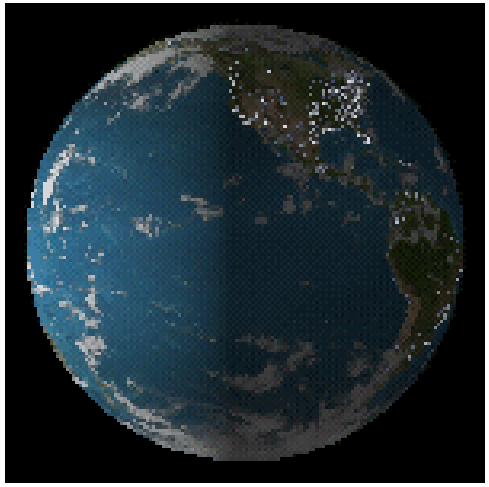
World Climate Patterns

Unit 2

Distinguish between the terms revolution & rotation.

- The earth **rotates (spins)** on its axis which takes **24 hours** and results in **day and night**.
- The earth **revolves (orbits) around** the sun which takes **365 days** and results in **seasons**.

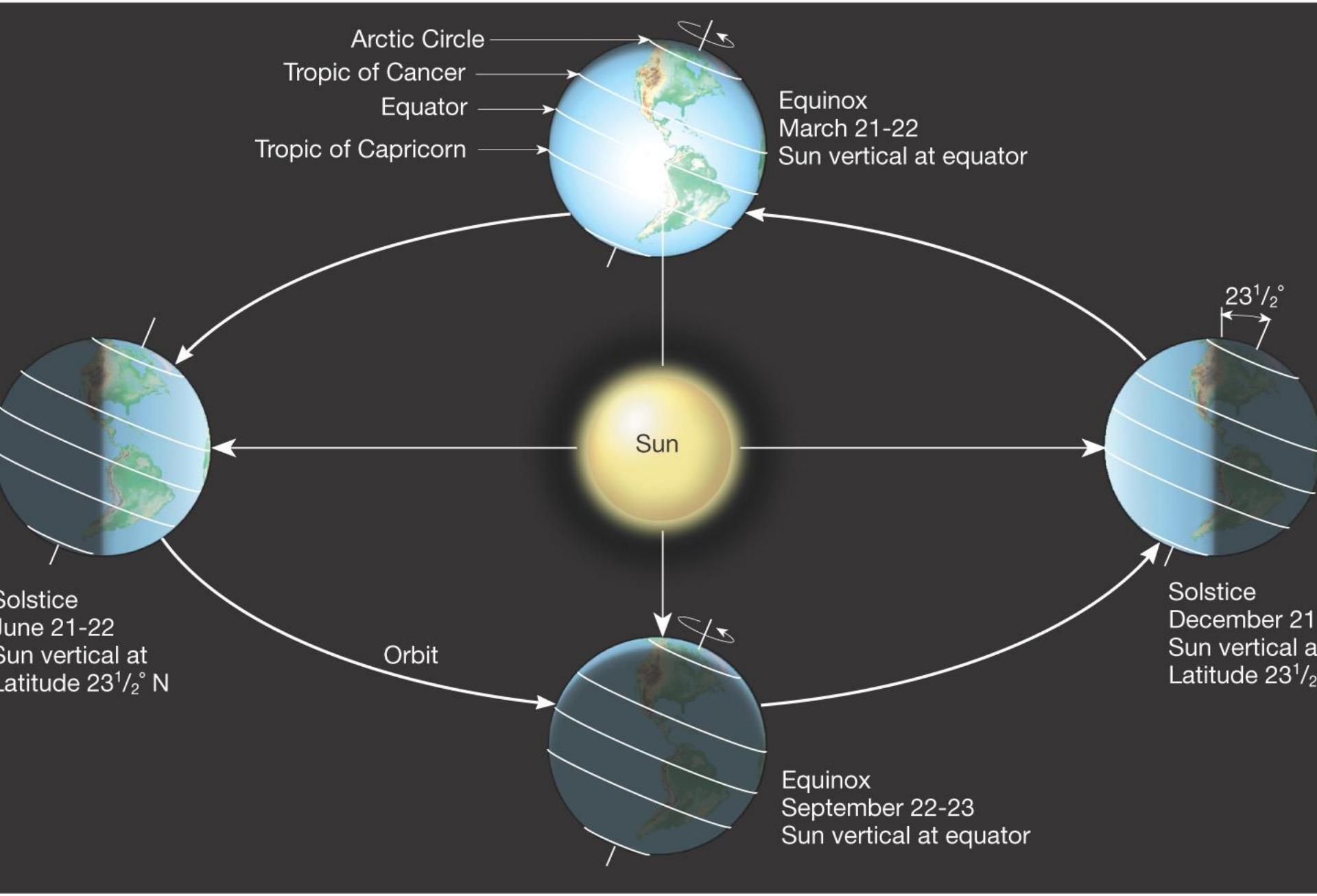
Day – Exposed to the sun



Night – Away from the sun

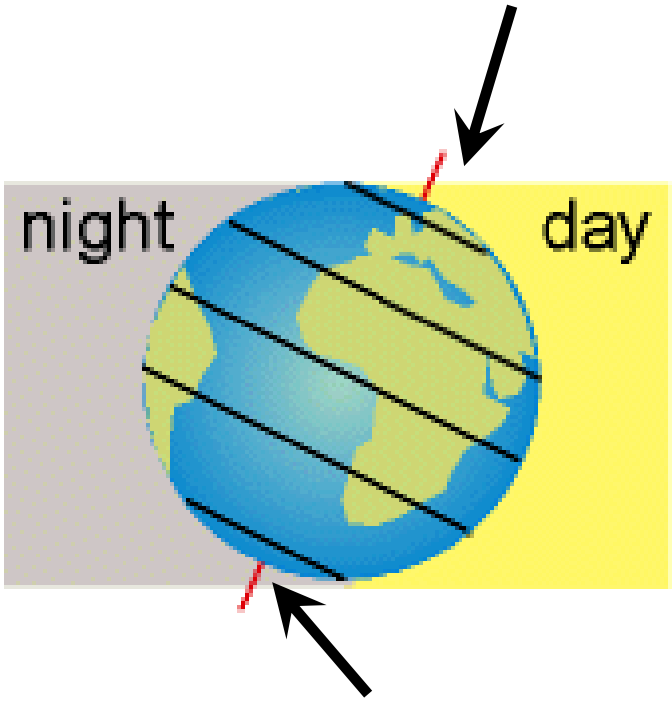
Tilt of the Earth

- The earth is tilted on its axis @ 23.5°
- At different times of the year, the North (or South) is pointed towards the sun, while other times pointed away from the sun.
- Causes days to be longer or shorter.
- Contributes to the seasons as well.

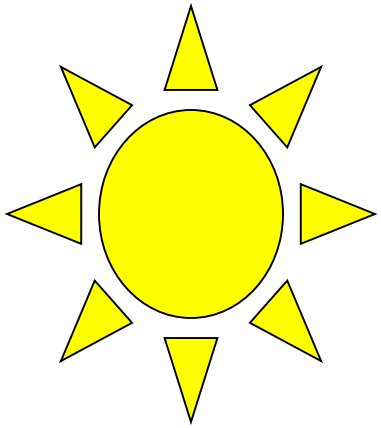

Arctic Circle
Tropic of Cancer
Equator
Tropic of Capricorn
Equinox
March 21-22
Sun vertical at equator
23 1/2°
Sun
Solstice
June 21-22
Sun vertical at
Latitude 23 1/2° N
Orbit
Solstice
December 21
Sun vertical a
Latitude 23 1/2
Equinox
September 22-23
Sun vertical at equator

Tilt of the Earth…
Northern Hemisphere – June

North pole experiences 24 hours of daylight



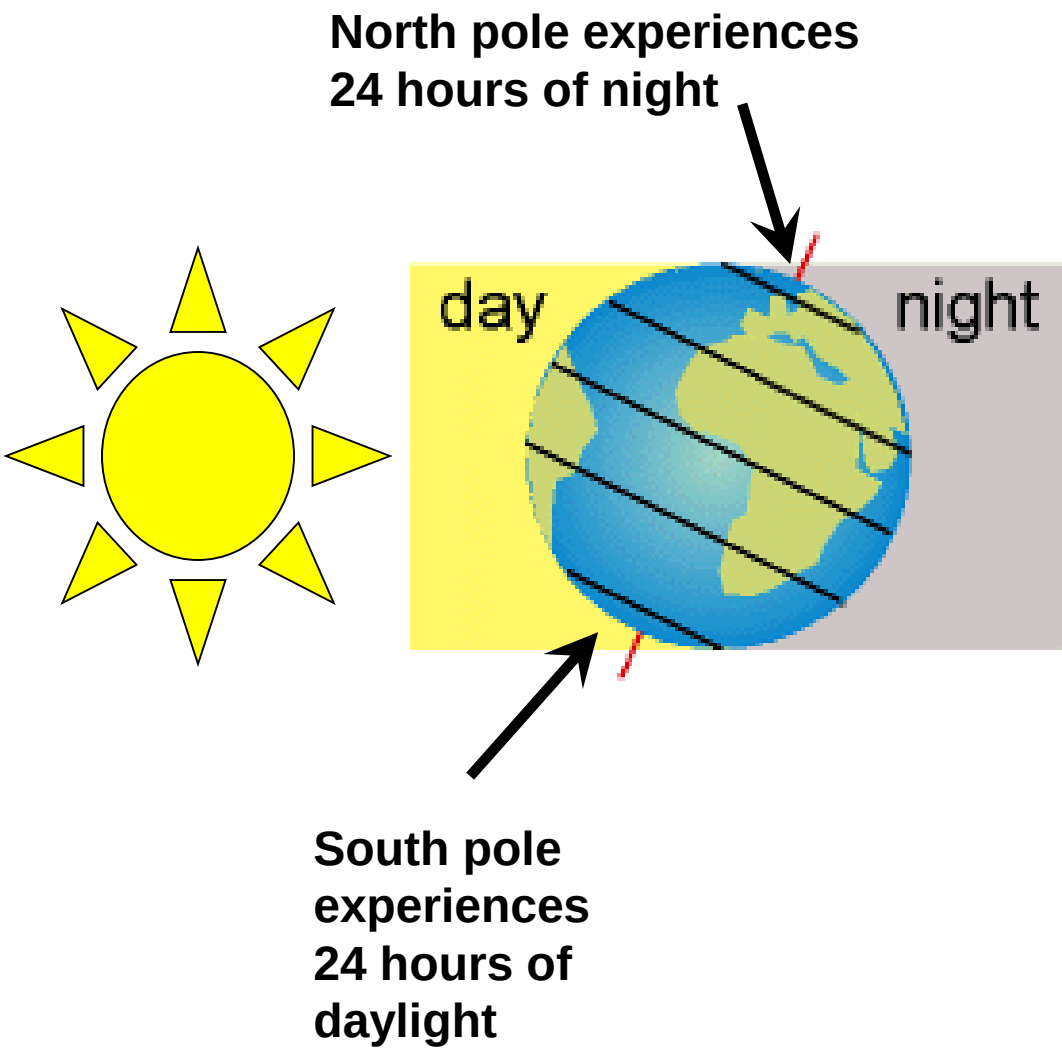
South pole experiences 24 hours of night



- Because of the tilt on the earth's axis, the north pole points towards the sun.
- It now receives more hours of exposure to the sun, hence giving it longer days.
- In NL: Light until 9:30 PM sunrise at 5:30 AM

Tilt of the Earth…
Northern Hemisphere- December

- Because of the tilt on the earth's axis, the north pole points away from the sun.
- It now receives fewer hours of exposure to the sun hence giving it shorter days.
- Here the northern hem. Rotates out of the sun for long periods.
- Dark at 5:30 PM, sunrise at 8:00 AM

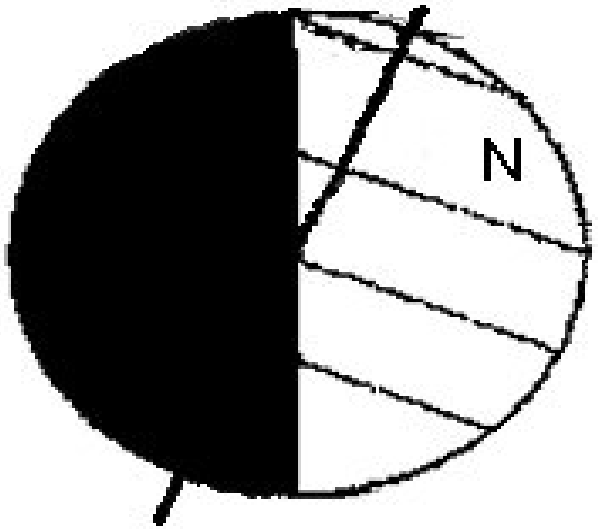


Day vs Night & Length of day

- Rotation on the axis causes day and night
- Tilt on axis causes length of day to be longer or shorter.
- When hemisphere is pointed towards the sun
- More hours of exposure to the sun
- Giving that hemisphere longer days.

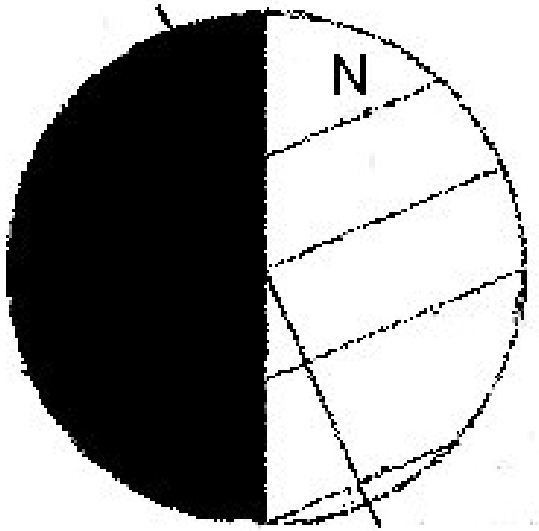
Differences in Day Length

Our Summer



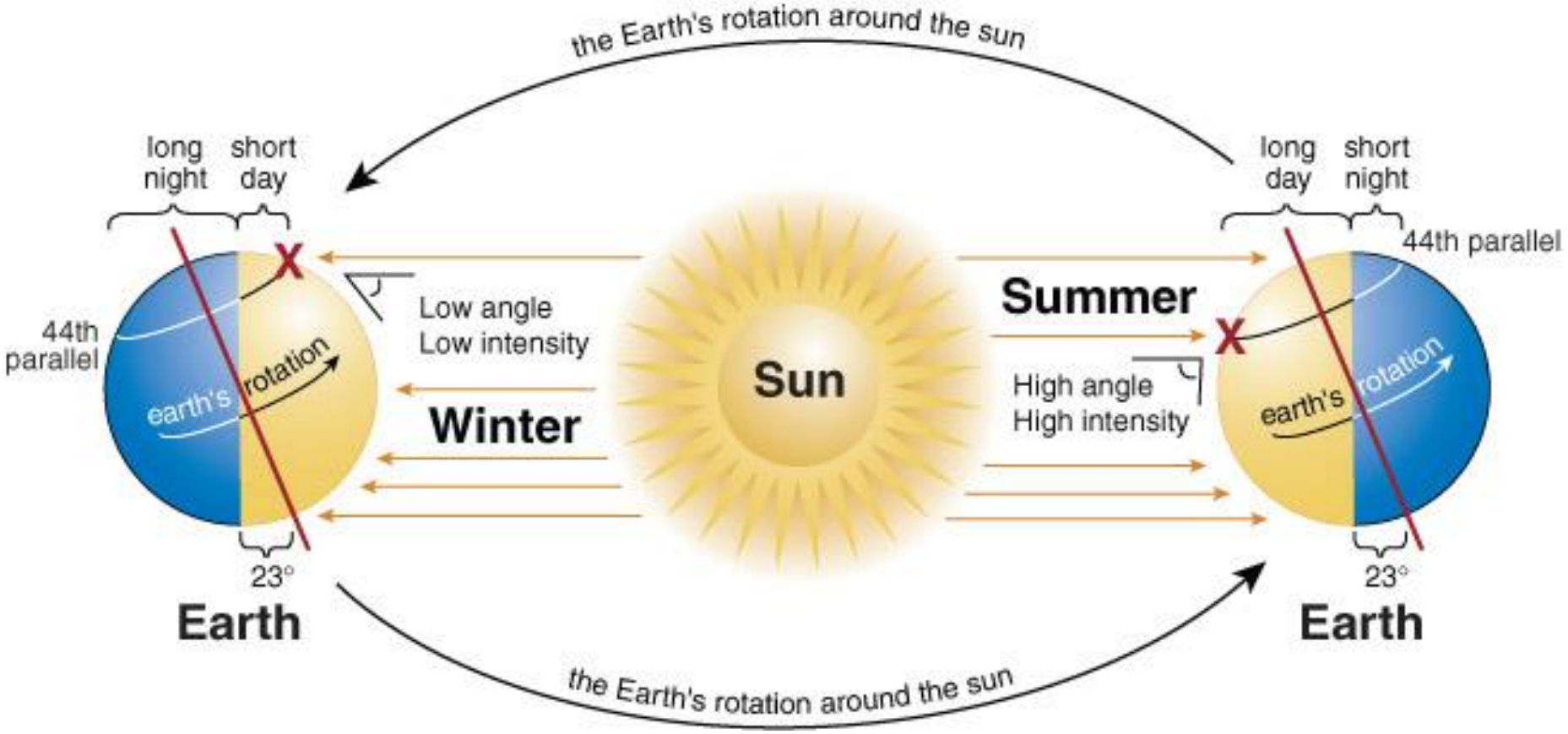
June

Our winter



<-----SUN

December


the Earth's rotation around the sun
long night
short day
44th parallel
Low angle
Low intensity
Winter
Sun
Summer
High angle
High intensity
long day
short night
44th parallel
earth's rotation
23°
Earth
the Earth's rotation around the sun

Explain how cloud cover influences the range of temperature from day to night.

- Nightly cloud cover reduces the range of temperature from day to night.
- Clouds reflect heat waves.
- Heat below clouds is reflected back to earth.
- Without clouds heat escapes giving colder nights
- Clouds act as a “blanket”!!

Does lack of cloud cover contribute to temperature patterns in the desert?

- Lack of cloud cover in the day results in high daily temperatures.
- There are no clouds to deflect or block heat from reaching the surface or area.
- However in the night the lack of cloud cover allows the heat to escape resulting in cold nightly temperatures.

How does cloud coverage aid in creating hot muggy summer nights?

- No clouds during the day, causing temperatures to be higher.
- As day gets late, clouds roll in and cover (blanket) the area.
- Heat gets trapped in, plus humidity from clouds causing hot muggy nights!!.

2.1- Seasons

- In this lesson you will learn to…
  - 2.1.3 Define the terms equinox and solstice. (k)
  - 2.1.4 Explain how changes in the seasons, in the northern hemisphere and southern hemisphere, relate to the earth's revolution around the sun. (k)
  - 2.1.6 Describe the factors that account for differences in temperature as seasons change. (k)

What is the speed of the Earth's rotation?

- At the equator, the circumference of the Earth is 40,070 kilometers, and the day is 24 hours long so the speed is 1670 kilometers/hour (1070 miles/hr).
- This decreases by the cosine of your latitude so that at a latitude of 45 degrees, cos(45) = .707 and the speed is .707 x 1670 = 1180 kilometers/hr.
- You can use this formula to find the speed of rotation at any latitude.

Orbits

- The Earth travels at an orbital speed of 108,000 km (67,000 miles) an hour around the Sun.
- The Earth has only one satellite, the Moon. The Moon is the second brightest object in the sky.
- The Moon orbits around the Earth at about 1 km/s or about 3700 km/h. The Moon takes about 27.3 days to orbit the Earth.

Explaining Why Seasons Occur

- Two characteristics of the earth-sun relationship result in the seasons occurring outside the **tropics** (the latitudes between 23.5˚ North and South):

  1. the tilt on the earth's axis

  2. the revolution of the earth around the sun

Explaining Why Seasons Occur

- **These two features of the earth-sun relationship mean that different latitudes on earth receive different directness of light at different times.**

- ***When the sun hits more directly the latitude gets hotter temperatures and what they call summer.***

Video resource…

- Equinox and Solstice Explained

Season changes

- **Seasonal changes are all driven by one underlying factor: *changes in available sunlight*.**
- **This includes:**
  - **the amount of available sunlight (called *day length or photoperiod*)**
  - **the sun's intensity (related to the angle at which it strikes the Earth).**
  - **NOTE: These will be ultimately be determined by:**

(i) The tilt and rotation of the earth on its axis AND

(ii) The position of the earth in its revolution around the sun

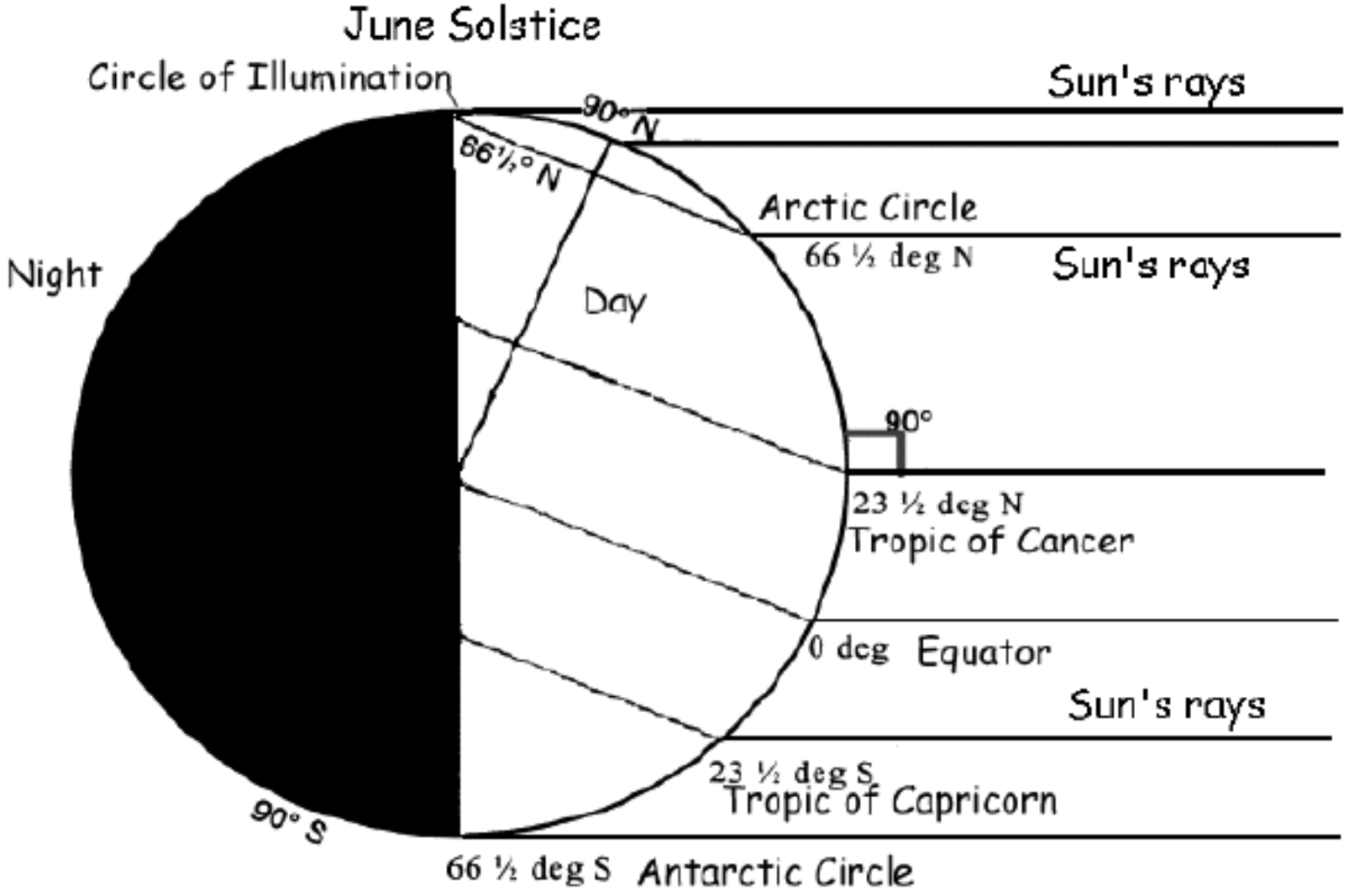
Define the terms equinox & solstice

SOLSTICE

1. From Latin for sun stand still
2. Sun is directly over head @ *12 noon on 23.5° North or South*.
3. Occurs Dec 21 (Winter) which is the shortest day of the year and..
4. June 21 (Summer) which is the longest day of the year.

EQUINOX

1. From Latin for equal day & night.
2. Sun is directly over head @ *12 noon on the equator*.
3. Occurs Sept. 21 (Autumnal/Fall) & March 21(Vernal/Spring)
4. Equal length of night & day everywhere on earth


June Solstice
Circle of Illumination
Sun's rays
90° N
66½° N
Arctic Circle
66 ½ deg N
Sun's rays
Night
Day
90°
23 ½ deg N
Tropic of Cancer
0 deg Equator
Sun's rays
23 ½ deg S
Tropic of Capricorn
90° S
66 ½ deg S Antarctic Circle

Define the terms equinox & solstice…cont'd

SOLSTICE

- The northern hemisphere pointed TOWARDS the sun in Summer
- The northern hemisphere pointed AWAY from the sun in Winter

EQUINOX

- Neither the northern hemisphere nor the southern hemisphere are pointed towards the sun

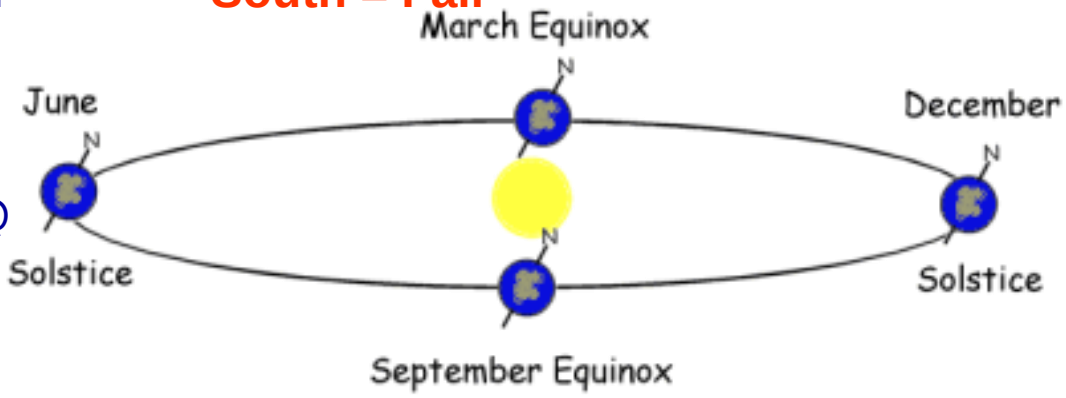
Reversal of Seasons by Hemisphere

- The Northern Hemisphere and the southern hemisphere have opposite seasons. This is due to the tilt on the earth's axis and its revolution around the sun.
- Canada's winter = Australia's Summer
- Canada's summer = Australia's Winter
- Canada's Fall = Australia's Spring
- Canada's Spring = Australia's Fall

Seasons Summary

- June 21st
- North = Summer
- More sun hours
- More direct sun
- Noon Sun 90^0 @ Tropic of Cancer
- South = Winter
- Less sun hours
- Less direct sun

- North = Spring
- 12 hrs day & 12 hrs night
- Noon Sun 90^0 @ Equator
- South = Fall



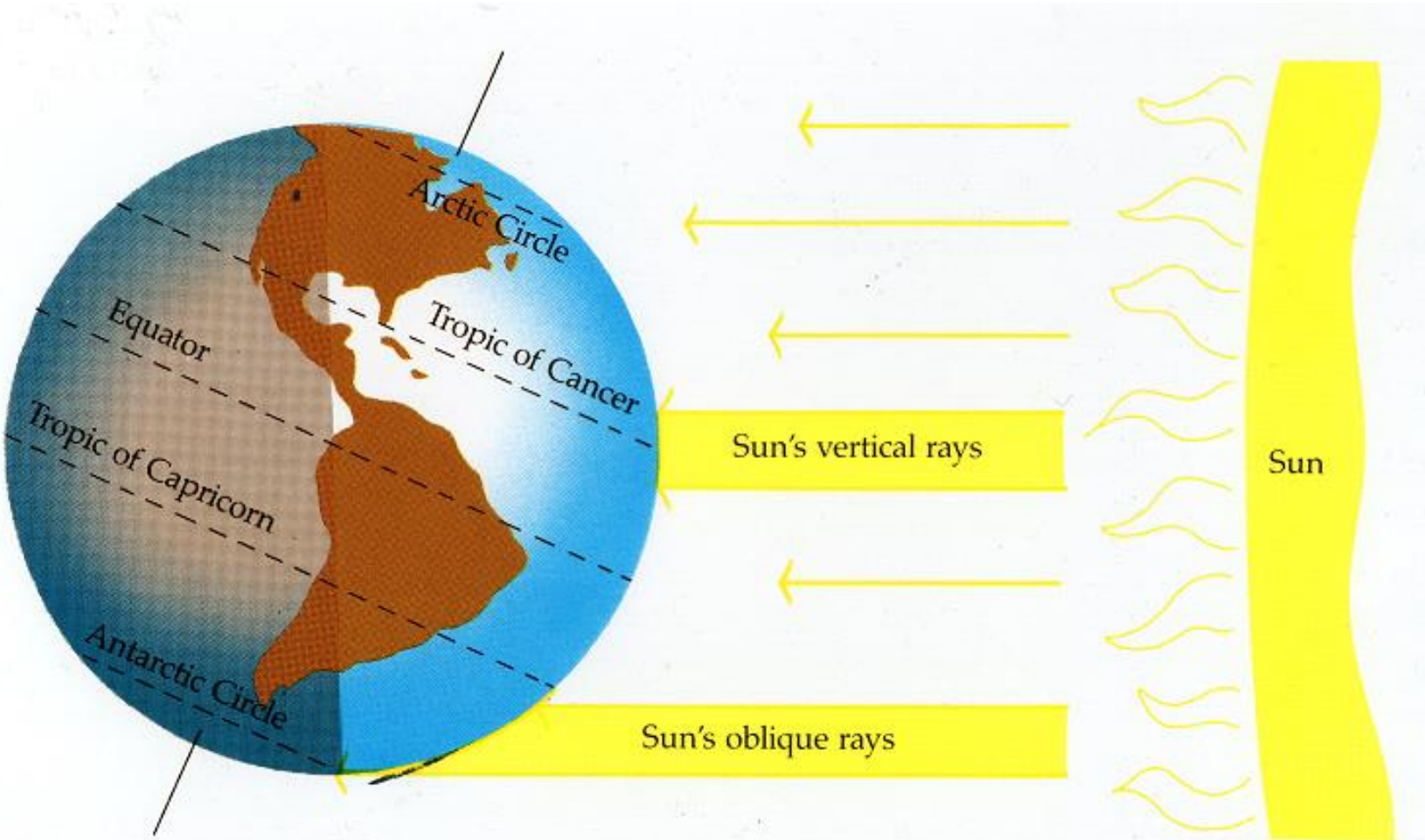
- September 21st
- North = Fall
- 12 hrs day & 12 hrs night
- Noon Sun 90^0 @ Equator
- South = Spring

- Dec 21st
- North = Winter
- Less sun hours
- Less direct sun
- South = Summer
- More sun hours
- More direct sun
- Noon Sun 90^0 @ Tropic of Capricorn

Tropics and Poles- Heat Intensity

- The **tropics** are located between 23.5˚north and 23.5 ˚south.
- In everyday language it refers to warm equatorial climates.
- The further you move outside the tropics the more severe the seasons.
- The **length of day varies** more the further you move from the equator.
- When light hits the earth towards the poles it is on a severe angle which **decreases the intensity of heat**.
- The same light/heat energy is spread over a greater area.

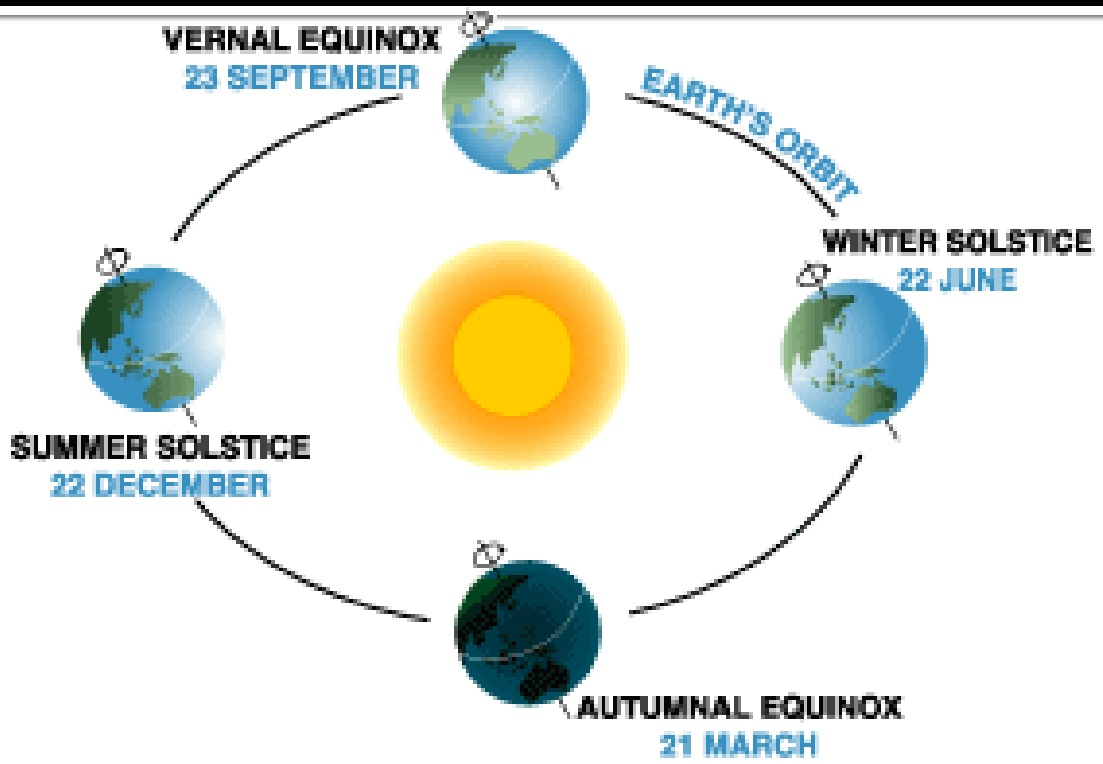
Intensity and Duration!!



Differences in Temperature

- There are two reasons for the differences in temperature **by season**:
  - More direct sunlight gives greater intensity of heat.
  - Longer summer daylight hours means there are more heating hours and fewer cooling hours. The opposite is true in the winter.

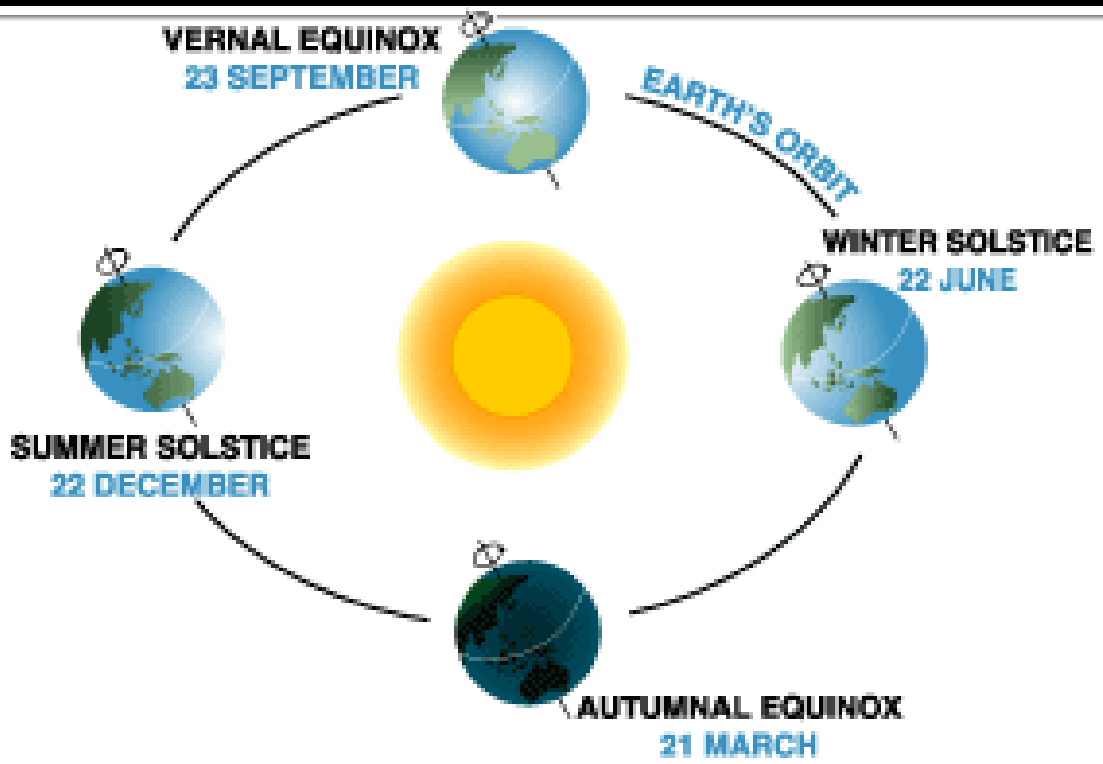
Where are these seasons experienced?



Northern Hemisphere or Southern Hemisphere?

How do you know?

Where are these seasons experienced?



Southern

Northern Hemisphere or Southern Hemisphere?

How do you know?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Temperature Patterns on Earth

- In this lesson you will learn to…
  - 2.2.1 Explain how the greenhouse effect moderates climate. (k)
  - 2.2.2 Generalize that temperatures tend to decrease from low to high latitudes. (a)
  - 2.2.3 Explain how the earth's shape causes temperatures to decrease from low to high latitudes. (k)
  - 2.2.4 Given selected data, assess the accuracy of temperature descriptions. (i)

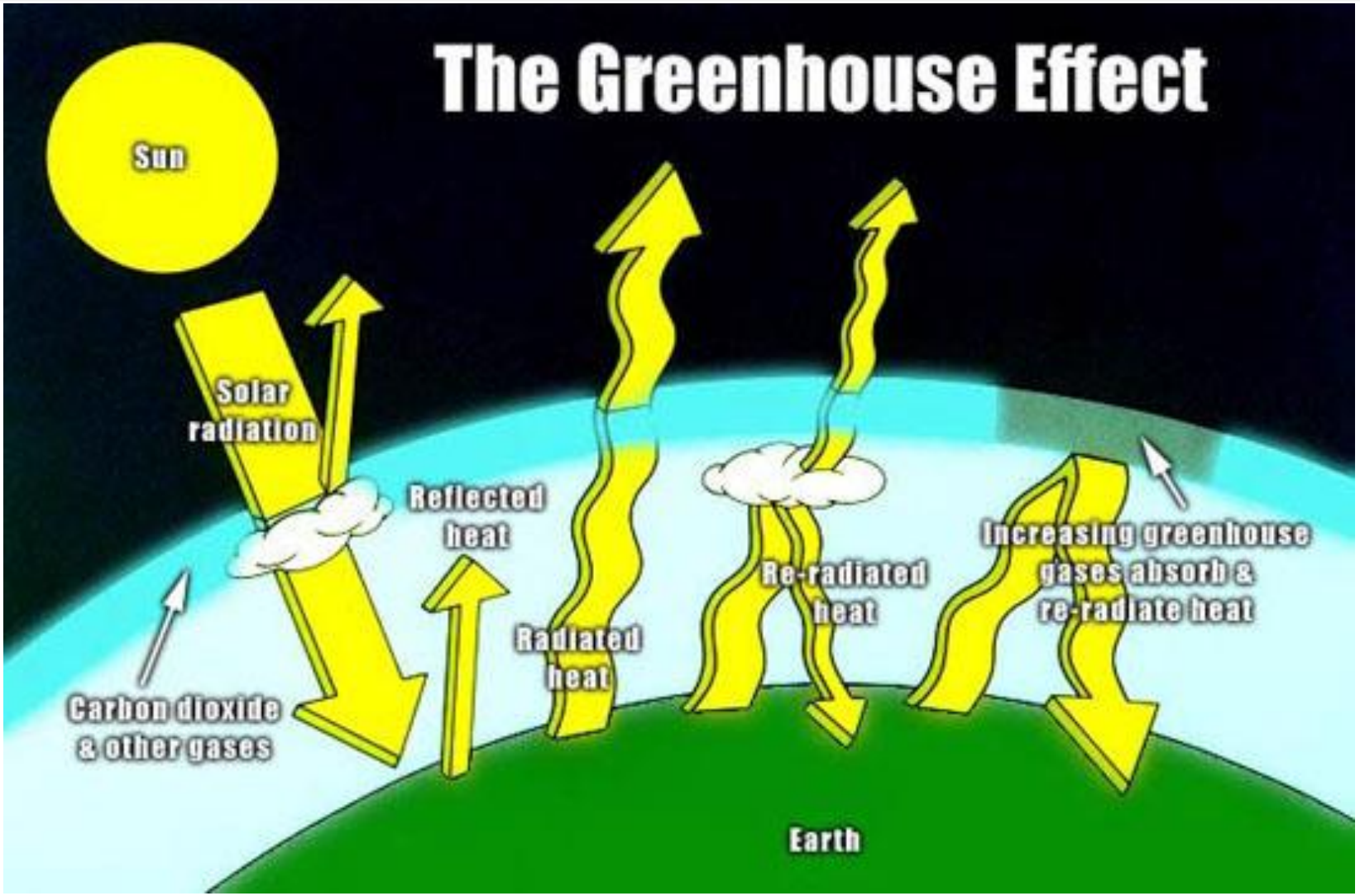
Explaining Temperature Patterns

- The **greenhouse effect** is a good thing. It moderates our temperature. (It is not "Global Warming".)
- Planets without atmospheres have an extreme variation in temperature between day and night.
- While facing the sun, those planets without an atmosphere get the full intensity of the sun making it very hot.
- It gets very cold in the night due the absence of radiant sun light. Without an atmosphere these planets have nothing to hold heat in.

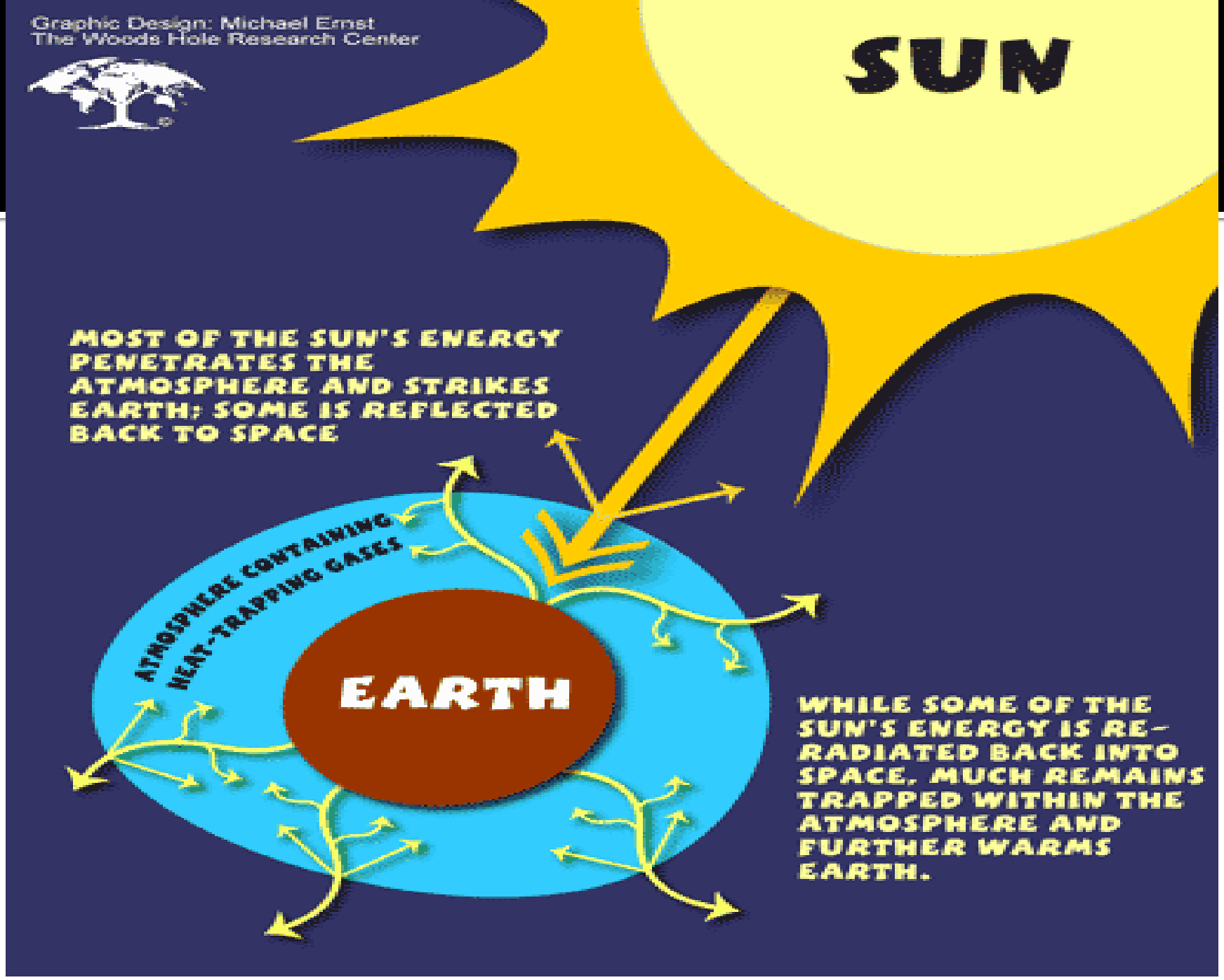
Greenhouse Effect

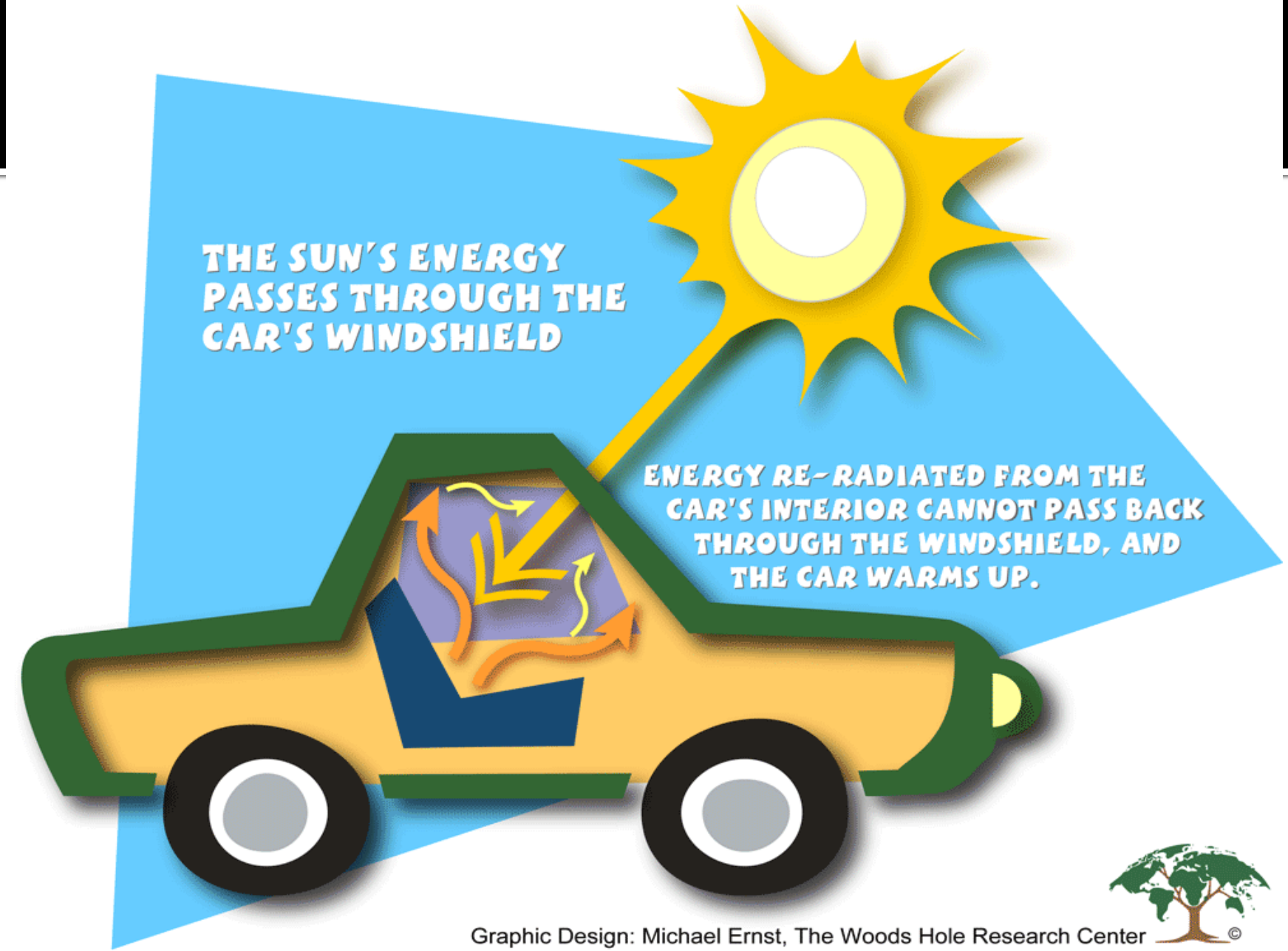
- Here on earth the atmosphere reflects and absorbs almost 50% of radiant energy.

- Here on earth the atmosphere acts like the glass on a greenhouse keeping in much of the heat. Consequently here on earth the nights are not as cold.
  - *Interactive Climate Map*


The Greenhouse Effect
Sun
Solar radiation
Reflected heat
Radiated heat
Re-radiated heat
Increasing greenhouse gases absorb & re-radiate heat
Carbon dioxide & other gases
Earth

- Earth has an average surface temperature of **13 degrees C** (55.4 degrees F).
- The planet would be much colder without greenhouse gasses, such as carbon dioxide and water vapor, to trap outgoing thermal radiation.
- The greenhouse effect raises the planet's temperature 35 degrees C (95 degrees F).


Graphic Design: Michael Ernst
The Woods Hole Research Center
SUN
MOST OF THE SUN'S ENERGY PENETRATES THE ATMOSPHERE AND STRIKES EARTH; SOME IS REFLECTED BACK TO SPACE
ATMOSPHERE CONTAINING HEAT-TRAPPING GASES
EARTH
WHILE SOME OF THE SUN'S ENERGY IS RE-RADIATED BACK INTO SPACE, MUCH REMAINS TRAPPED WITHIN THE ATMOSPHERE AND FURTHER WARMS EARTH.


THE SUN'S ENERGY PASSES THROUGH THE CAR'S WINDSHIELD
ENERGY RE-RADIATED FROM THE CAR'S INTERIOR CANNOT PASS BACK THROUGH THE WINDSHIELD, AND THE CAR WARMS UP.
Graphic Design: Michael Ernst, The Woods Hole Research Center ©

Altitude/Latitude & Temperature are Inversely Proportional

- Living in the North we realize that the closer we get to the equator the warmer it gets.
- As **latitude** increases, temperature decreases.
- Increased latitude exhibits decreased temperature.
- As **altitude** increases, temperature decreases.
- Increased altitude exhibits decreased temperature.

- See Figure 4.7 on page 60
  - NPR: Climate Connections Interactive Map

Sample Public Exam Question

17. Which is true?

- (A)Temperature decreases as longitude decreases.
- (B) Temperature decreases as longitude increases.
- (C) Temperature increases as latitude decreases.
- (D) Temperature increases as latitude increases.