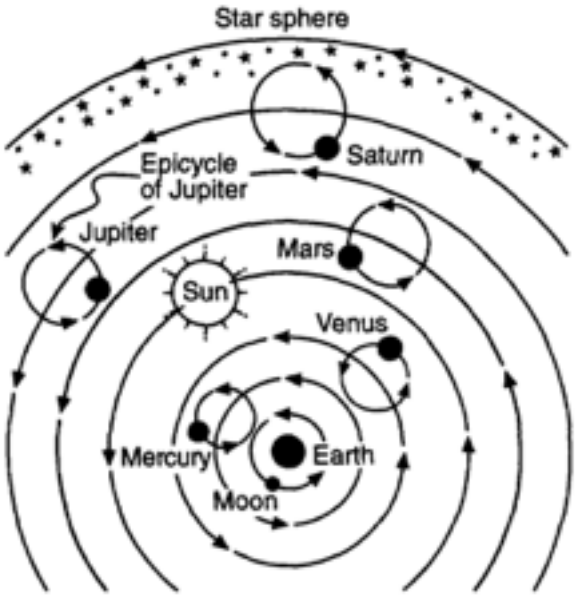
Guided Notes
Earth-Moon-Sun System

Earth in Space
Geocentric Model
Heliocentric Model
Earth's Rotation
Coriolis Effect
Foucault Pendulum
Earth's Revolution
Intensity of Insolation
Duration of Insolation
Seasonal Changes

1. How has human belief in Earth's motions changed over time?

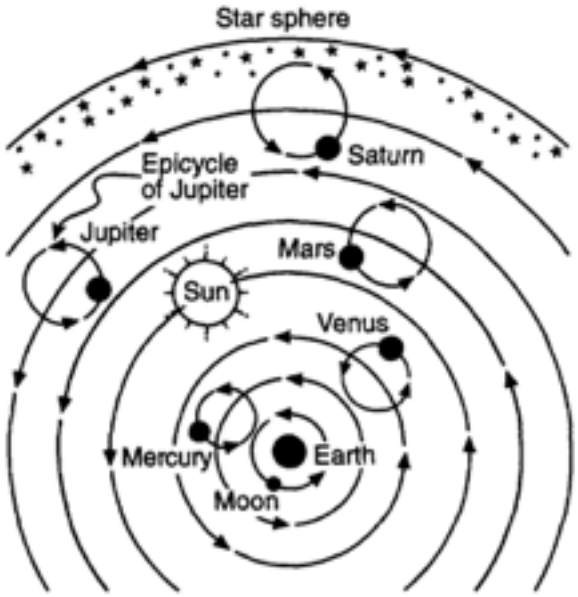
- **The geocentric model was used by Aristotle (350 BC) & Ptolemy (15 AD) and throughout most of human history.**



  - **<u>Geocentric Model</u>: Earth is a stationary object in the center of the universe & everything revolves around it**

1. How has human belief in Earth's motions changed over time?

- **Why?** To an observer, it looks like objects in the sky are moving around us in the sky. The Earth does not feel like it is moving.
- **Problem:** Some of the planetary motions were very complex and hard to explain.

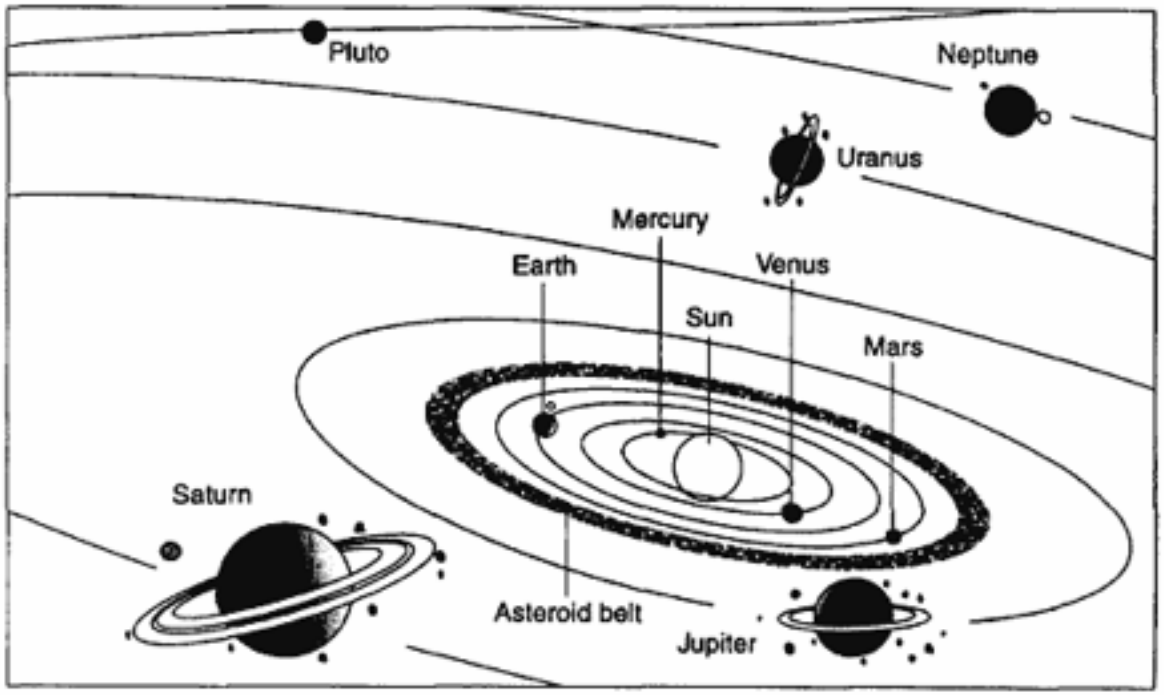


1. How has human belief in Earth's motions changed over time?

- **In the late 1500's and early 1600's, Copernicus, Galileo, and Kepler provided evidence of the heliocentric model using the new invention, the telescope.**

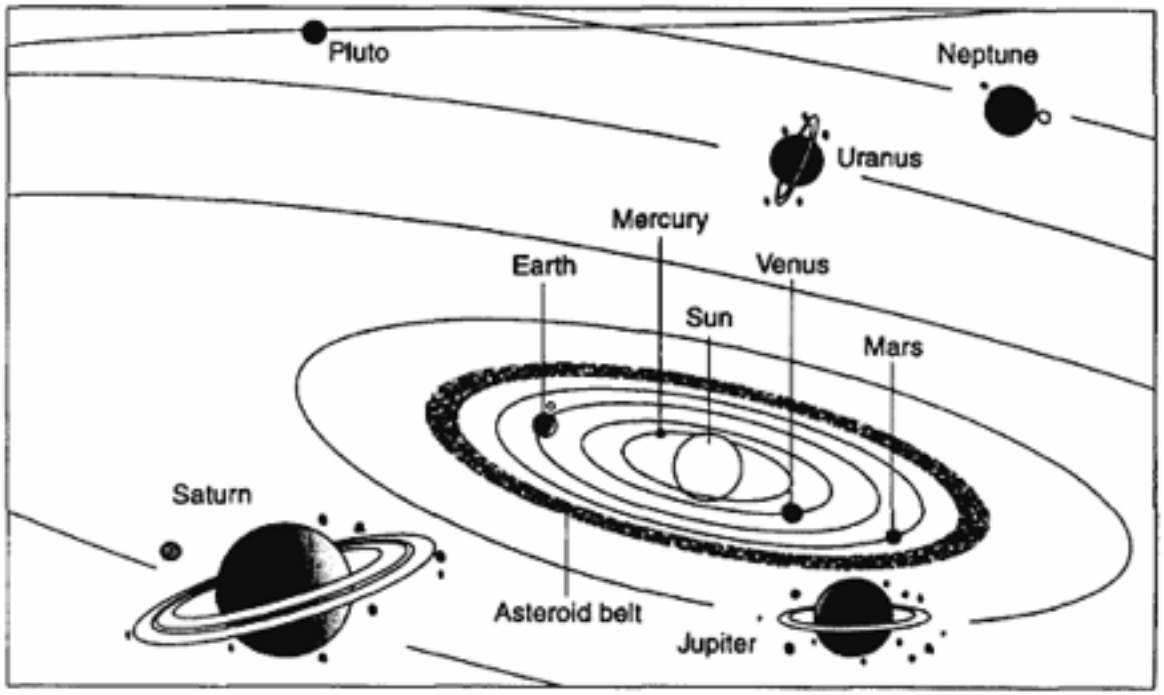
1. How has human belief in Earth's motions changed over time?

- **Heliocentric Model**: **the Sun is the center of the solar system & all the planets around it, including Earth, revolve around it**



1. How has human belief in Earth's motions changed over time?

- **Why was this a better model? Provided a much simpler explanation for the movement of the planets.**



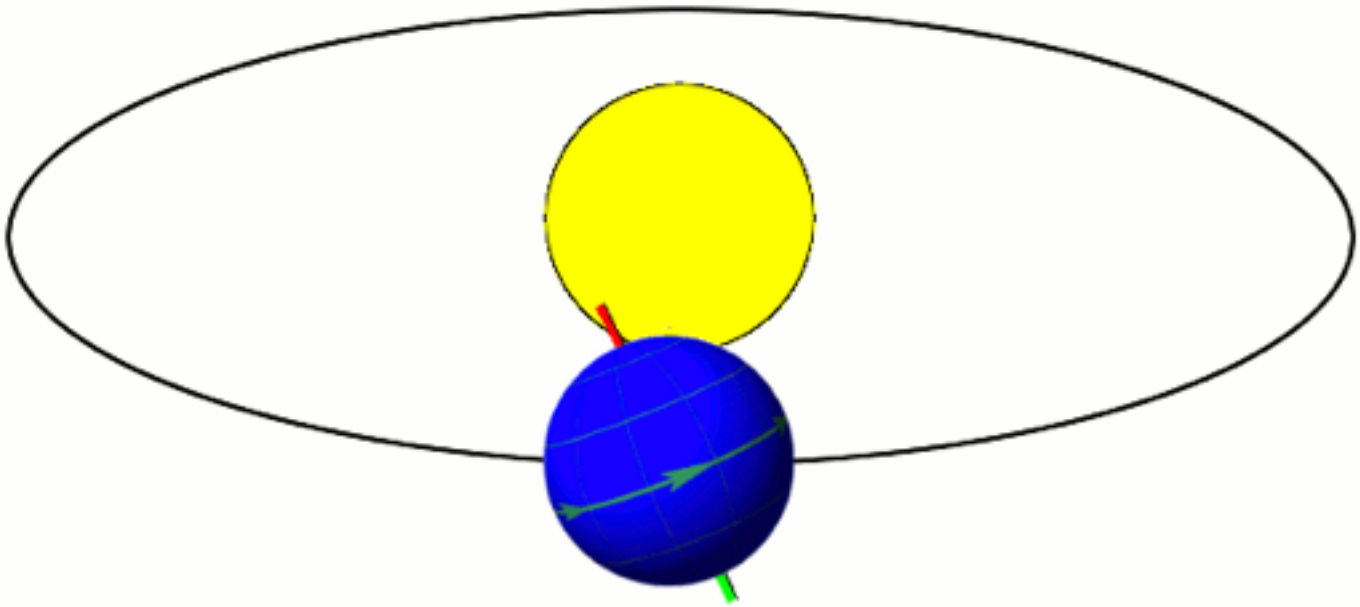
2. How is the Earth moving in space?

- **The actual motions of the Earth are based upon the heliocentric model:**

1) Rotation: spinning motion

2. How is the Earth moving in space?

2) <u>Revolution</u>: moving around (orbiting) an object



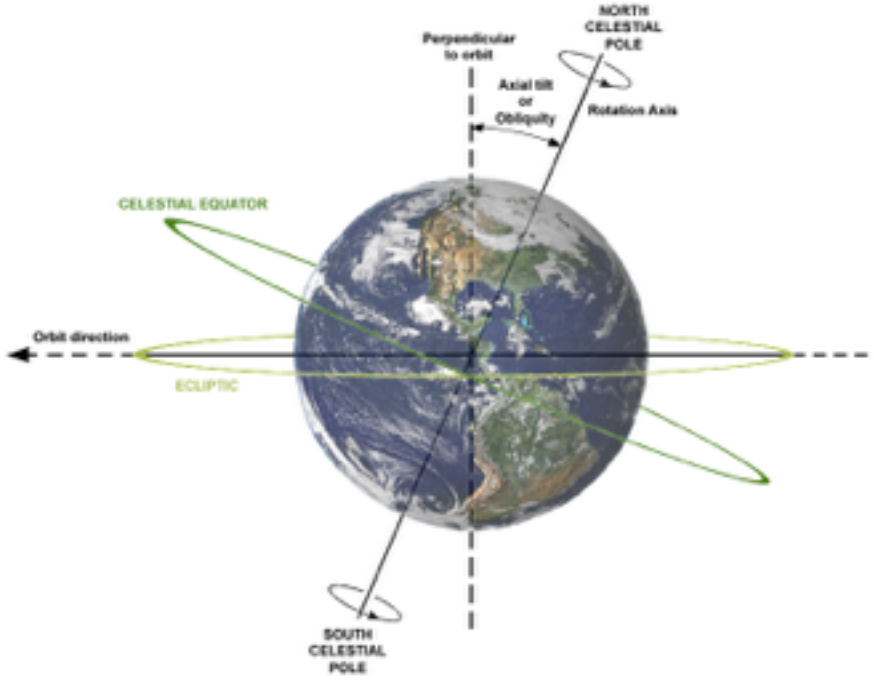
3. How does Earth rotate?

- **Earth's Rotation: Earth rotates on its axis west-to-east one time each day**
  - **<u>Axis</u>: imaginary pole that runs through the center of the planet (23.5˚ angle tilt on Earth)**

4. How fast is the Earth rotating?

- **Period of Rotation: 24 hours (1 day)**

- **Rate of Rotation: 15˚ per hour (or 360˚ per day)**



5. **What would happen if Earth rotated at a different rate?**

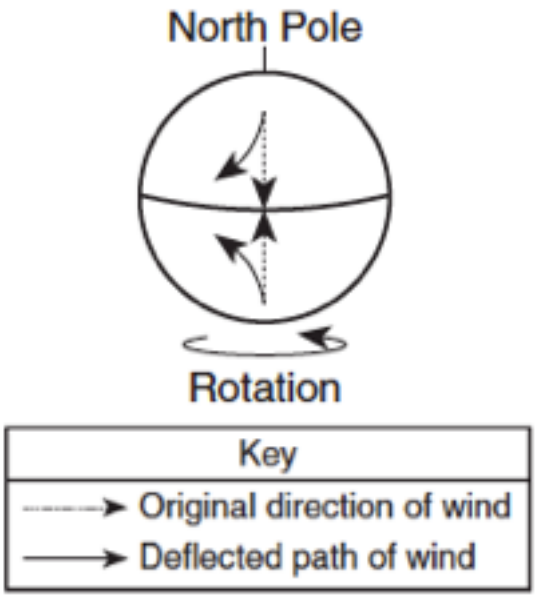
1) If the Earth rotated faster, the length of the day would ?

2) If the Earth rotated slower, the length of the day would ?

6. How do we know the Earth is rotating?

- **Evidence of Earth's Rotation:**

1) **Coriolis effect**: **deflection or curving of planetary winds caused by Earth's rotation**

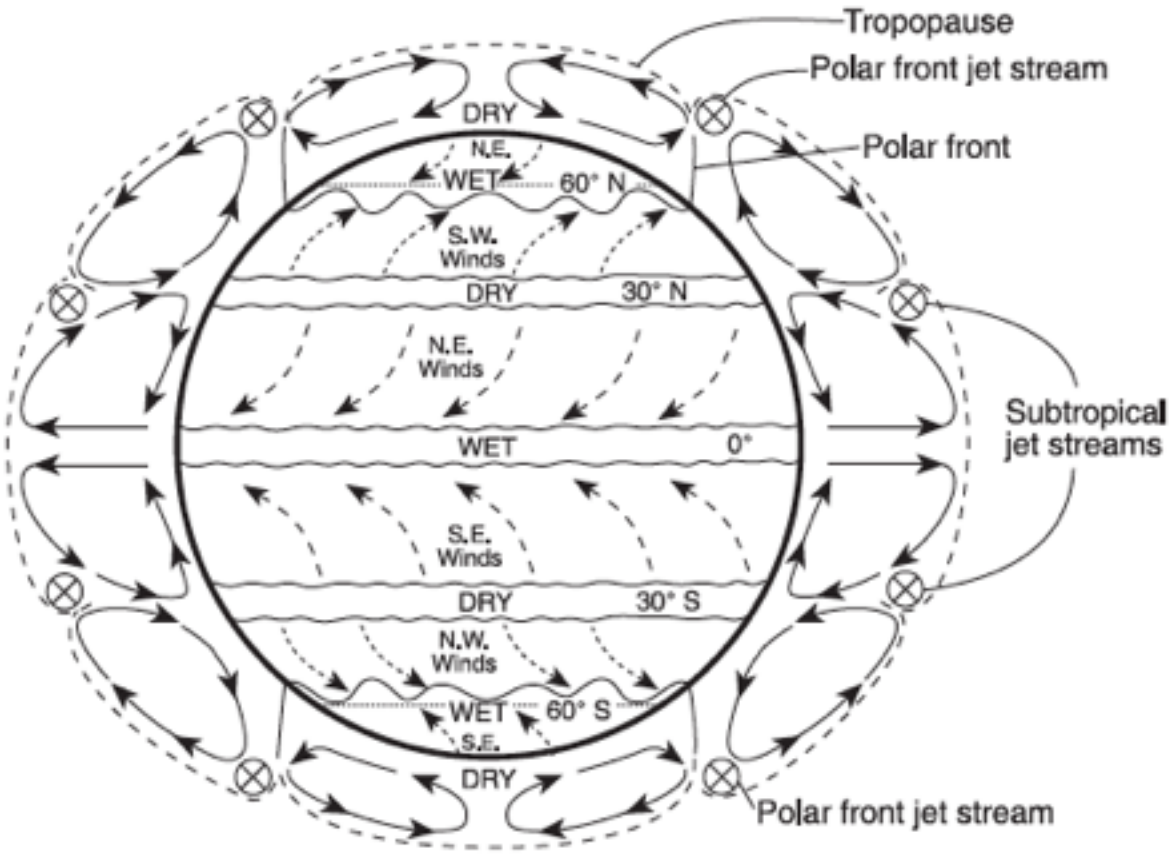


- **In the Northern Hemisphere, winc curve to the right.**

- **In the Southern Hemisphere, winds curve to the left.**

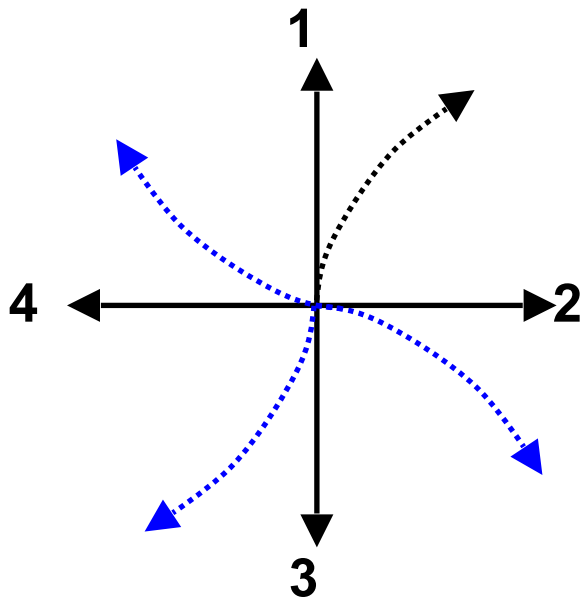
6. **How do we know the Earth is rotating?**

***See ESRT page 14 "Planetary Wind Belts".**



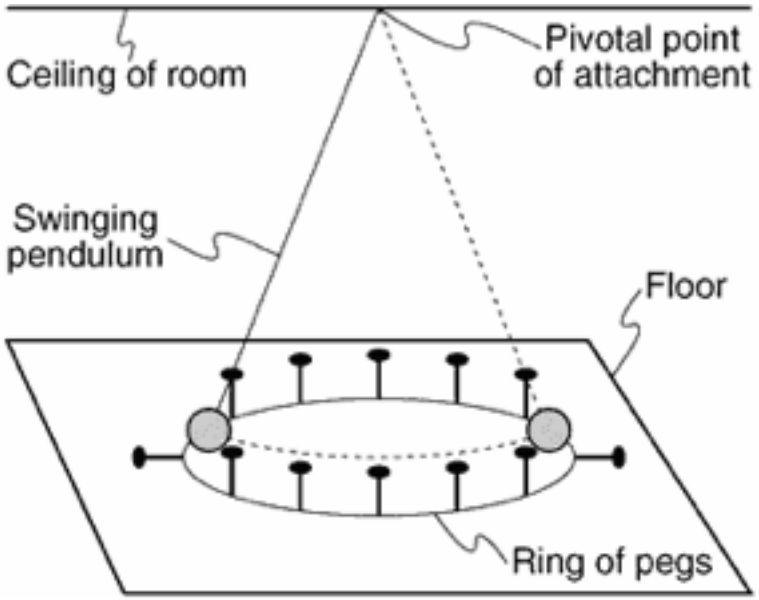
6. How do we know the Earth is rotating?

- **The diagram below shows a curve to the right for path 1. Starting from the center, make three more right curves for paths 2, 3, and 4.**



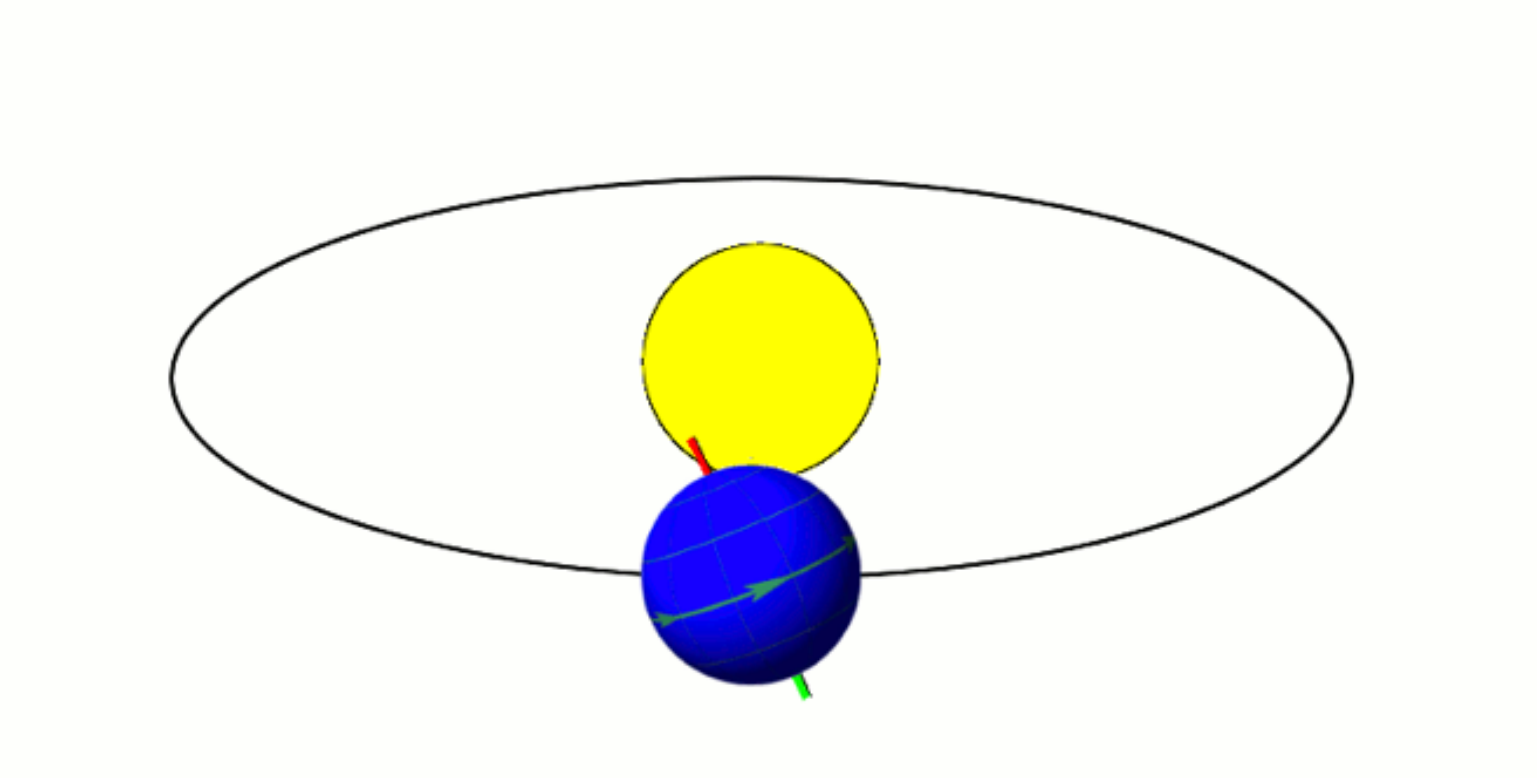
6. How do we know the Earth is rotating?

2) Foucault pendulum: A pendulum never changes the direction of its swing, but the Foucault pendulum *appears* to change direction of swing over the course of 1 day because the Earth is rotating underneath the pendulum.



7. How does the Earth revolve?

- **Earth's Revolution: Earth revolves (orbits) around the Sun counterclockwise one time each year**



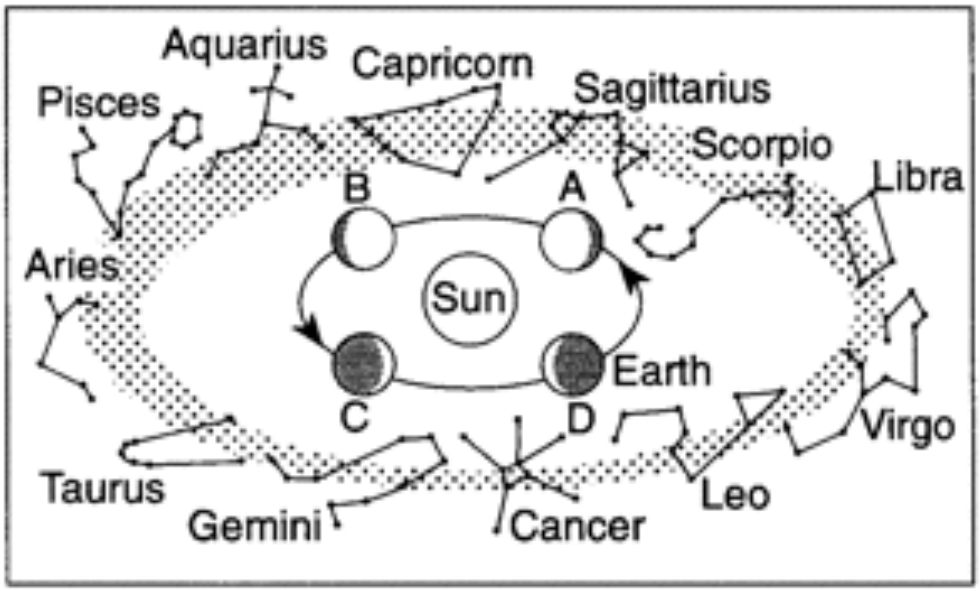
8. How fast is the Earth revolving?

- **Period of Revolution: 365.25 days (1 year)**
  - **Leap year: Every 4 years, an extra day is added to the calendar (February 29) which is the 366th day of the year to account for the extra quarter day in Earth's revolution.**
- **Rate of Revolution: 1˚ per day (approximately 360˚ per year)**

10. **How do we know the Earth revolves?**

- **Evidence of Revolution:**

1) Constellations: different star constellations are visible from Earth at different seasons of the year.



10. **How do we know the Earth revolves?**

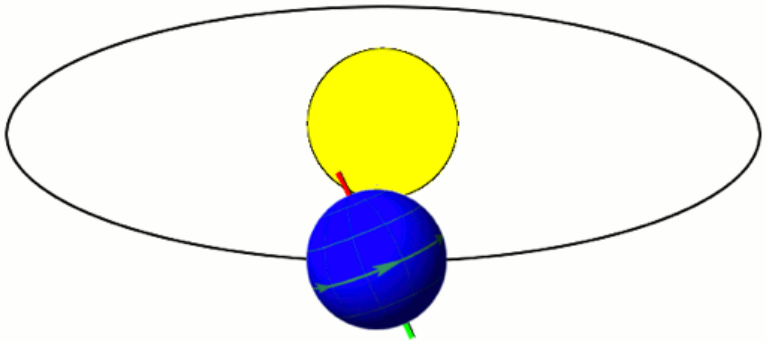
- **Evidence of Revolution:**

2) Seasons: based upon 3 factors:

1) Earth's tilt of 23.5˚

2) Earth's revolution around the Sun

3) Earth's axis always points to Polaris



11. When does each season begin?

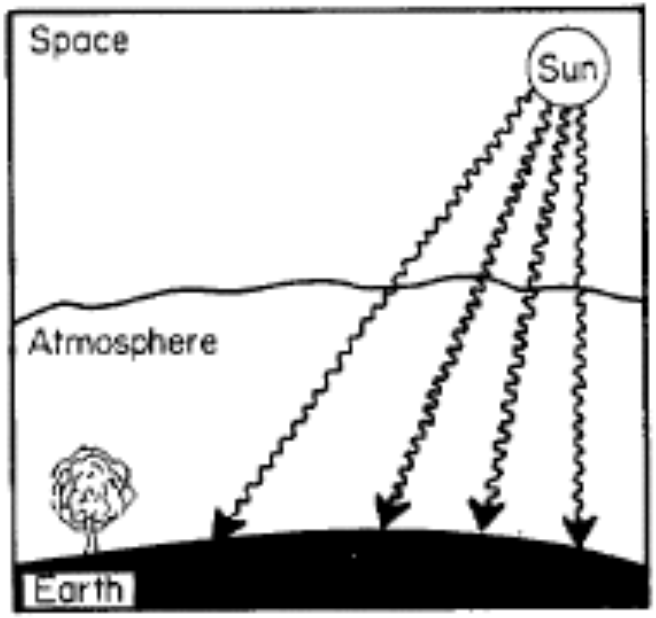
- **In the Northern Hemisphere:**
  - **March 21: First day of Spring (Vernal equinox)**
  - **June 21: First day of Summer (Summer solstice)**
  - **September 23: First day of Fall (Autumnal equinox)**
  - **December 21: First day of Winter (Winter solstice)**

- **Seasons are opposite in the Southern Hemisphere.**

12. **How does the Sun affect the changing seasons?**

- **Insolation: the energy from the sun that reaches the Earth (rays of sunlight)**

  - **Insolation = Incoming Solar Radiation**

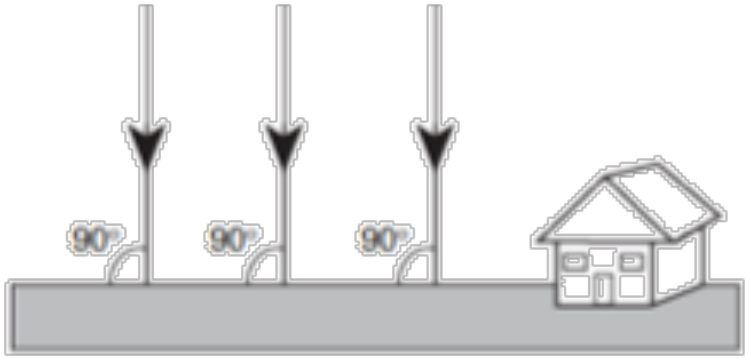


13. How does the angle of insolation affect seasons?

- **Angle of Insolation**: the angle at which the Sun's rays strike the ground

1) **Direct (vertical) rays**: when the rays of sunlight strike the ground at an angle near 90˚ (greatest possible angle)

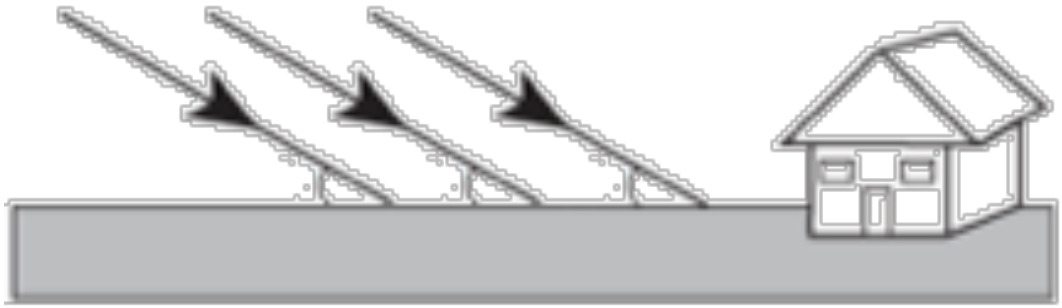
○ Sun rays are strongest and temperatures are **warmest**.



13. **How does the angle of insolation affect seasons?**

2) Slanted rays: when the rays of sunlight strike the ground at a low angle

- **Sun rays are weaker and temperatures are cooler.**

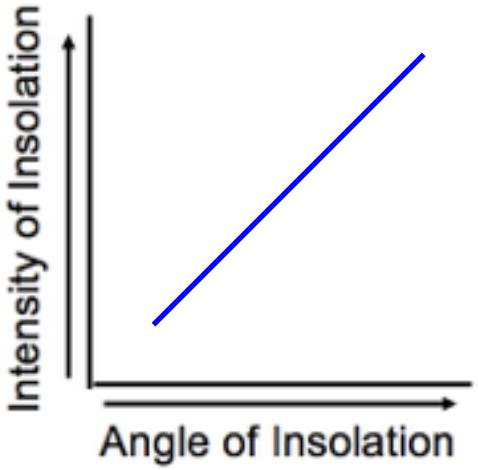


14. How does the angle of insolation affect the strength of the Sun's rays?

- **Intensity of Insolation: the strength of the Sun's rays**

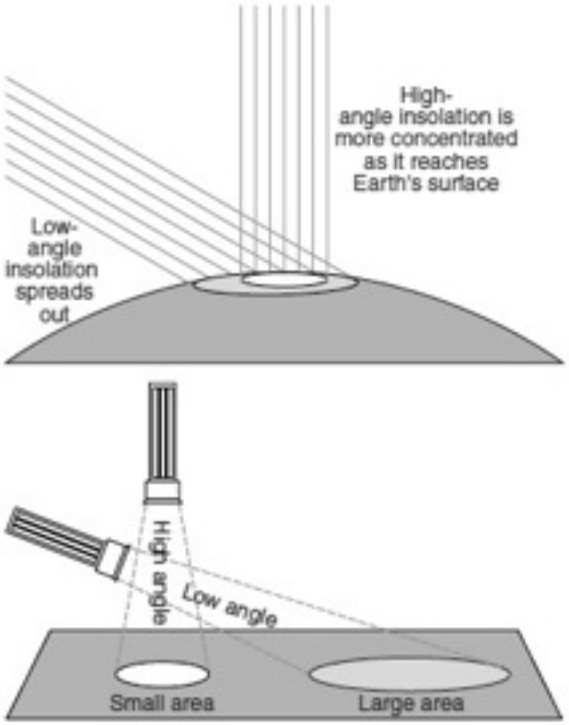
- **As the angle of insolation increases, the intensity of insolation increases.**

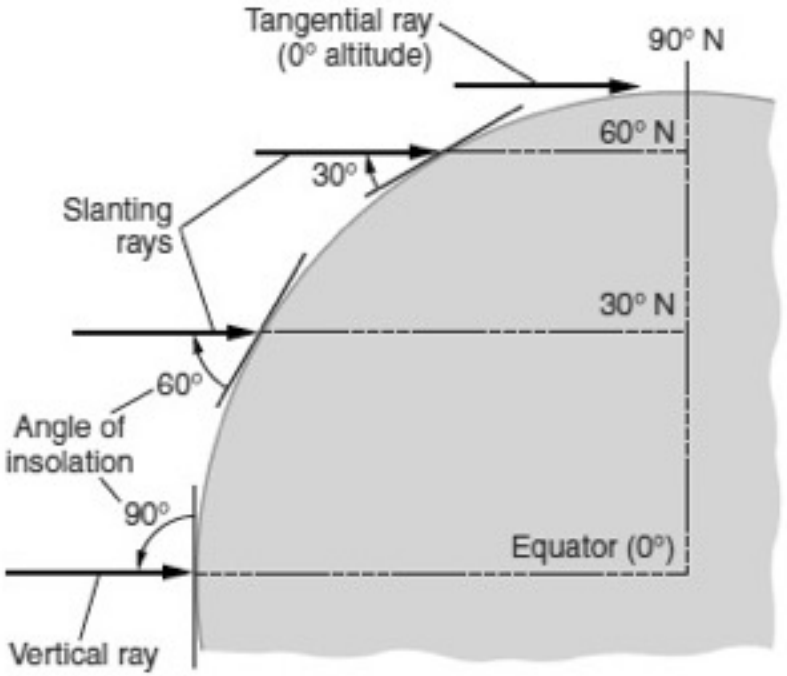
- **The greater the intensity of insolation, the greater the temperature.**



14. How does the angle of insolation affect the strength of the Sun's rays?

- **The changing seasonal temperatures are caused by the changing angle at which the Sun's rays strike the ground.**

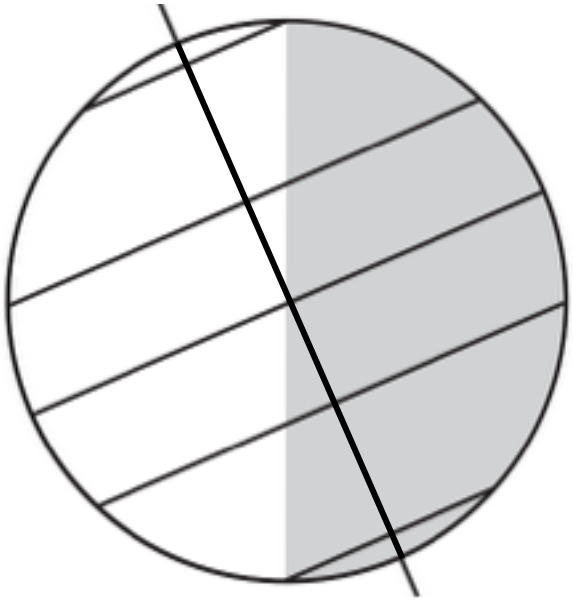


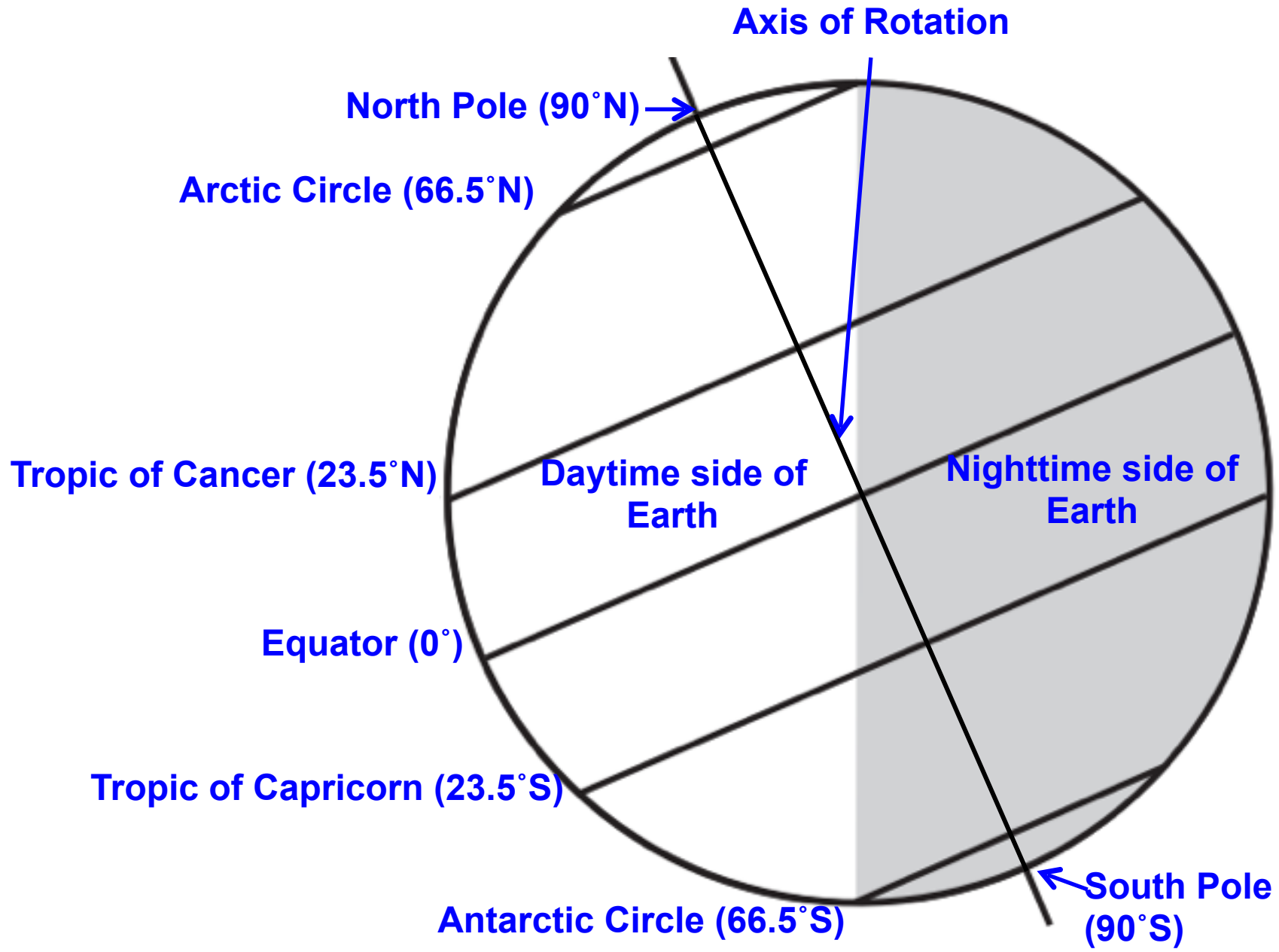


15. Which latitudes receive the direct rays throughout the year?

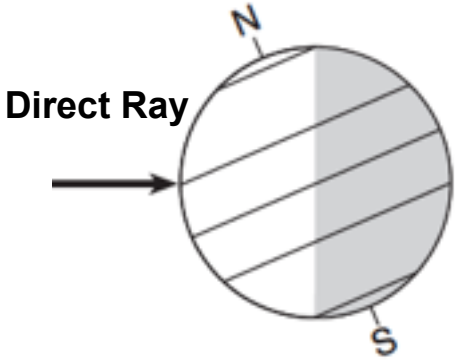
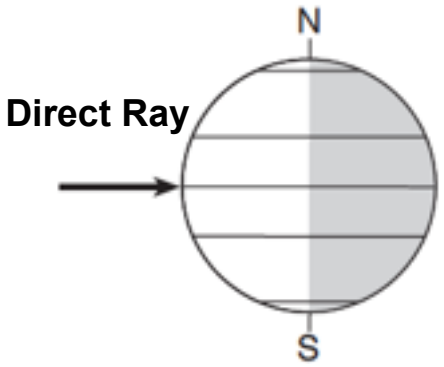
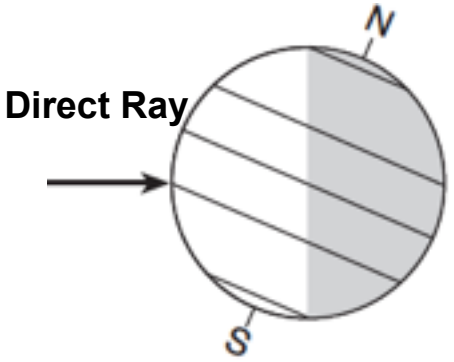
- **Latitude Review**: Label the diagram using the following locations.

1. Nighttime side of Earth
2. Daytime side of Earth
3. North Pole (90°N)
4. South Pole (90°S)
5. Equator (0°)
6. Tropic of Cancer (23.5°N)
7. Tropic of Capricorn (23.5°S)
8. Arctic Circle (66.5°N)
9. Antarctic Circle (66.5°S)
10. Axis of Rotation



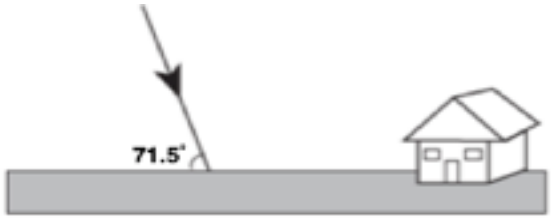

Axis of Rotation
North Pole (90˚N)
Arctic Circle (66.5˚N)
Tropic of Cancer (23.5˚N)
Daytime side of Earth
Nighttime side of Earth
Equator (0˚)
Tropic of Capricorn (23.5˚S)
Antarctic Circle (66.5˚S)
South Pole (90˚S)

- **The location of direct rays changes throughout the year, but it is always in the area of the tropics:**

June 21	March 21/September 23	December 21
		
Direct rays hit the Tropic of Cancer (23.5˚N) on June 21.	**Direct rays hit the equator on the equinox dates.**	**Direct rays hit the Tropic of Capricorn (23.5˚S) on December 21.**

16. How does the angle of insolation in New York State change throughout the year?

- **Our view of the Sun's angle on the first day of each season in New York:**

June 21	March 21/September 23	December 21
		

16. **How does the angle of insolation in New York State change throughout the year?**

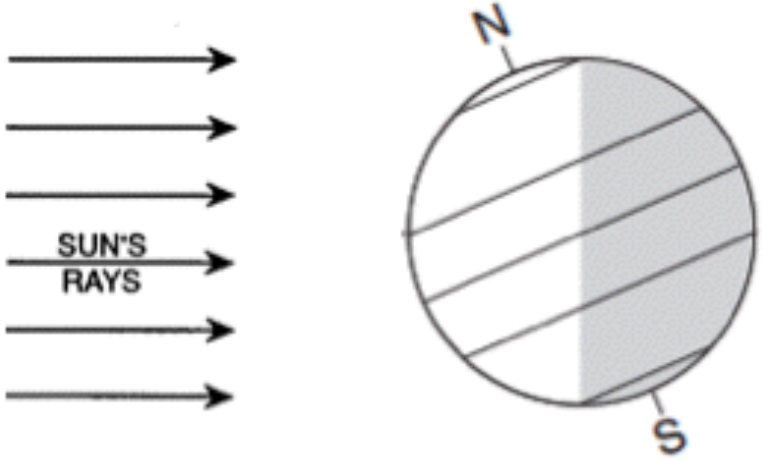
- **New York State never receives direct insolation (90˚ sunlight).**
- **The angle of insolation is greatest on June 21.**
- **The angle of insolation is lowest on December 21.**
- **The angle of insolation changes by 23.5˚ each season.**

17. **How does the length of daylight change from season to season?**

- **<u>Duration of Insolation</u>: the number of hours of daylight that occur on a particular day**

17. How does the length of daylight change from season to season?

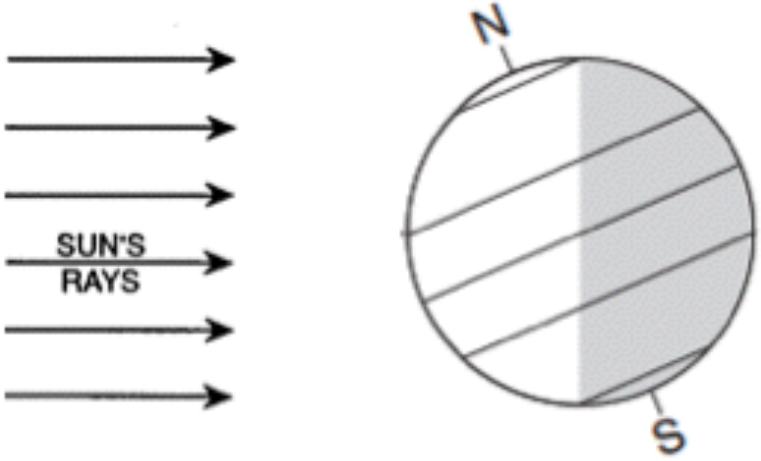
1) *June 21*: **the more the Northern Hemisphere is on the sunlit side than on the nighttime side. Thus, days are longer than nights.**



- **The area south of the Antarctic Circle is in constant darkness.**

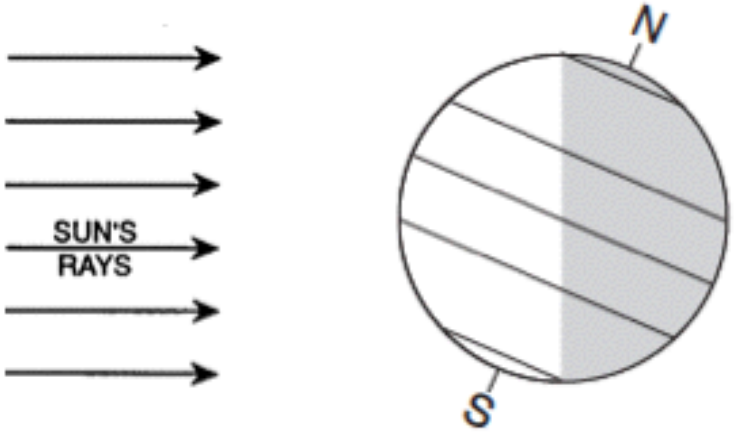
17. How does the length of daylight change from season to season?

- **Duration of insolation at specific latitudes:**
  - **90˚N (North Pole): 24 hours**
  - **42˚N (NYS): 15 hours**
  - **0˚ (Equator): 12 hours**
  - **90˚S (South Pole): 0 hours**



17. How does the length of daylight change from season to season?

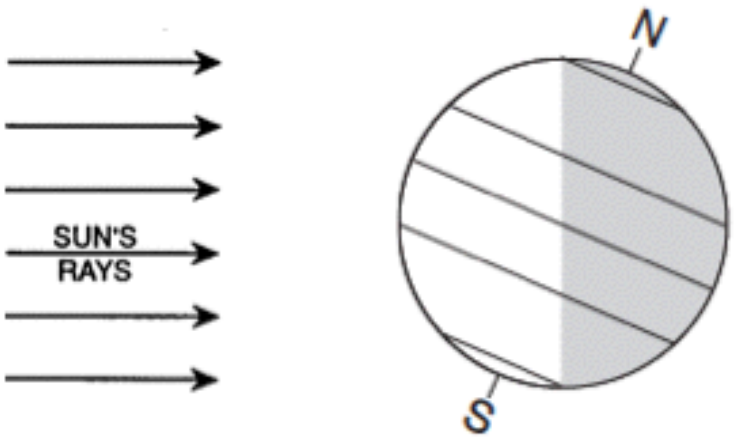
2) *December 21*: more of the Northern Hemisphere is on the night side of the Earth than on the sunlit side. Thus, nights are longer than days.



- **The area north of the Arctic Circle is in constant darkness.**

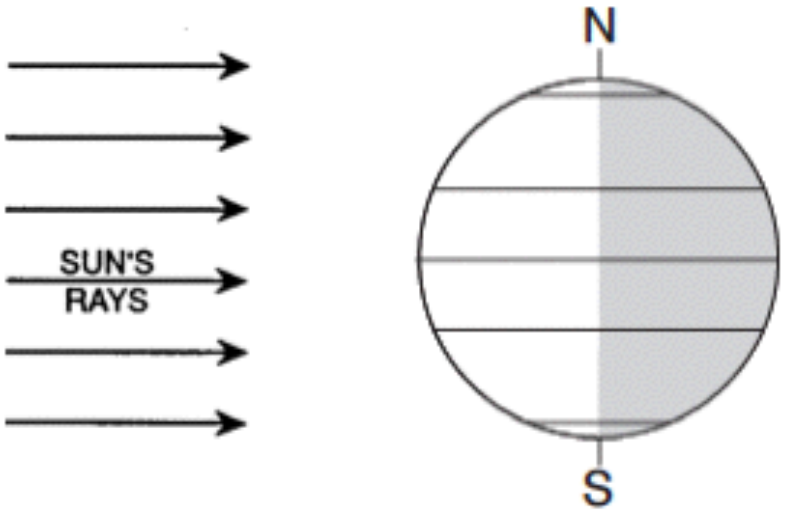
17. How does the length of daylight change from season to season?

- **Duration of insolation at specific latitudes:**
  - **90˚N (North Pole): 0 hours**
  - **42˚N (NYS): 9 hours**
  - **0˚ (Equator): 12 hours**
  - **90˚S (South Pole): 24 hours**



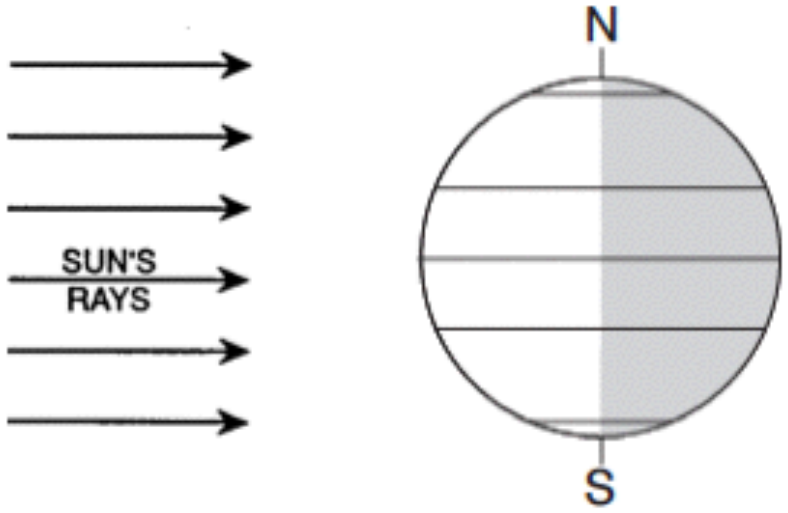
17. How does the length of daylight change from season to season?

3) *March 21/September 23*: **the Earth is evenly in the sunlit side and the nighttime side. Thus, days and nights are equal worldwide.**



17. How does the length of daylight change from season to season?

- Duration of insolation at specific latitudes:
  - 90˚N (North Pole): 12 hours
  - 42˚N (NYS): 12 hours
  - 0˚ (Equator): 12 hours
  - 90˚S (South Pole): 12 hours



How can we determine dates on a seasonal diagram?

- **Procedure:**

1) **Determine which Earth models represent 12/21 and 6/21. These diagrams will always be on the right/left side of the diagram.**

- **12/21 will always have the North Pole pointing away from the Sun.**
- **6/21 will always have the North Pole pointing towards the Sun.**

2) In a counterclockwise sequence, fill in the dates of 3/21 and 9/23.

Practice #1 In Packet