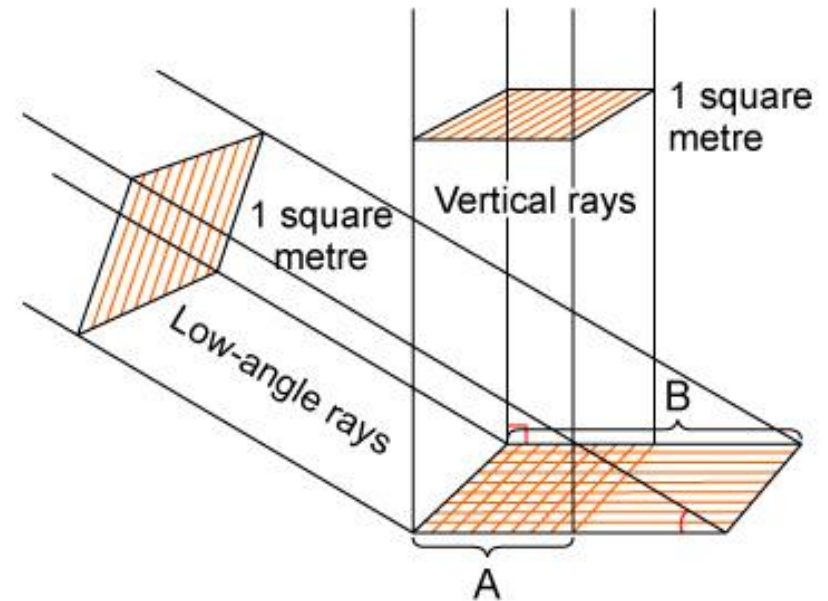
What is insolation?

What factors affect insolation received on the earth's surface?



1 Angle of the sun

- The angle of the sun refers to the angle at which sunlight strikes the earth's surface.
- When the sun is directly overhead, or when the angle of the sun is 90° , it is known as the **overhead sun**.



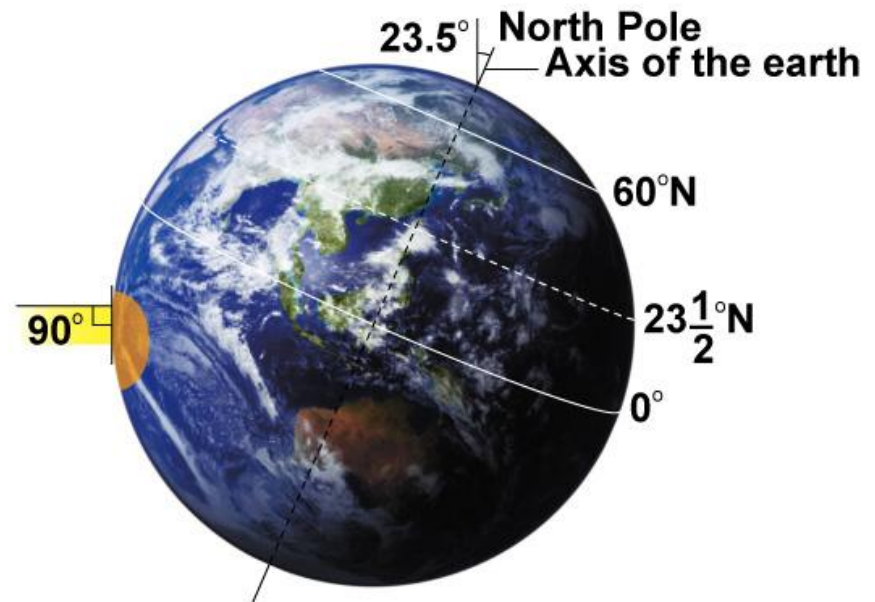
	Area A	Area B
Angle of the sun	90° / Right angle	$< 90^\circ$ / Acute angle
Area to warm up	Smaller	Larger
Intensity of insolation	High / More intense	Low / Less intense

1 Angle of the sun

A Latitude

In low-latitude regions:

- The angle of sun is (smaller / larger).
- The insolation concentrates on a (smaller / larger) area.
- Therefore, the insolation is (weaker / stronger).



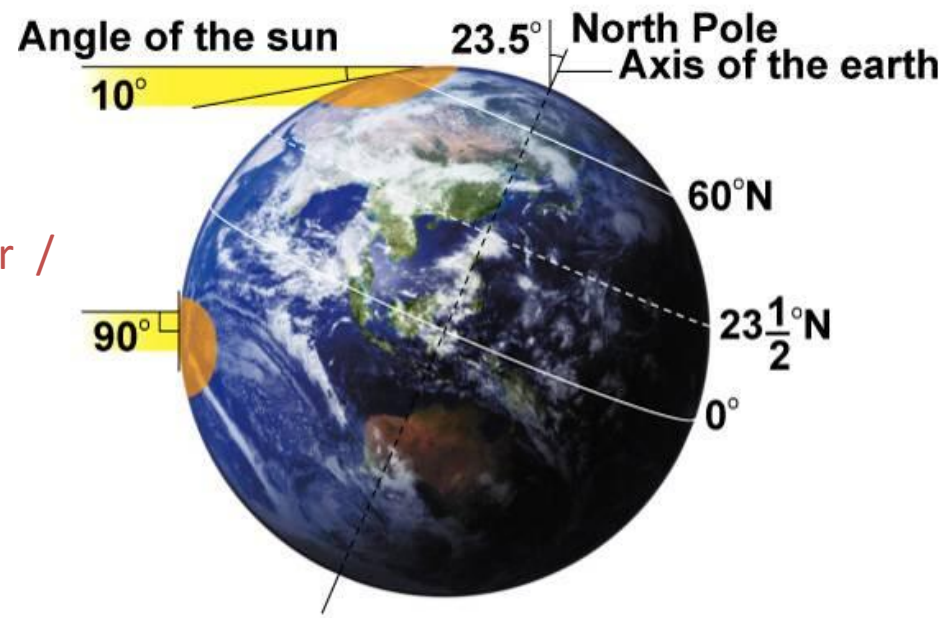
(Credit: NASA)

1 Angle of the sun

A Latitude

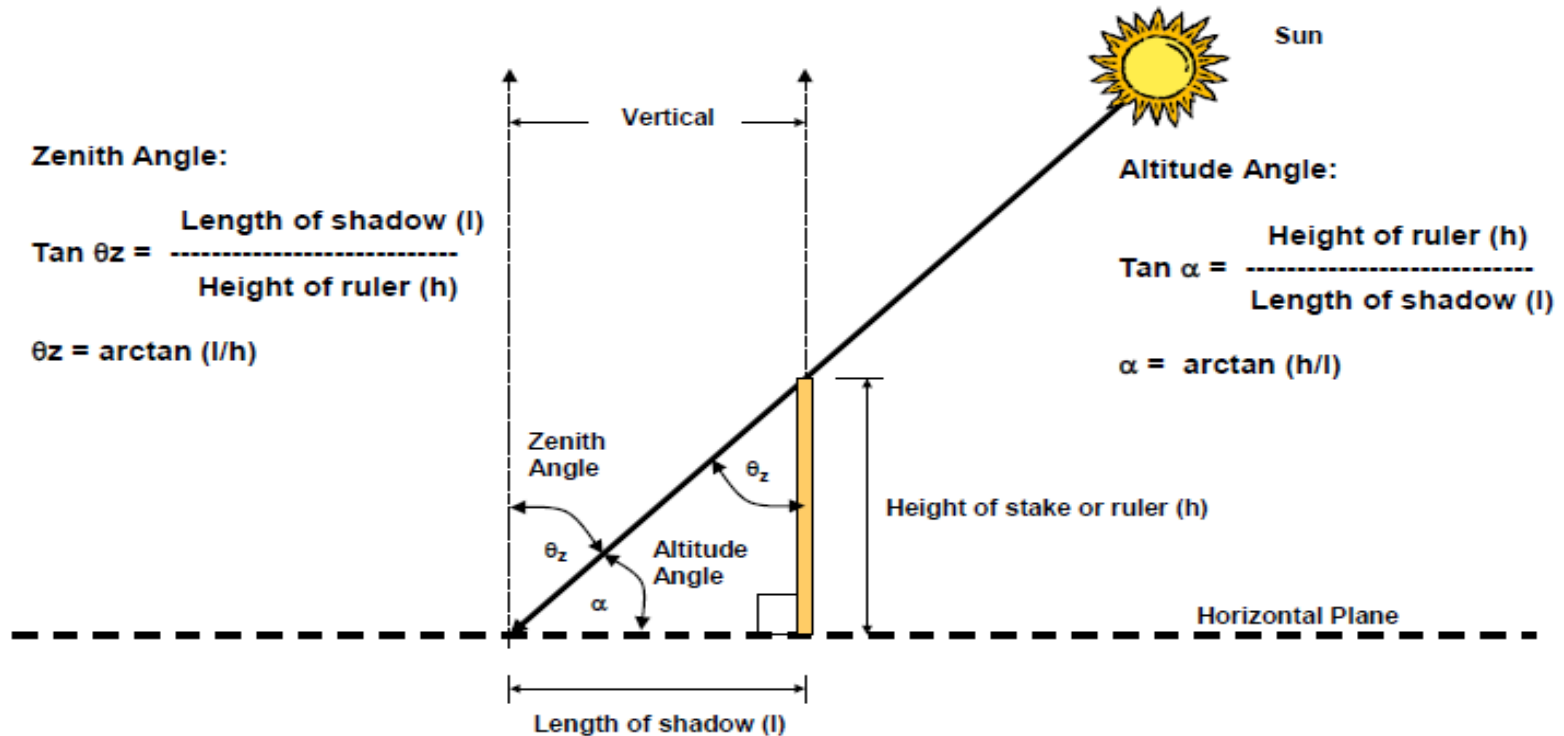
In high-latitude regions:

- The angle of sun is (smaller / larger).
- The insolation concentrates on a (smaller / larger) area.
- Therefore, the insolation is (weaker / stronger).

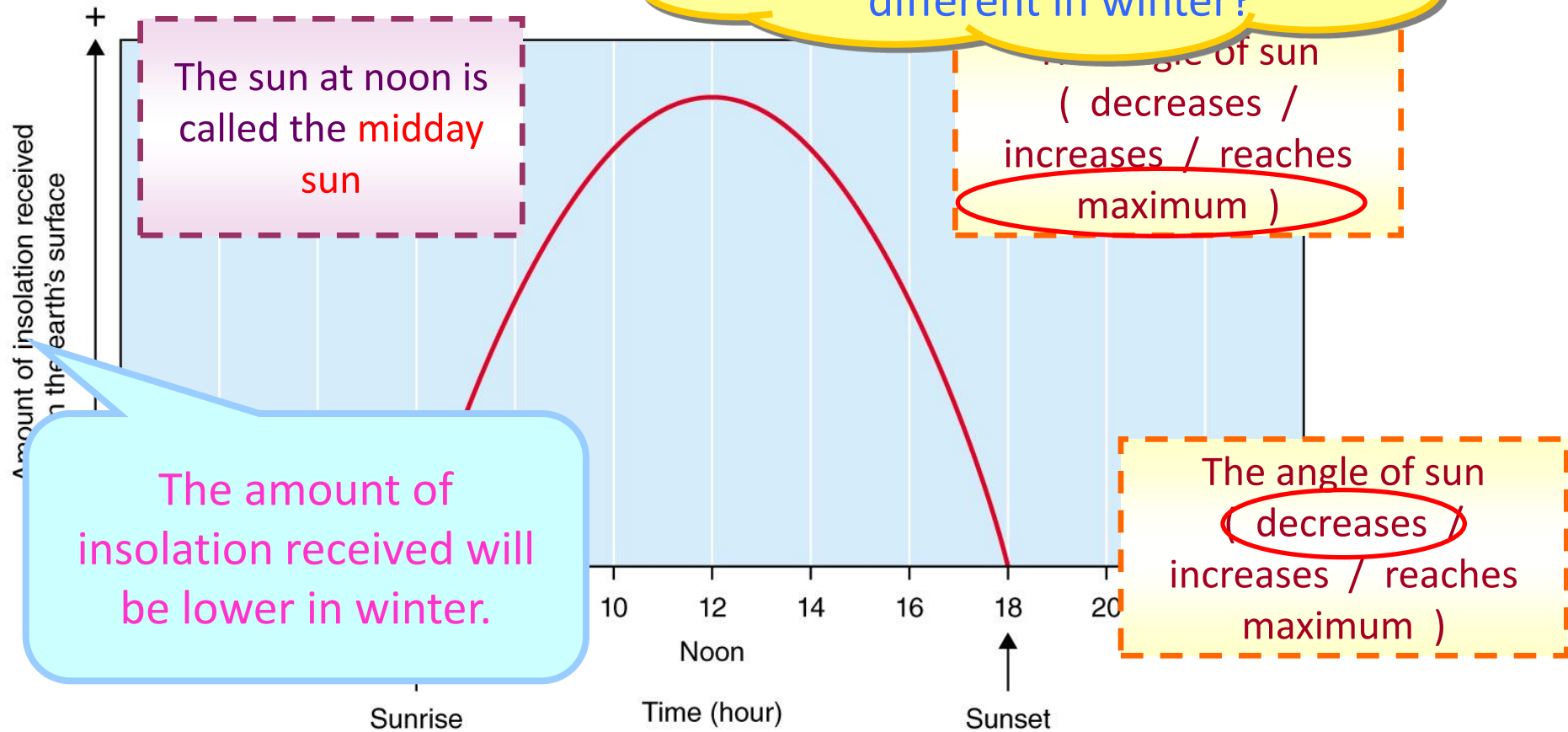


(Credit: NASA)

MEASURING ZENITH AND ALTITUDE ANGLES

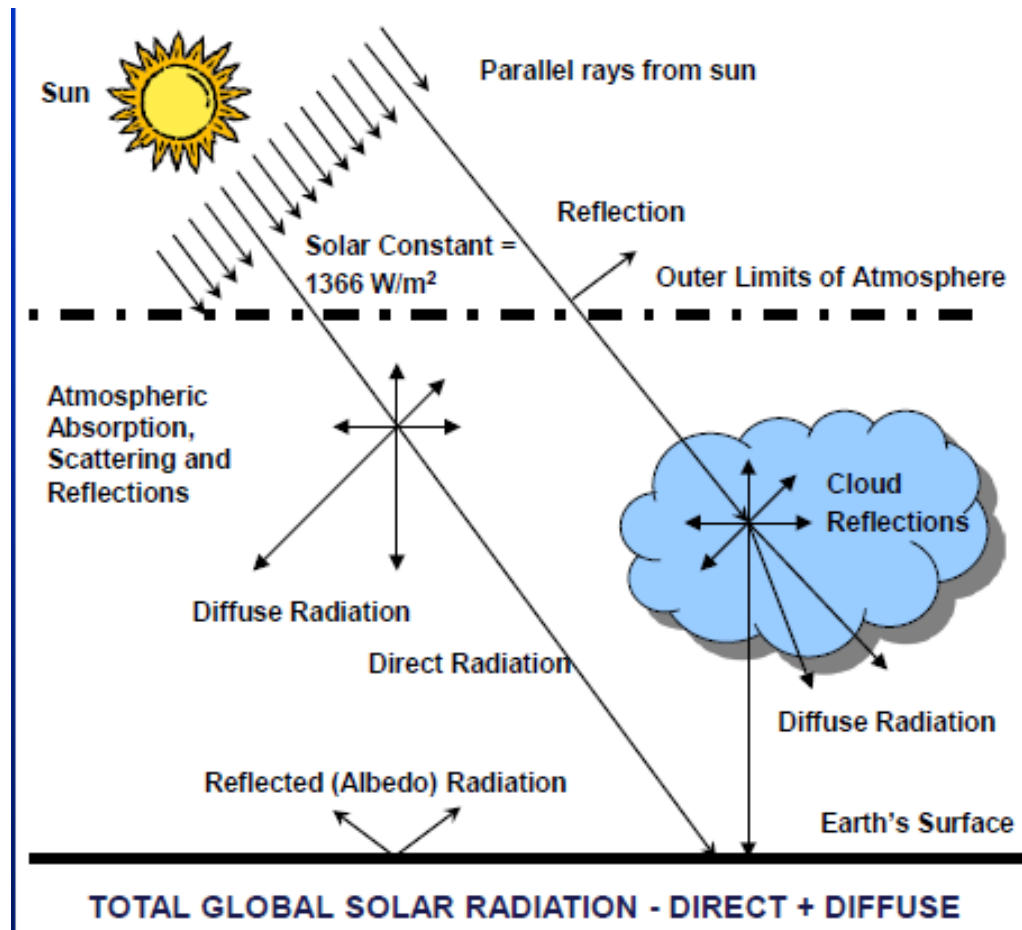


1 Angle of the sun B Time of a day

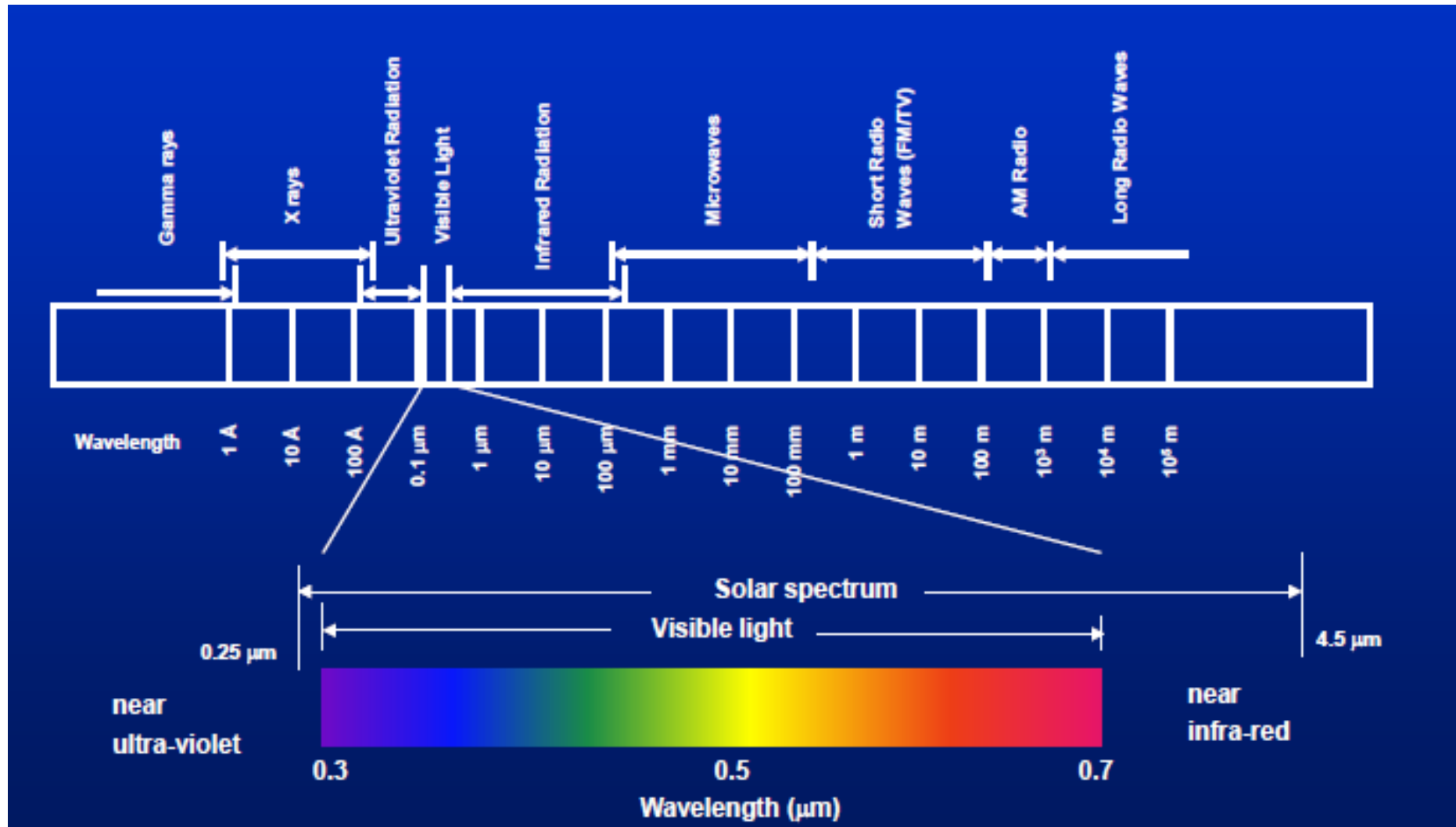


The amount of insolation received in a mid-latitude site in the Northern Hemisphere around the spring equinox

ATMOSPHERIC EFFECTS

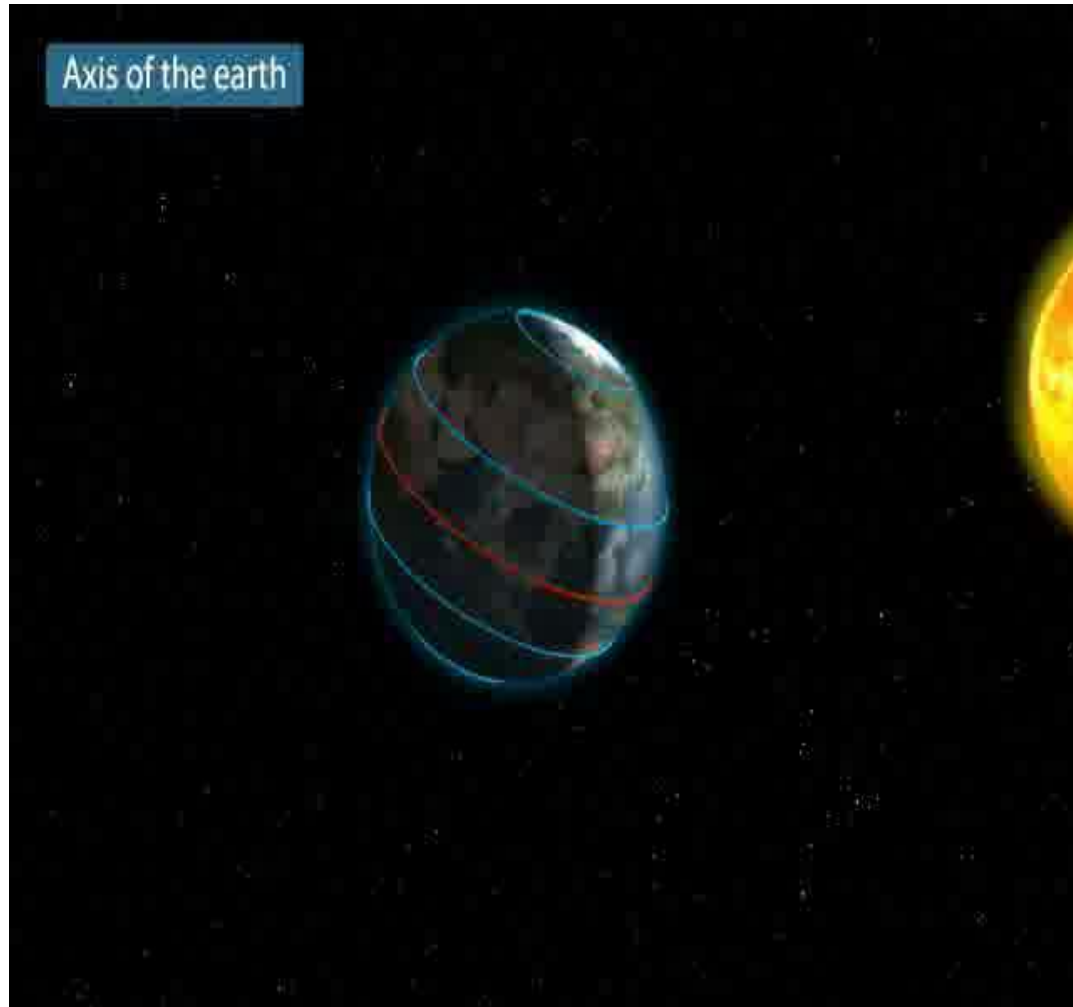


ELECTROMAGNETIC SPECTRUM

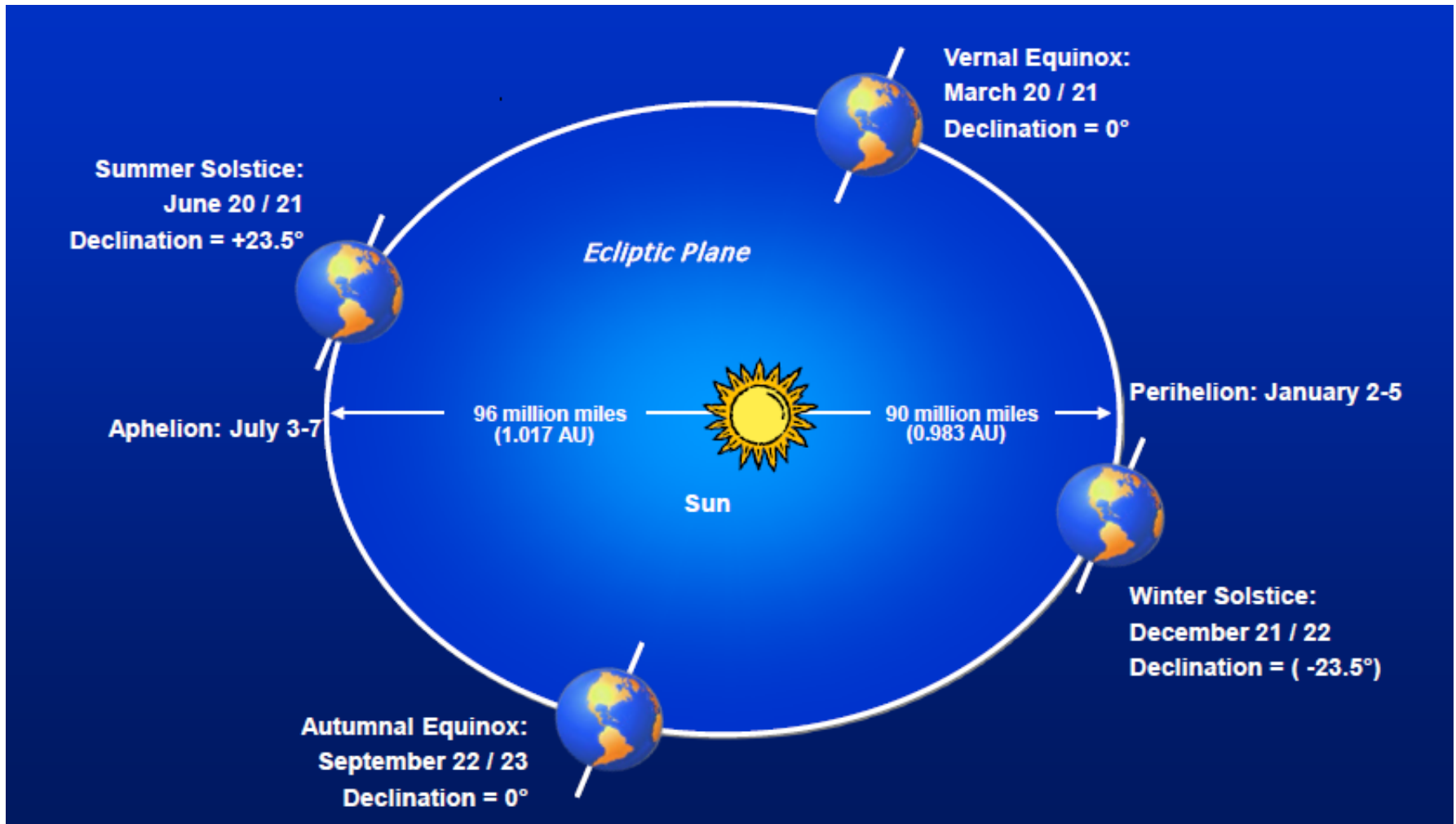


1 Angle of the sun

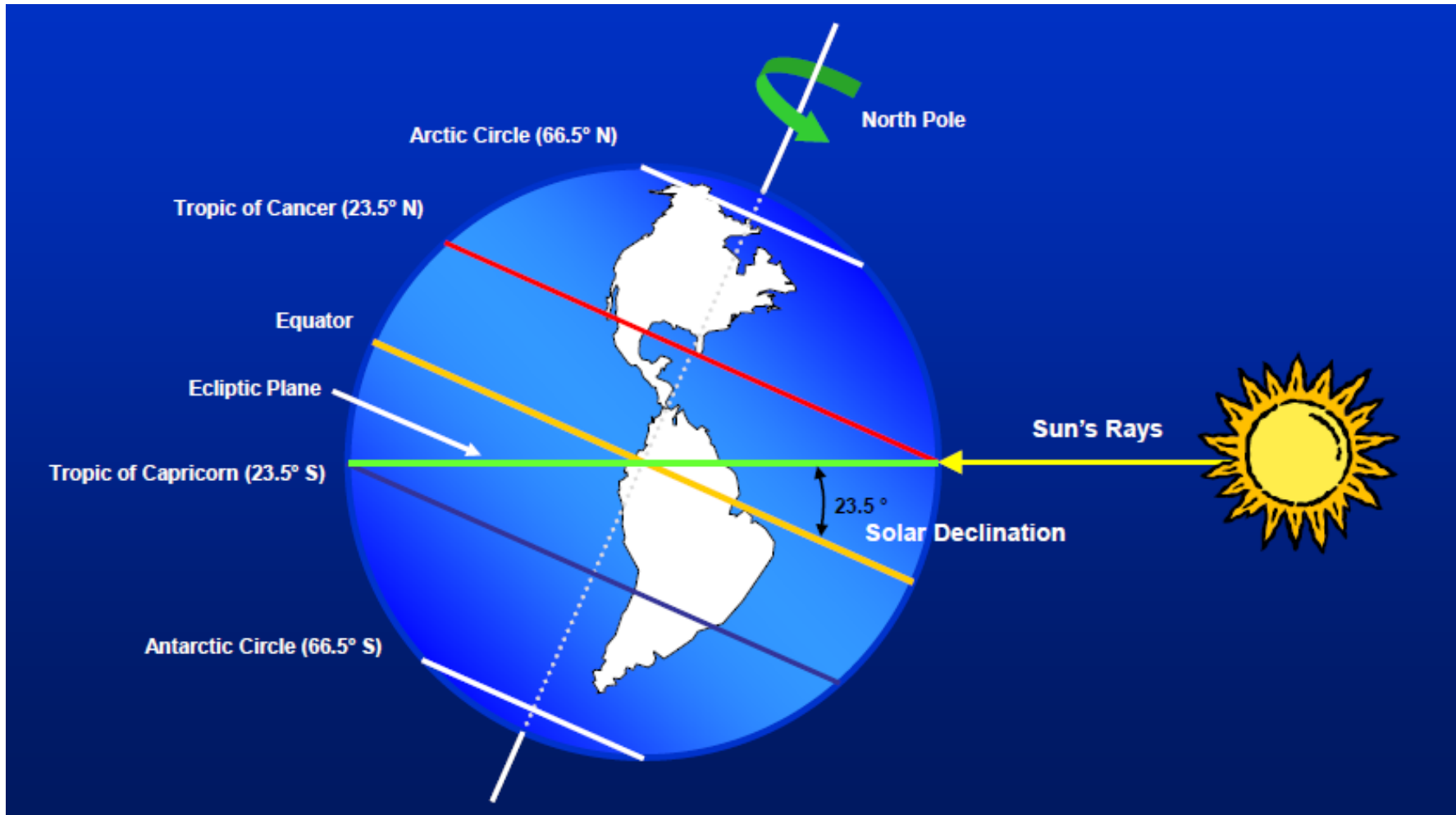
C Season



EARTH'S ORBIT AROUND THE SUN

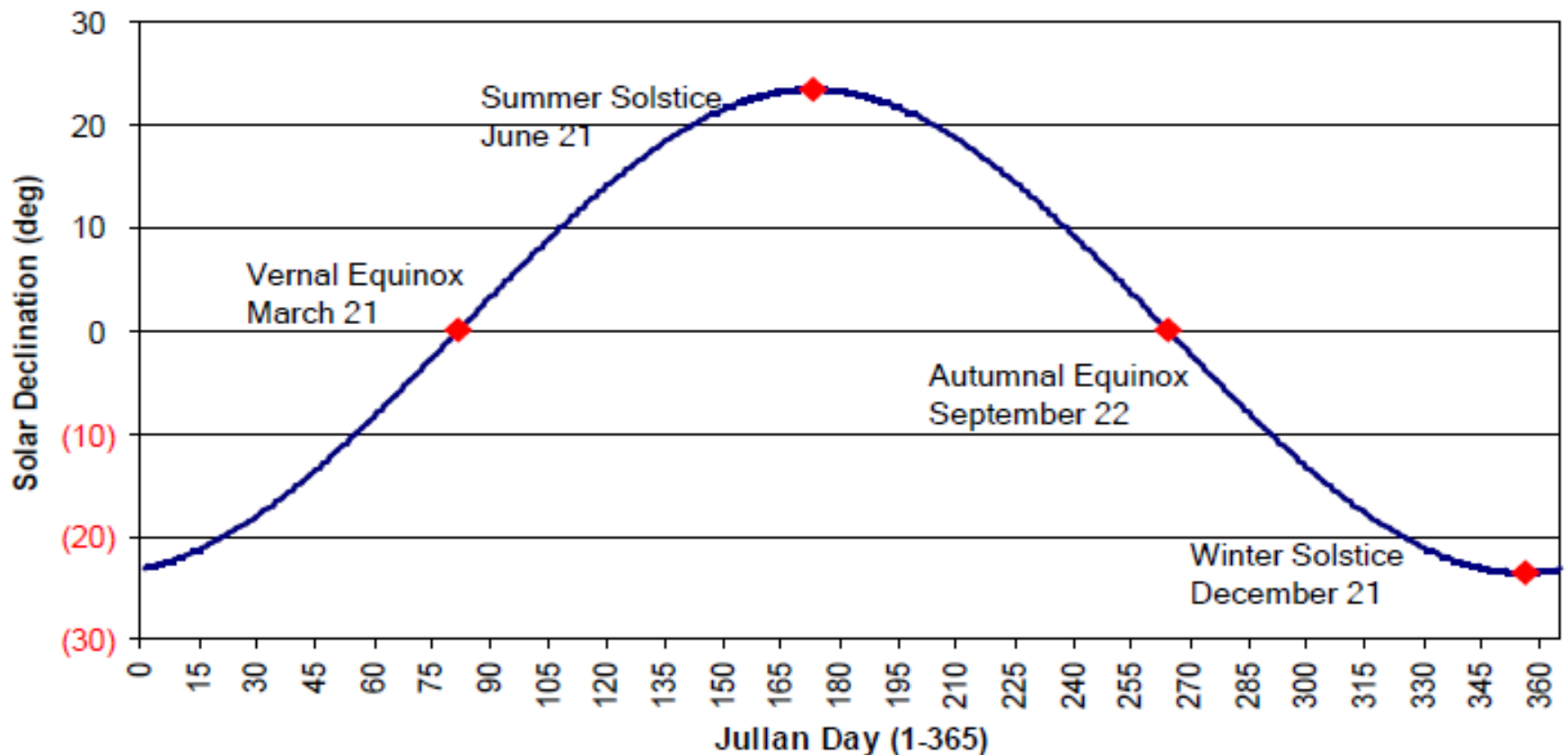


SOLAR DECLINATION

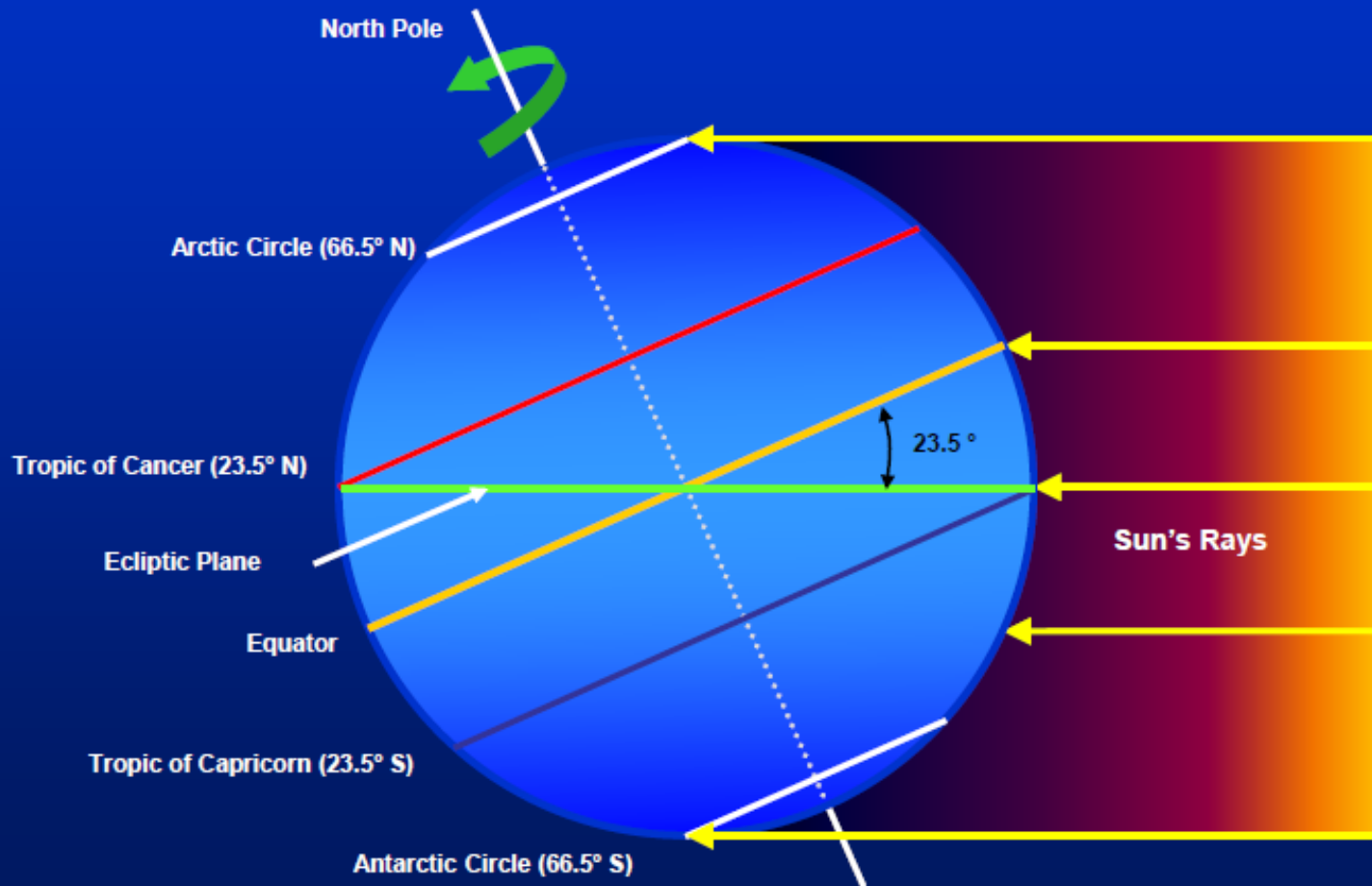


SOLAR DECLINATION

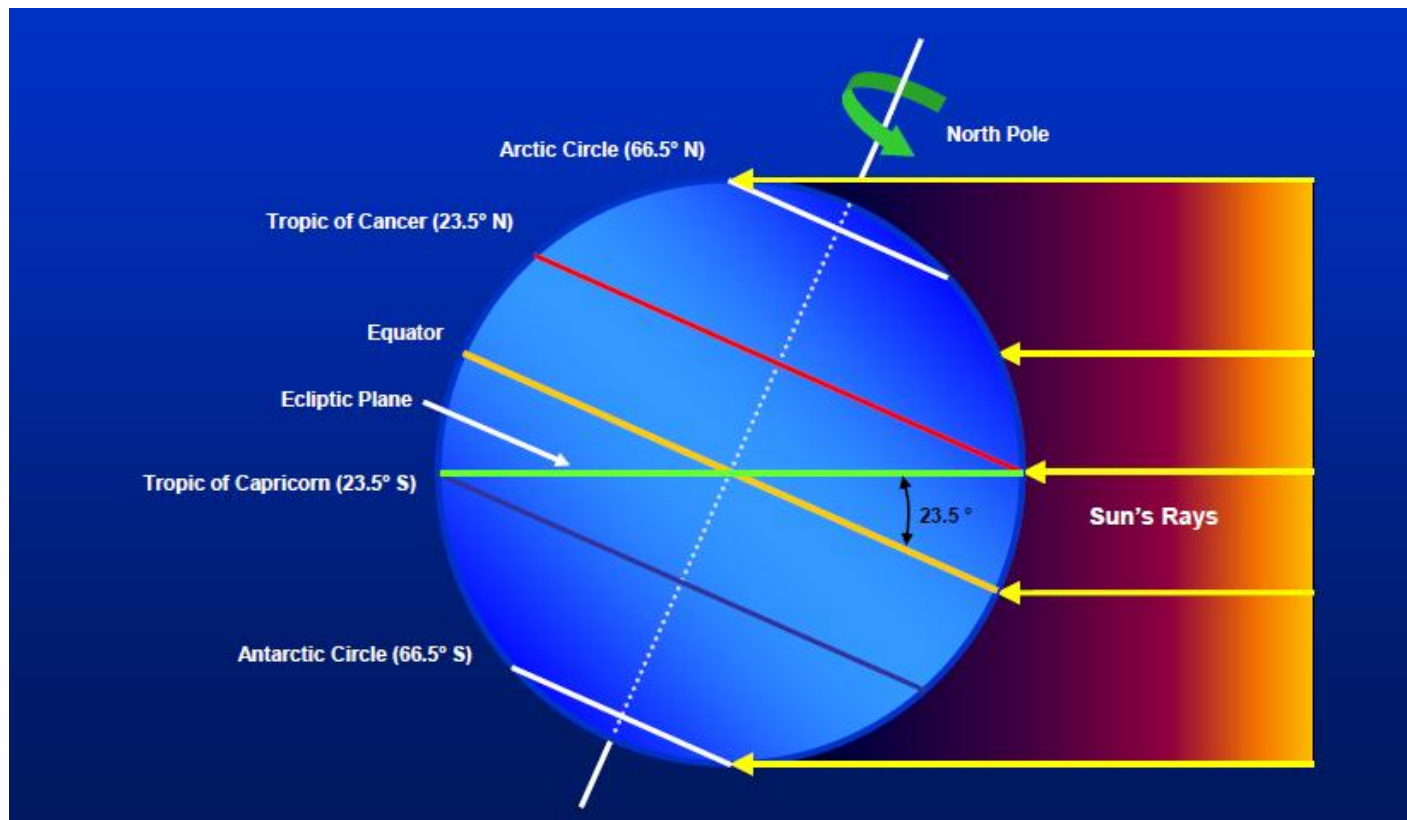
Solar Declination



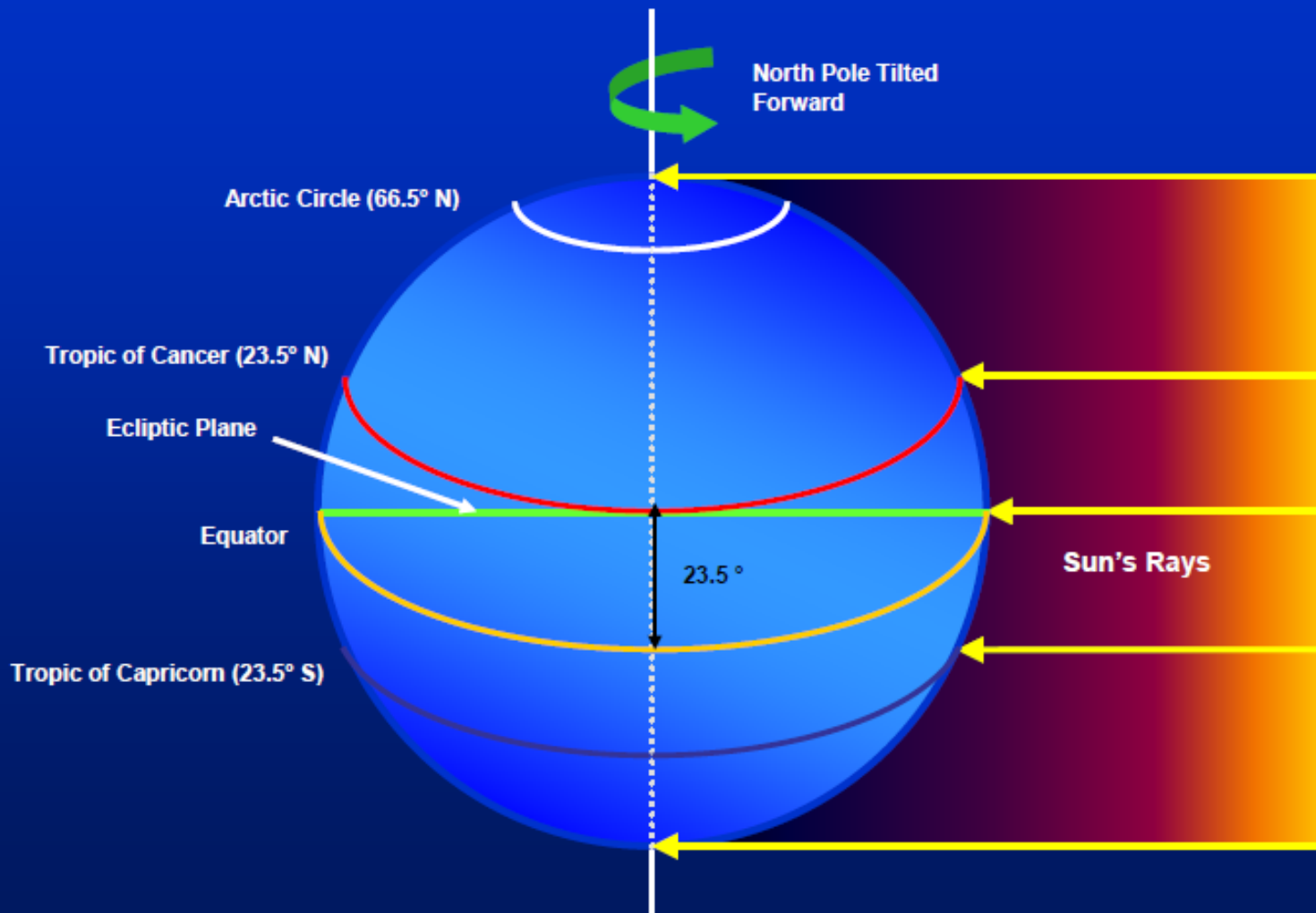
WINTER SOLSTICE



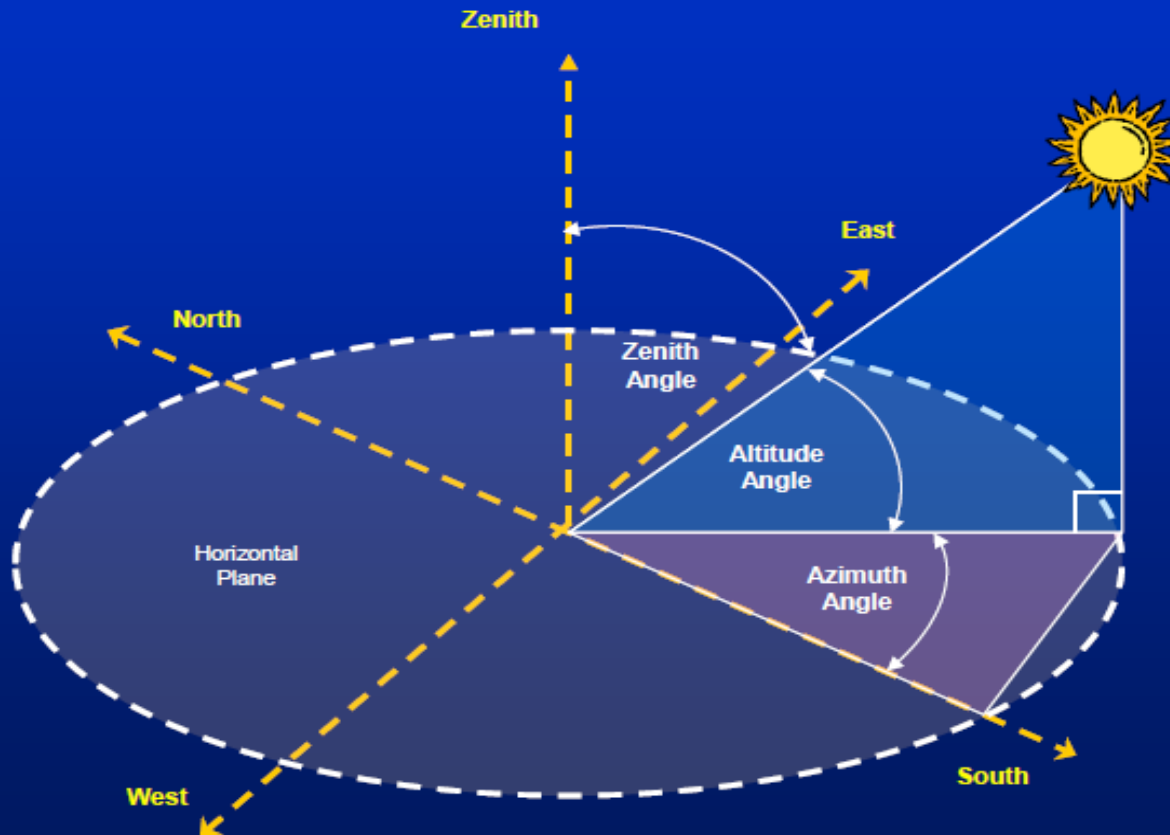
SUMMER SOLSTICE



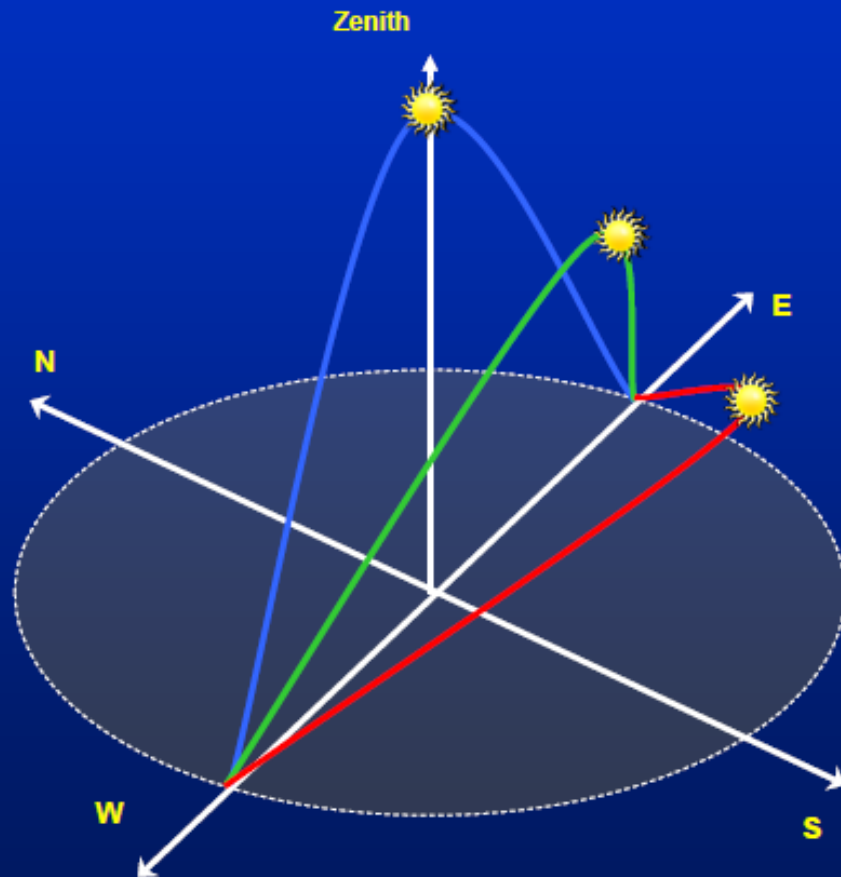
AUTUMNAL EQUINOX



SUN POSITION

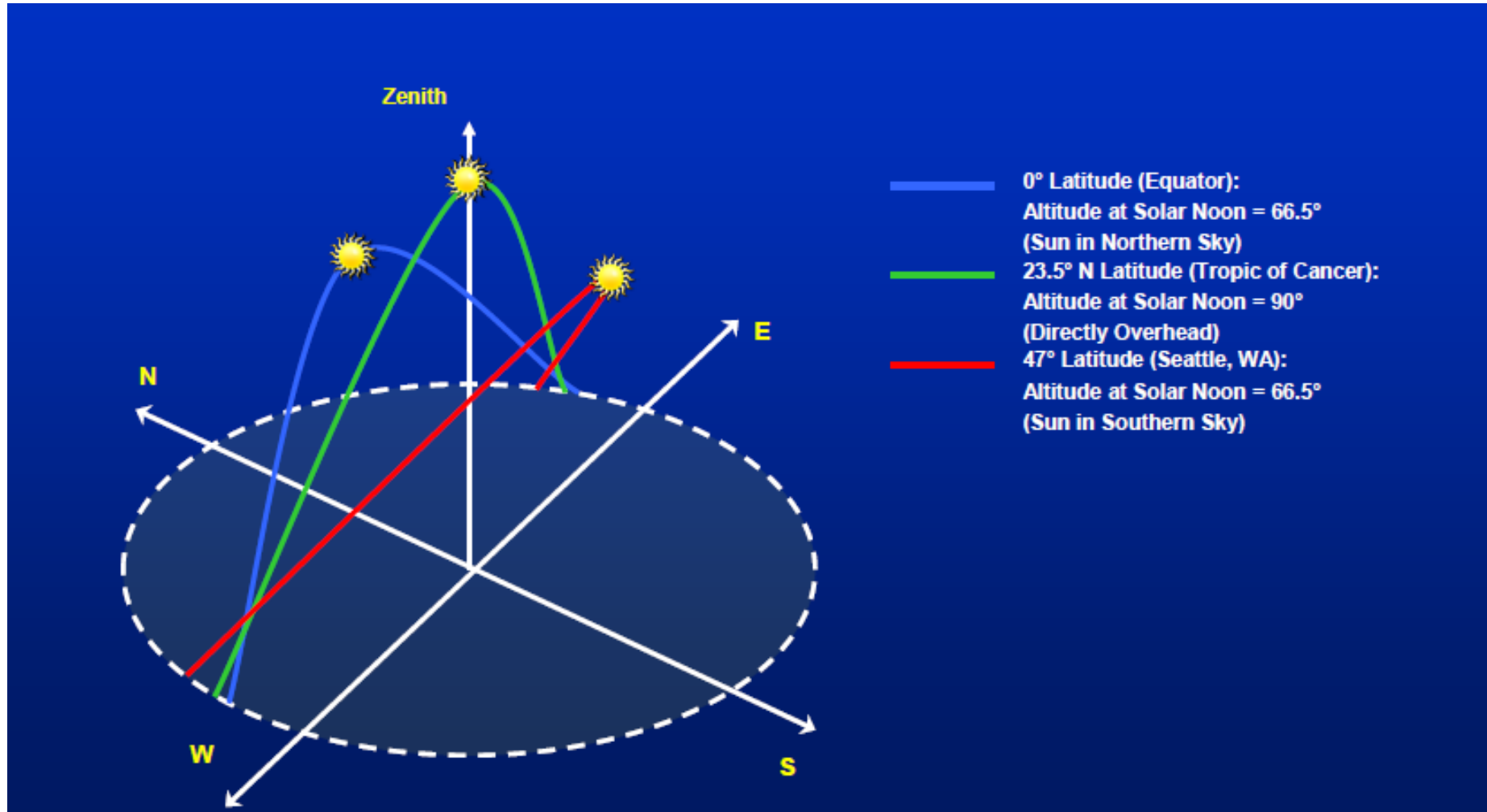


SUN PATH DIAGRAMS AT THE EQUINOXES

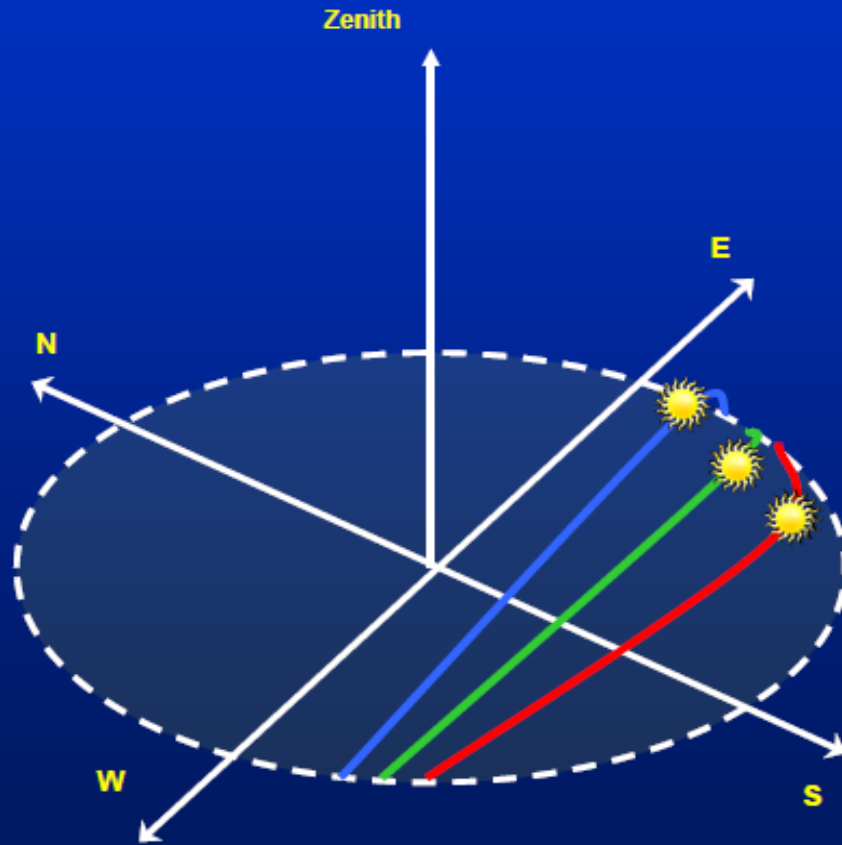


- 0° Latitude (Equator):
Altitude at Solar Noon = 90°
- 23.5° N Latitude (Tropic of Cancer):
Altitude at Solar Noon = 66.5°
- 47° N Latitude (Seattle, WA):
Altitude at Solar Noon = 43°

SUN PATH DIAGRAMS AT THE SUMMER SOLSTICE

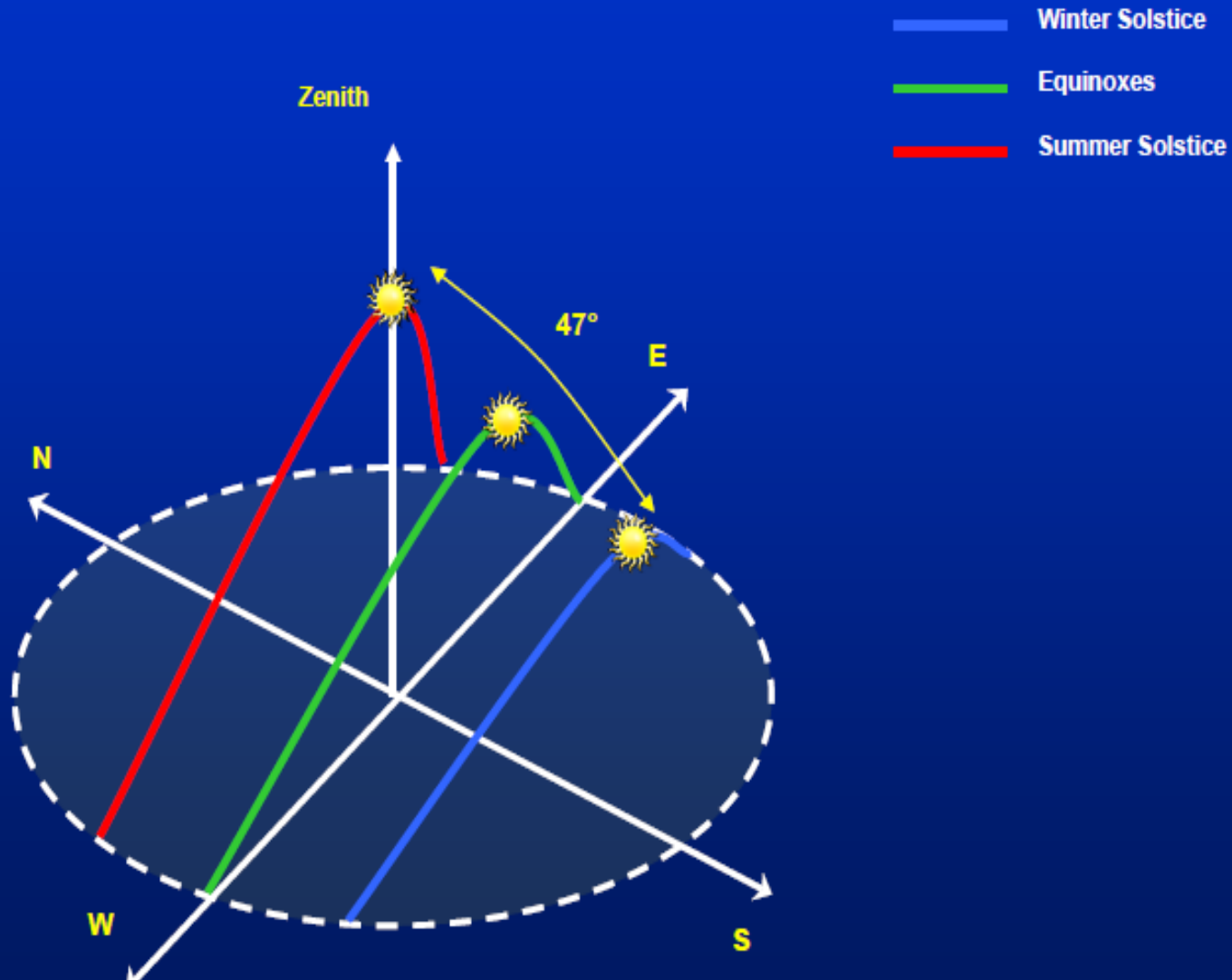


SUN PATH DIAGRAMS AT THE WINTER SOLSTICE

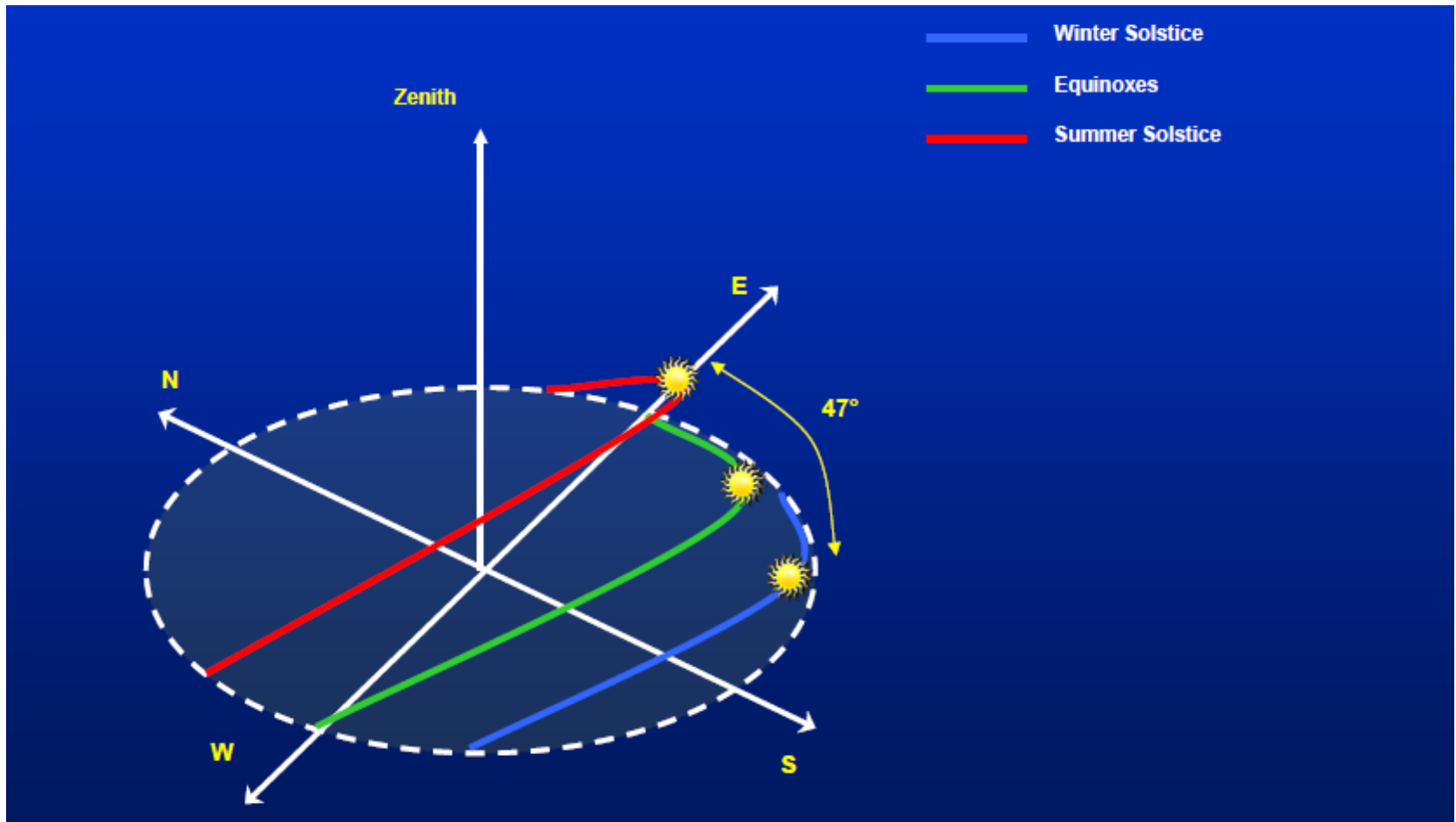


- 0° Latitude (Equator):
Altitude at Solar Noon = 66.5°
- 23.5° N Latitude (Tropic of Cancer):
Altitude at Solar Noon = 43°
- 47° Latitude (Seattle, WA):
Altitude at Solar Noon = 19.5°

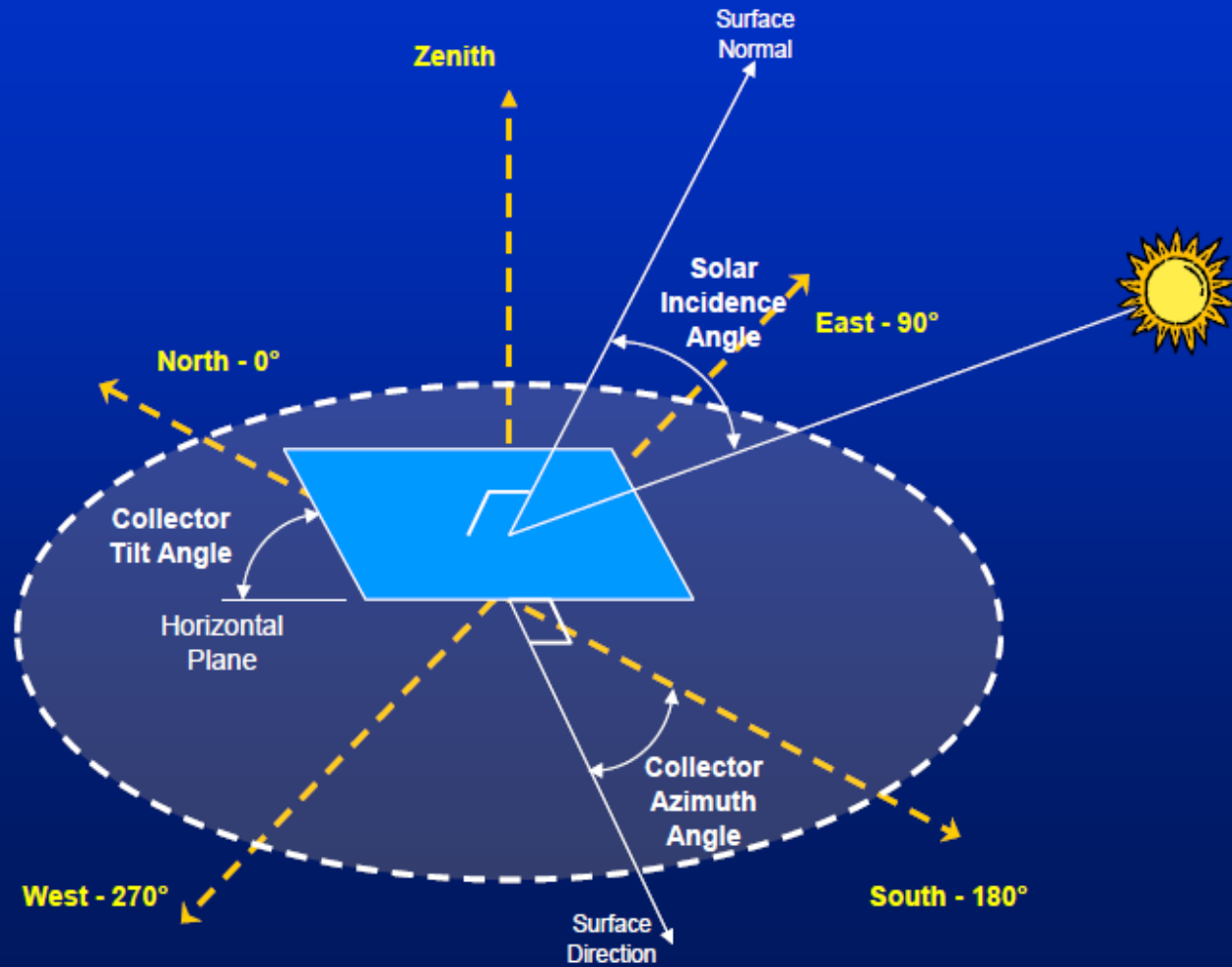
SOLAR WINDOW ON THE TROPIC OF CANCER (23.5°N)



SOLAR WINDOW IN SEATTLE, WA (47°N)



ARRAY ORIENTATION



Duration of Insolation:

- Length of daylight

Factors Affecting Duration

1. Seasons-

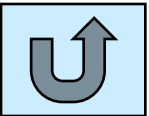
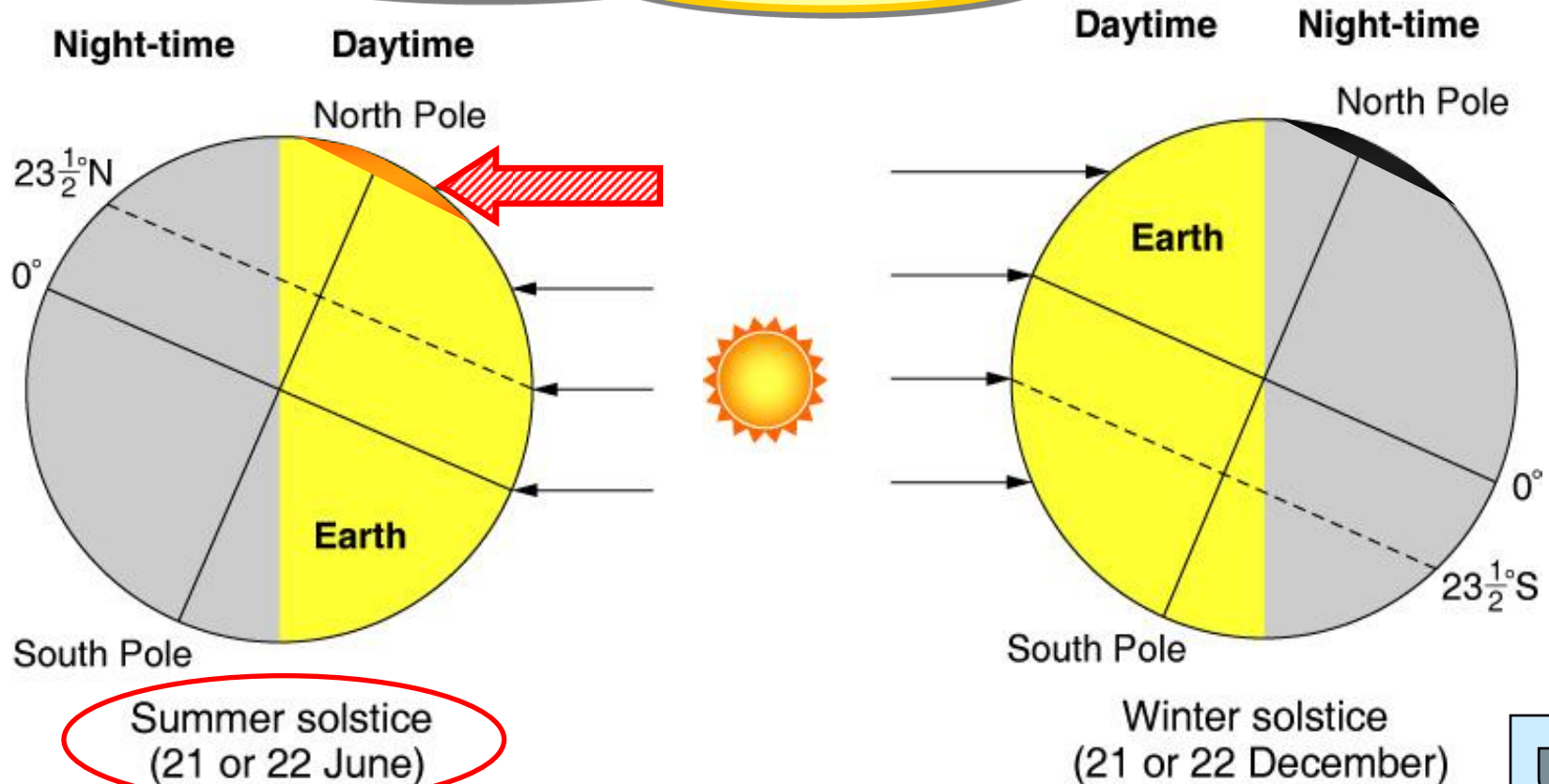
Maximum Duration – June 21 (≈ 15 hrs.)

Minimum Duration – Dec 21 (≈ 9 hrs.)

Equinox – March 21 & Sept 23 (≈ 12 hrs.)

Duration of daylight

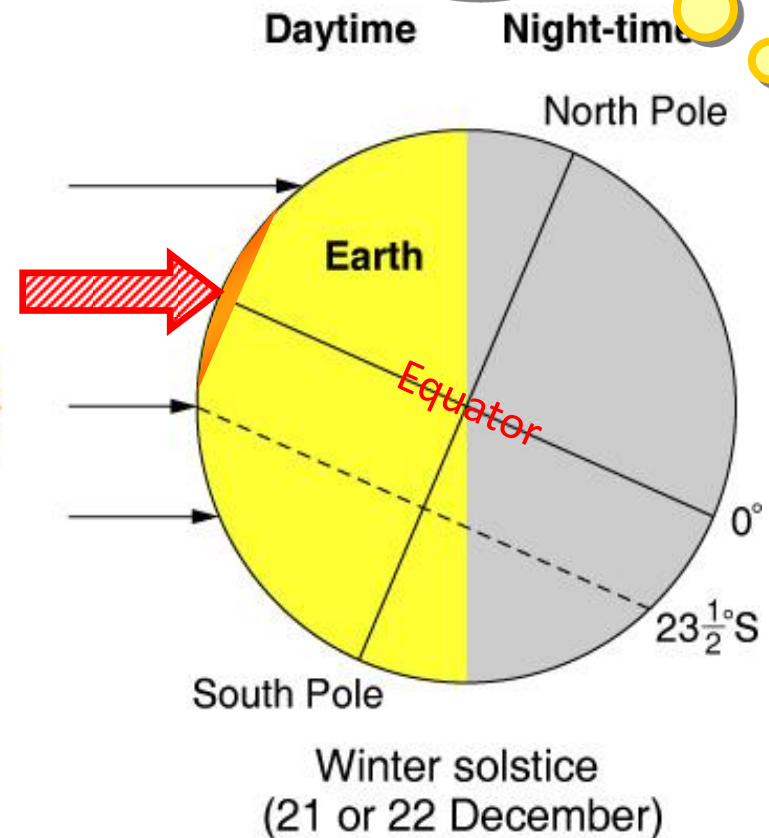
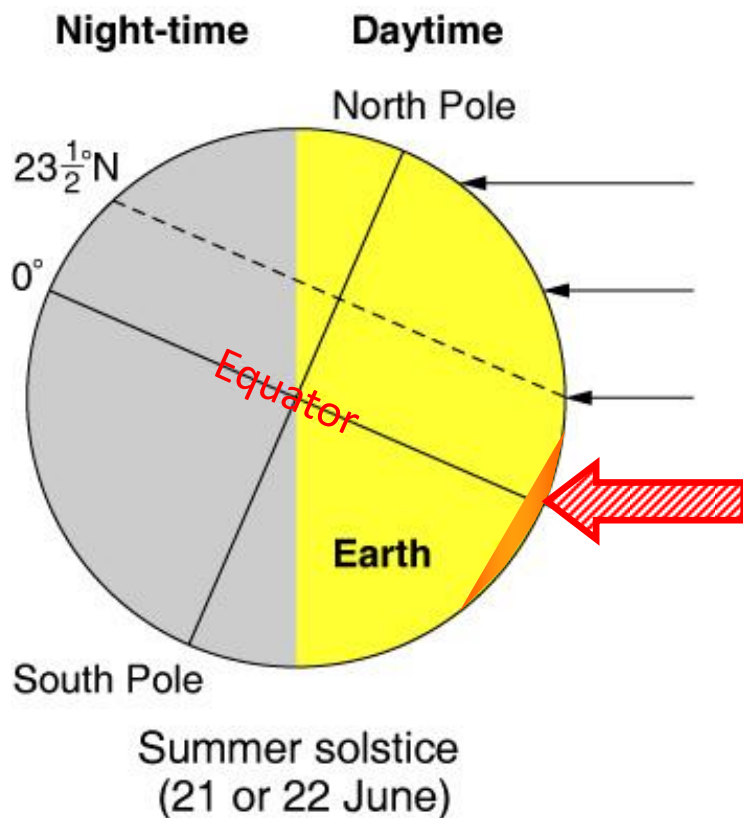
When does the North Pole receive the largest amount of insolation?



Duration of daylight

- The duration of daylight in equatorial regions is al

Is the case in polar areas different?

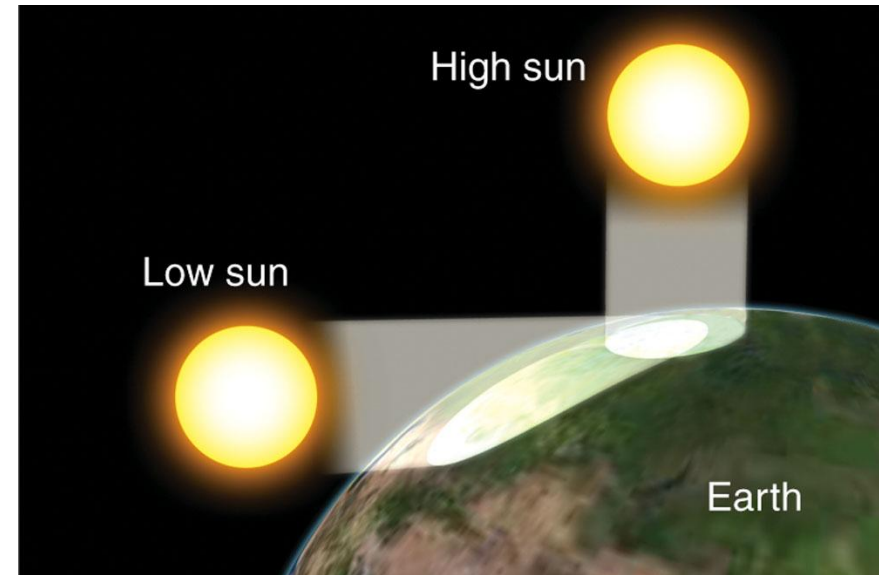
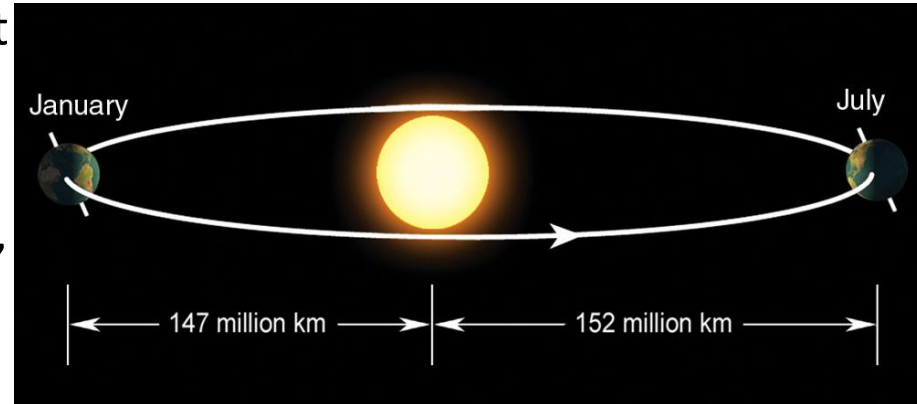


The orbit of the Earth around the Sun

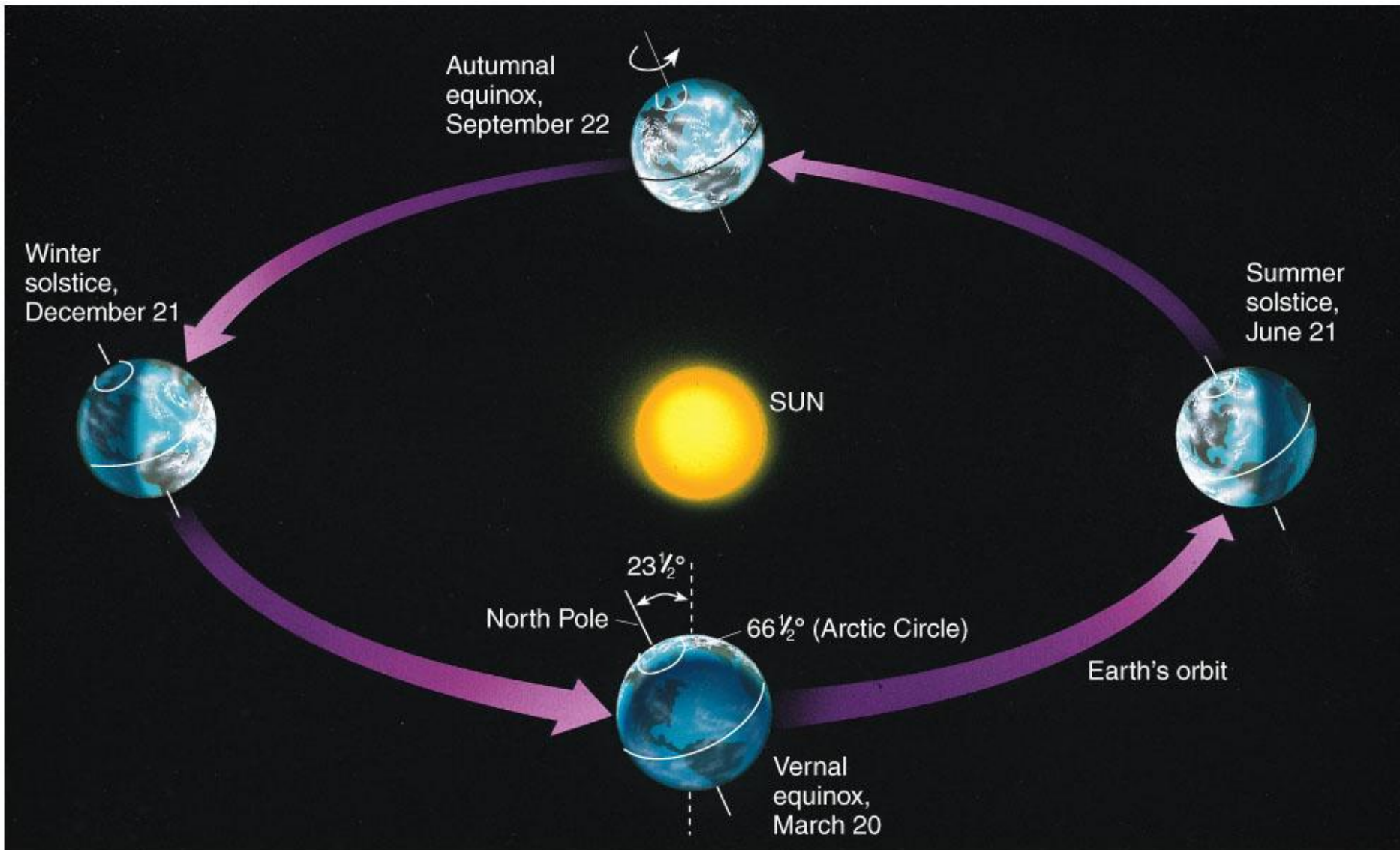


How much solar energy do we get?

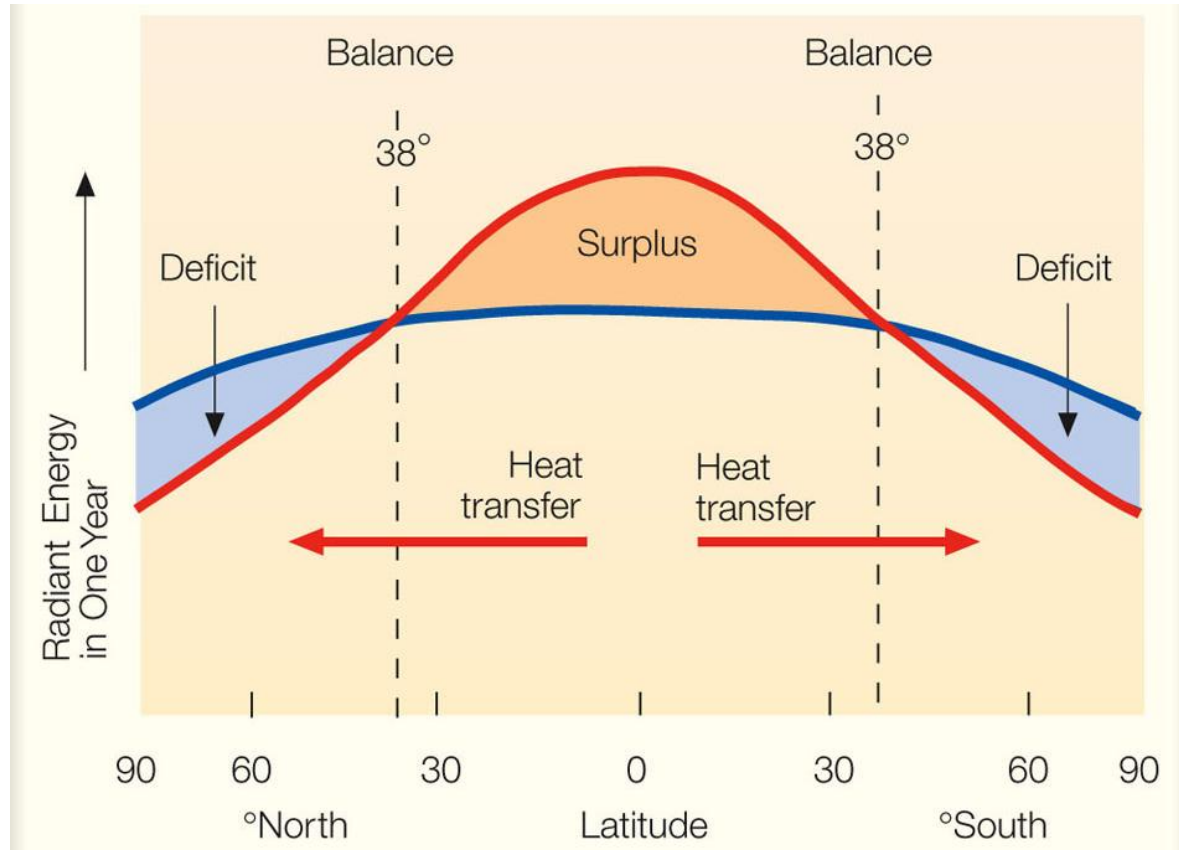
- The amount of solar energy received at the Earth's surface depends on several factors
 - Distance to the sun (not important, varies a few %)
 - How long the sun shines
 - The angle at which the sun rays strike the Earth's surface
- All three factors depend on the season



The Orbit of the Earth



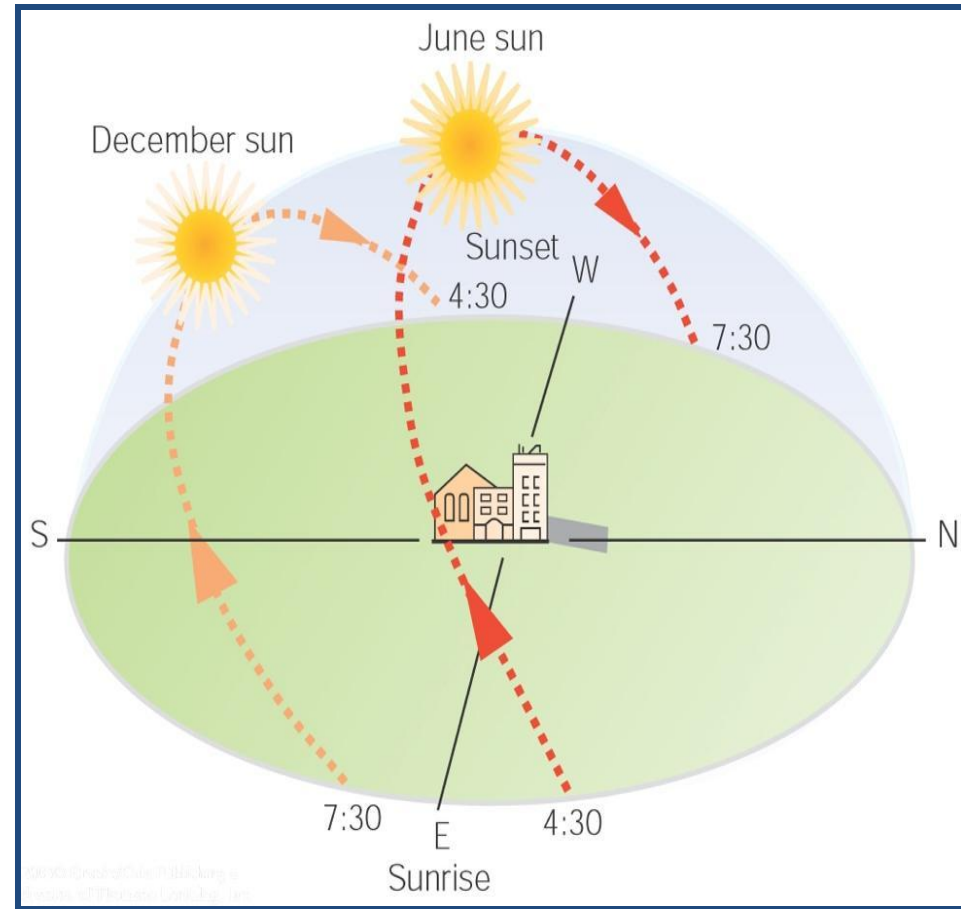
The Energy Balance



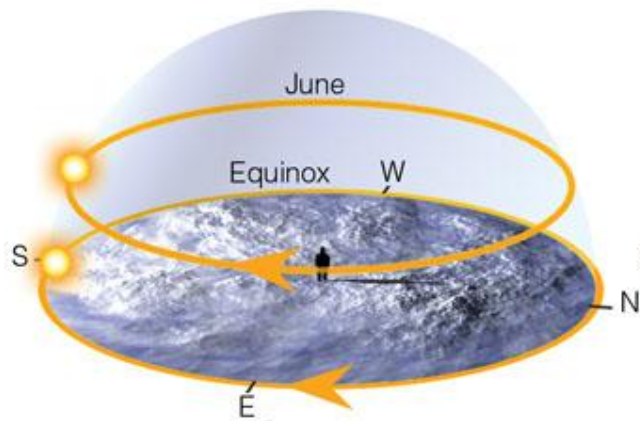
- Blue – IR energy emitted by the Earth
- Red - solar energy received by the Earth
- Low latitudes receive more energy than they emit- warming
- Higher latitudes receive less energy than they emit- cooling
- The energy in the atmosphere is redistributed by heat transfer (convection, conduction, radiation).

The Sun's position in the sky.

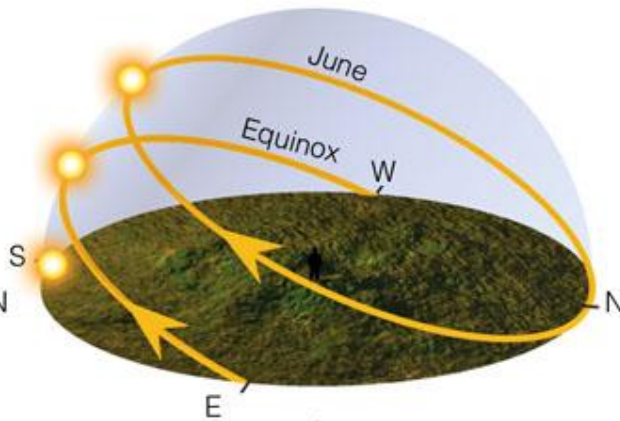
- In the **continental US** the sun is never directly overhead
- In the **winter**
 - the sun is rising **south of east**
 - The noon sun is very **low**
- In the **summer**
 - The sun is rising **north of east**
 - The noon sun is **high**



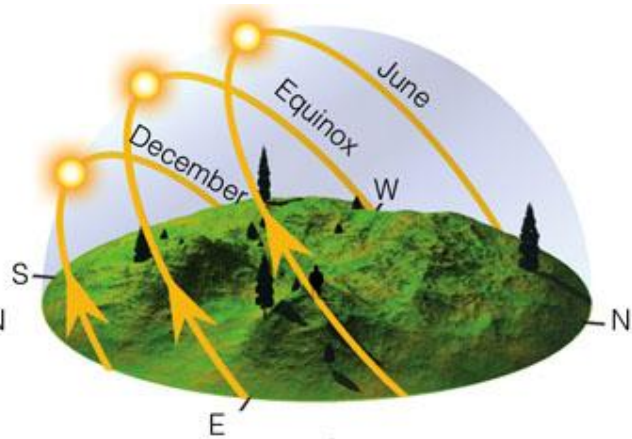
The Sun's position in the sky



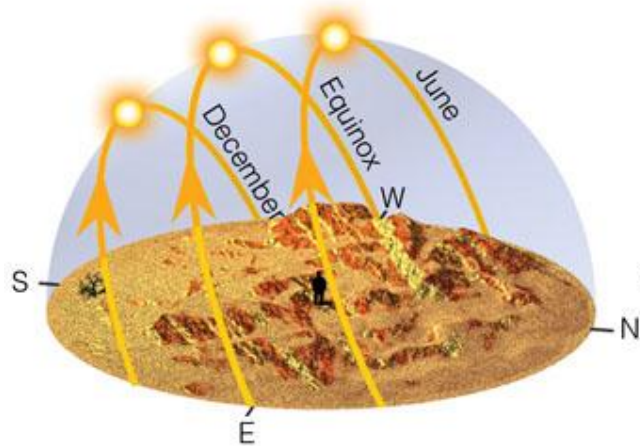
(a) North Pole, 90°N



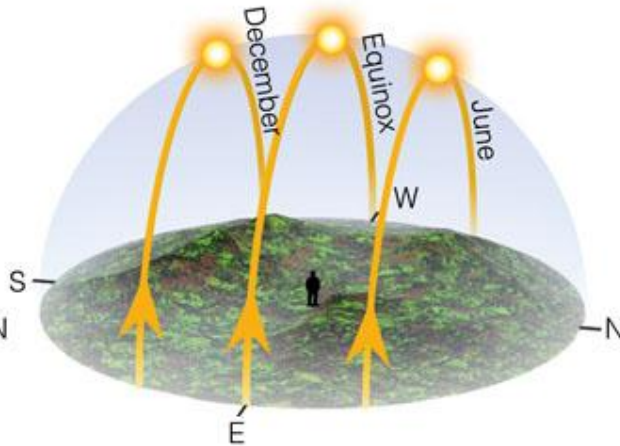
(b) Arctic Circle, $66\frac{1}{2}^\circ\text{N}$



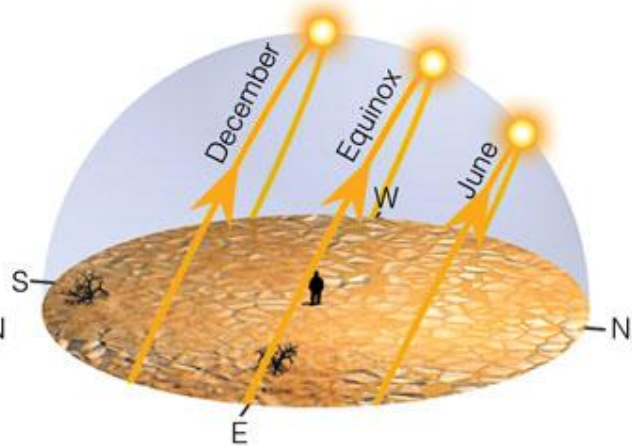
(c) Middle latitudes, 40°N



(d) Tropic of Cancer, $23\frac{1}{2}^\circ\text{N}$



(e) Equator, 0°



(f) Tropic of Capricorn, $23\frac{1}{2}^\circ\text{S}$

REFERENCES

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nitrogen



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