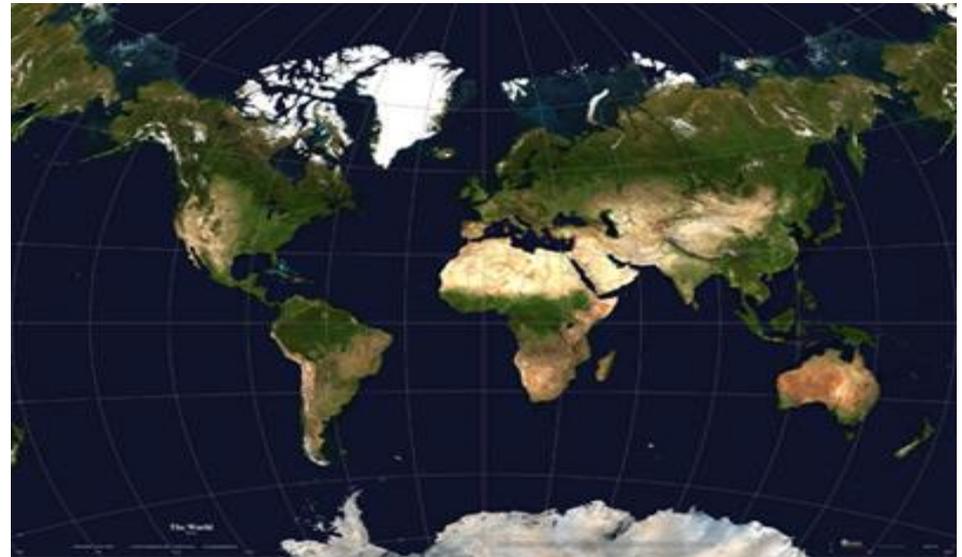
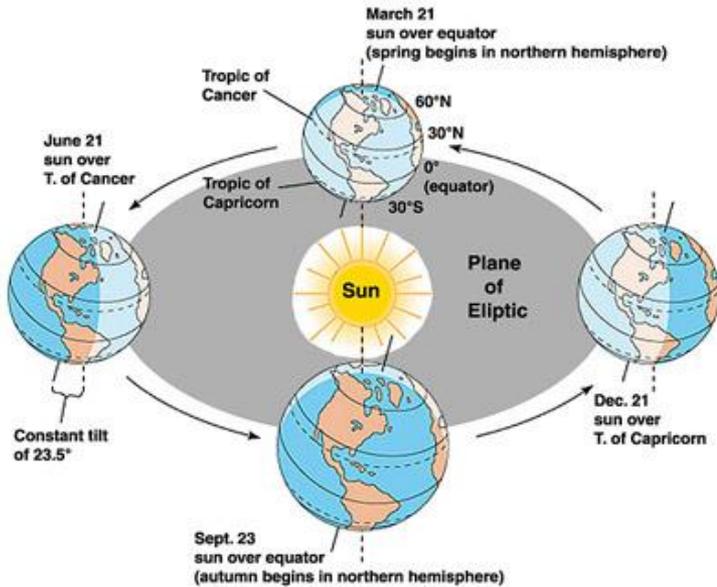
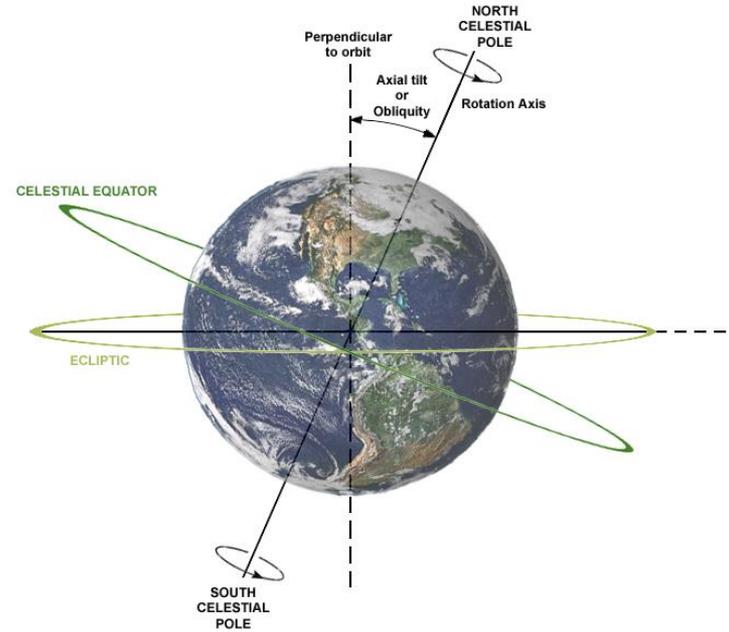




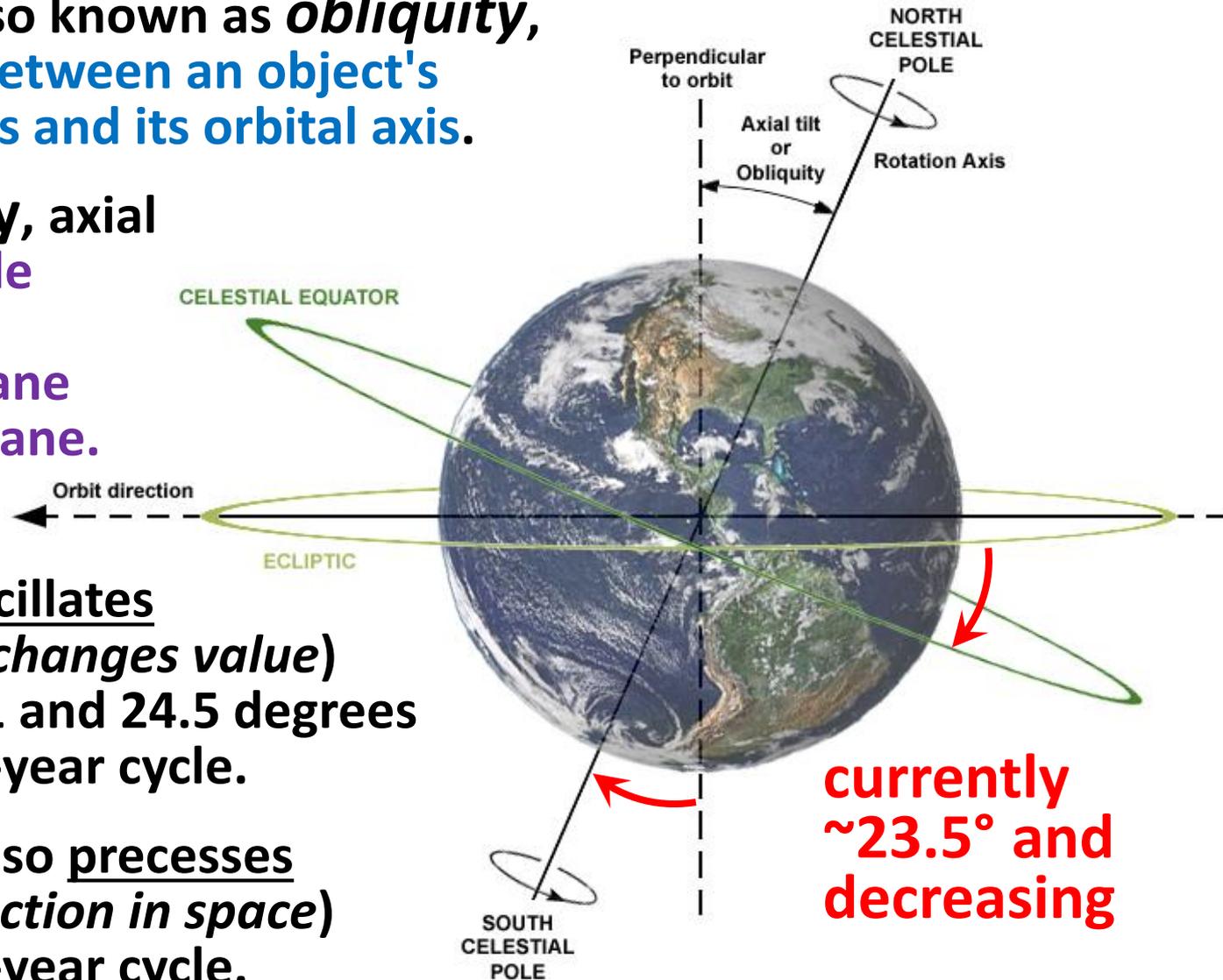
Planet Earth

Part 3



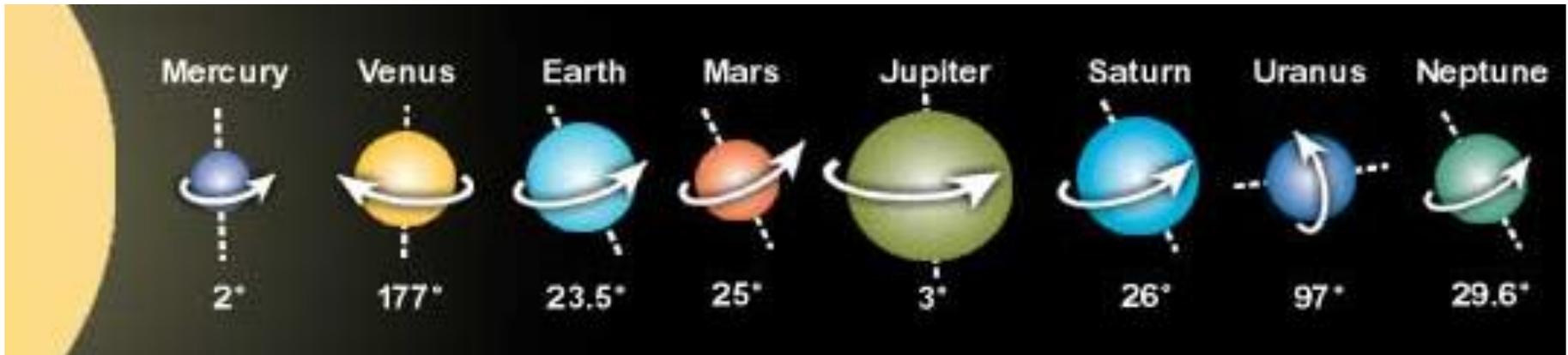
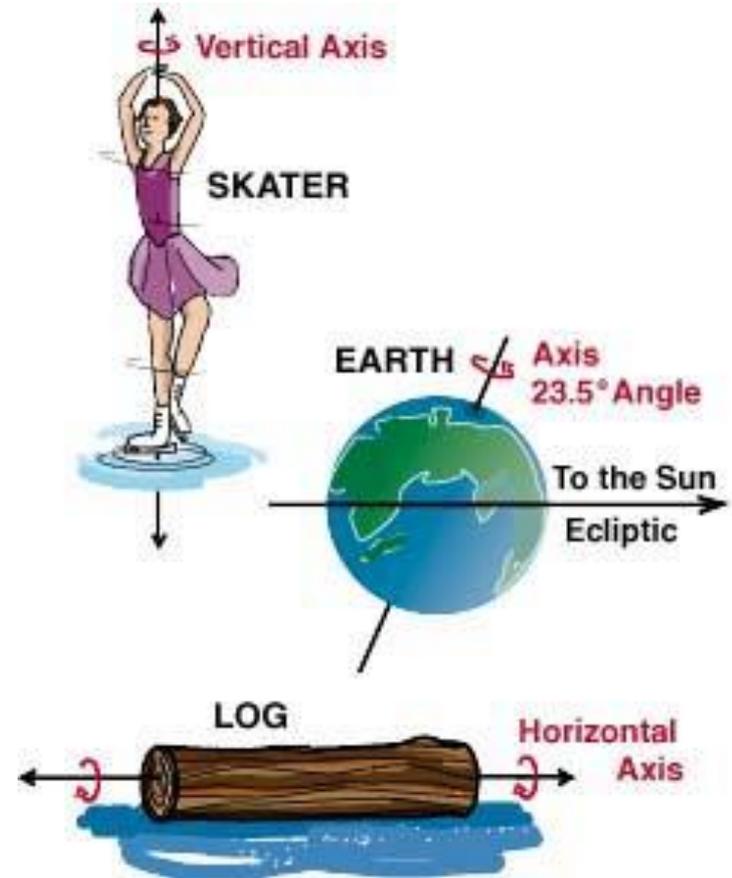
Earth Axis Tilt

- Axial tilt, also known as *obliquity*, is the angle between an object's rotational axis and its orbital axis.
- Equivalently, axial tilt is the angle between its equatorial plane and orbital plane.
- Earth's tilt oscillates (periodically changes value) between 22.1 and 24.5 degrees on a ~41,000-year cycle.
- Earth's axis also precesses (changes direction in space) on a ~26,000-year cycle.



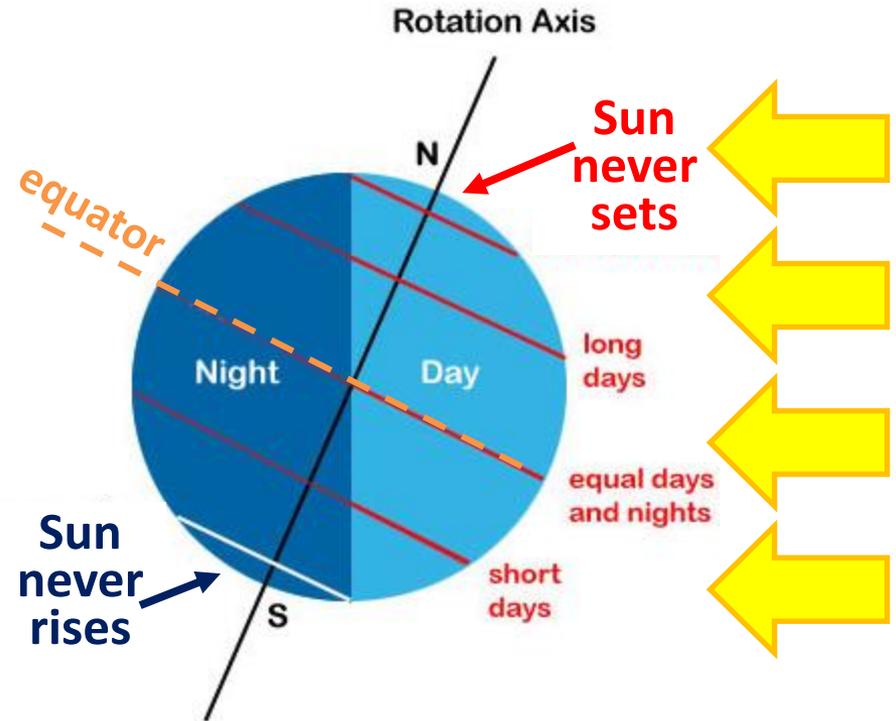
Exercise:

1. Which planets of the Solar System can be considered **skaters**? **logs**?
2. Which planets have tilt similar to Earth's?



Day and Night

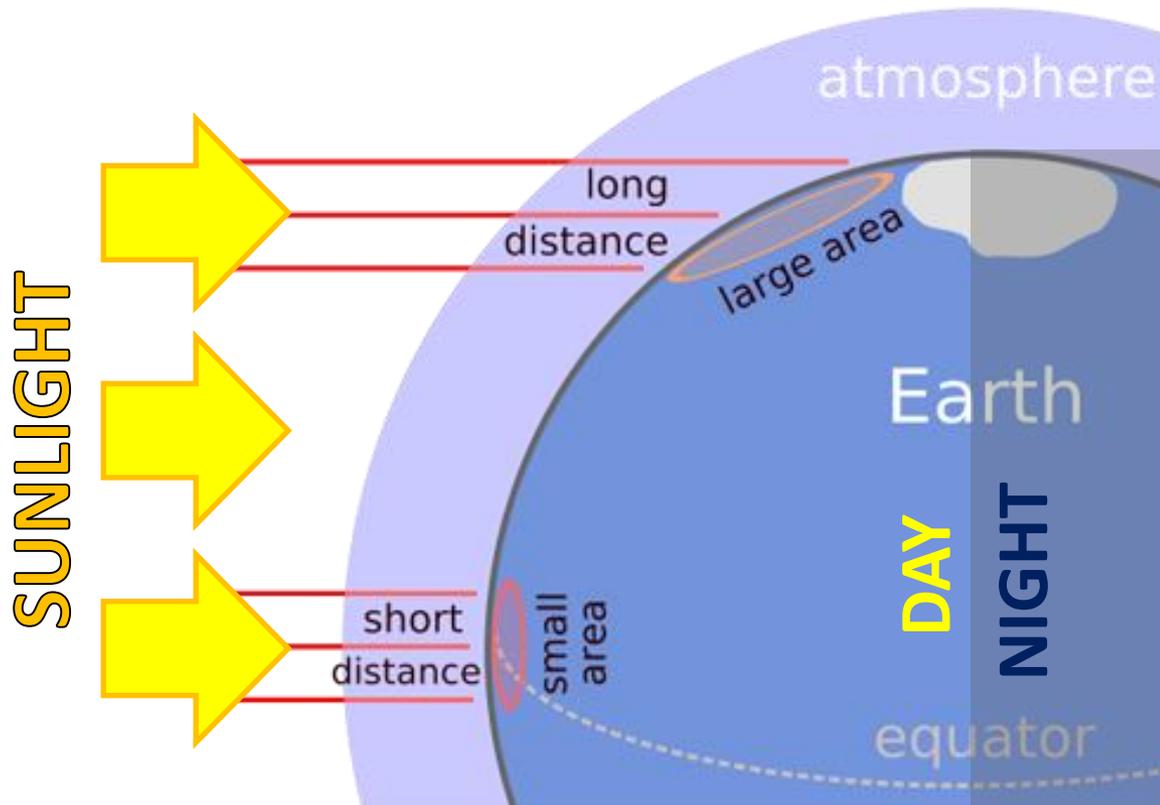
- Earth rotates on its axis, making **one full rotation every 24 hours** (86,400 seconds).
- Every moment of time half of the planet is exposed to sunlight (day) while the other half is turned away from the Sun (night).
- Different parts of the globe receive different illumination:



- due to the **Earth's tilt** - day-to-night ratio varies over **latitude**,
- depending on the position of Earth along its **orbit** - day-to-night ratio at given latitude varies over the **course of the year**.
- Special **days** of the year: solstices and equinoxes.
- Special **lines** on the surface: tropics and polar circles.

Angle of Sunlight

Due to the Earth's curvature, the **amount of sunlight (energy)** reaching any given point on the surface **varies greatly with latitude**.

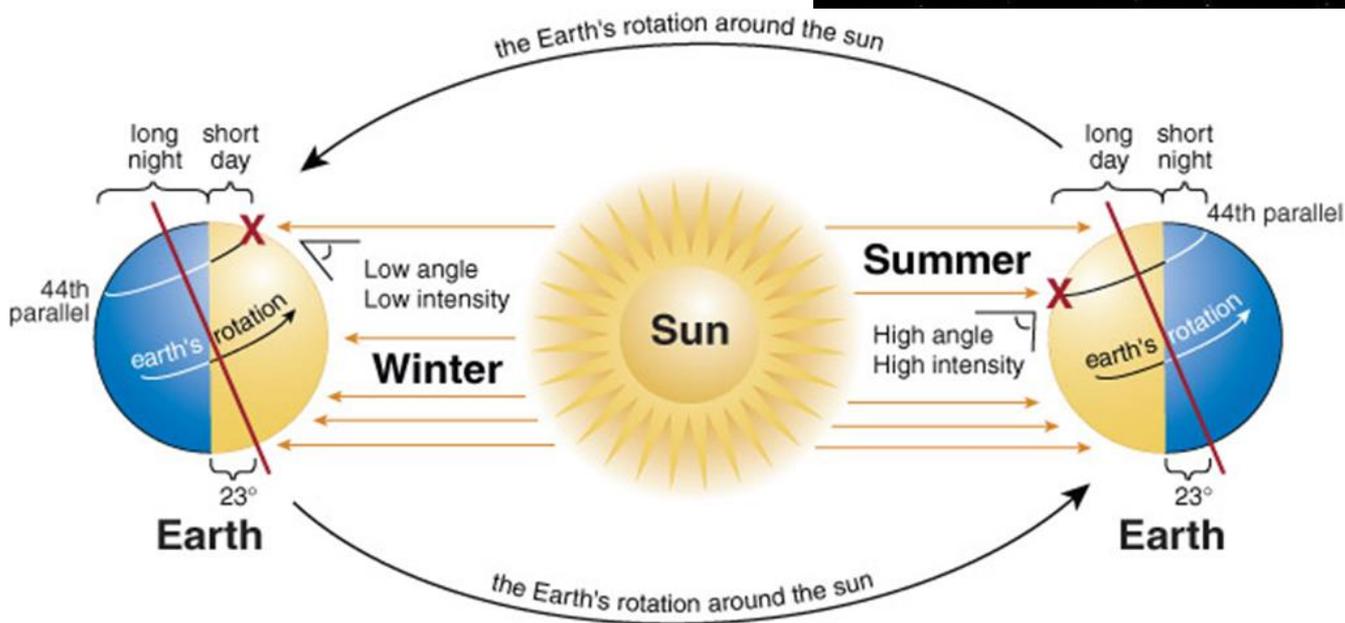
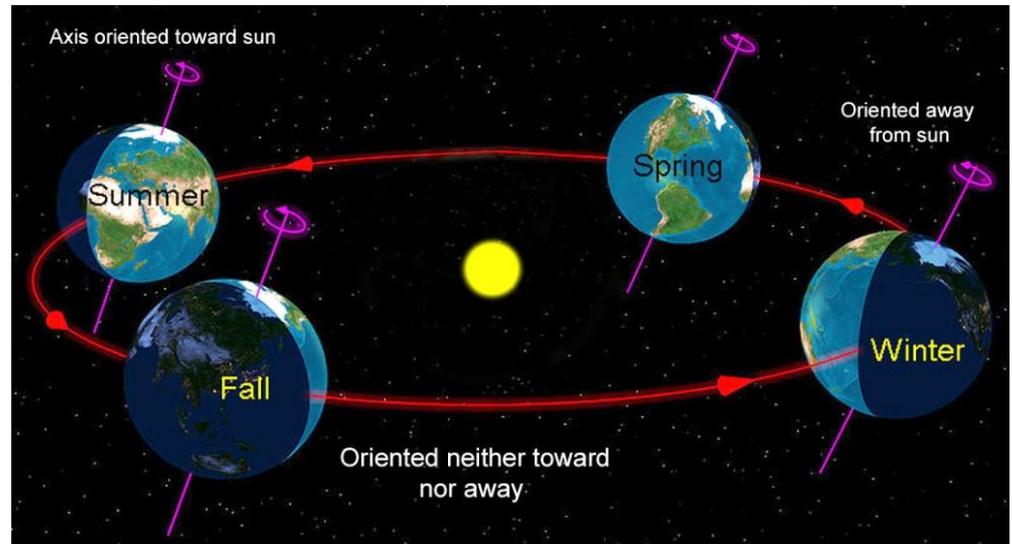


- Regions near the **Equator** receive most direct, that is concentrated Sun rays.
- At **high latitudes**, the same amount of the incoming Sun energy is spread over much greater area of surface.

The available amount of energy defines how much warmed up a certain area can get during the day time... **does it change?**

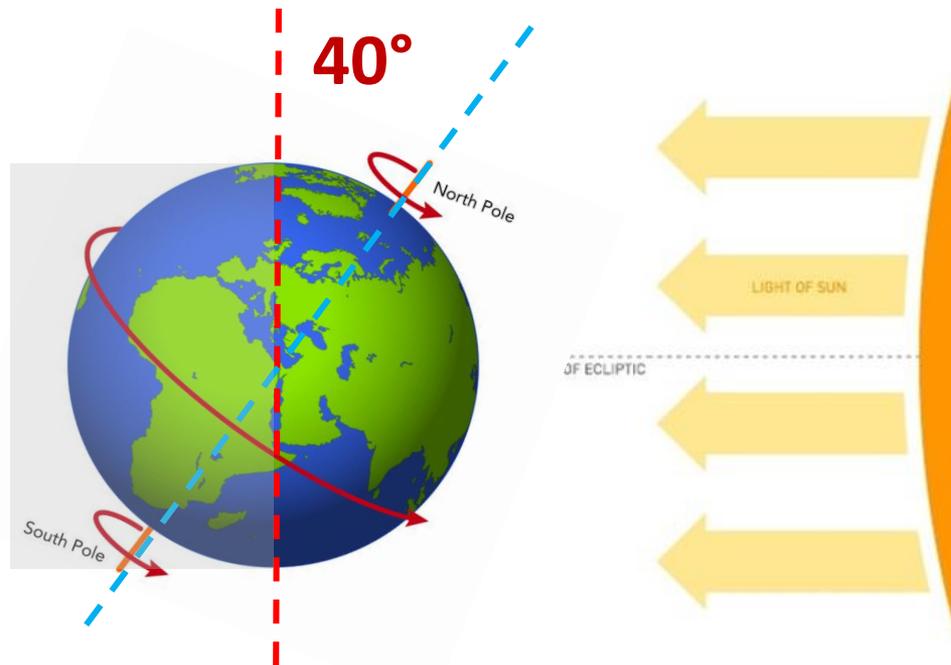
Change of Seasons

Due to the Earth's tilt with respect to its orbital plane, the **amount of sunlight (energy)** reaching any given point on the surface **varies over the course of the year.**



Astronomers and scientists use the dates of **equinoxes** and **solstices** to mark the change of seasons.

Exercise: if Earth was tilted at 40 degrees instead of 23.5 degrees, would winters in New York (or *Russia*) be **warmer** or **colder**?

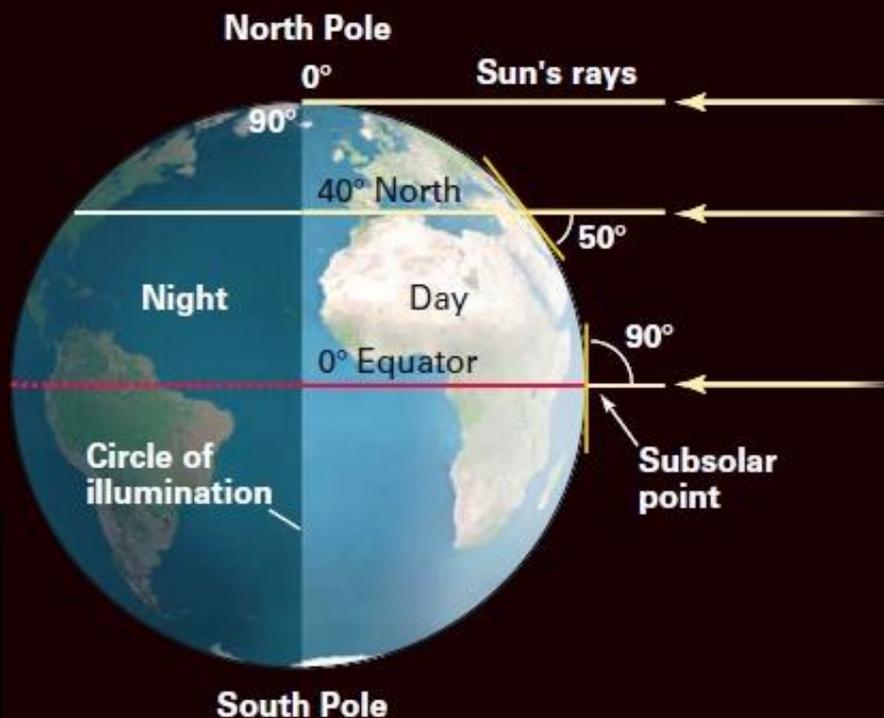


Colder! And summers would be hotter since the **larger tilt** would mean that the hemispheres would be tilted **more away** or **more towards** the Sun. However, the equator would still be the same average temperature!

Equinox conditions

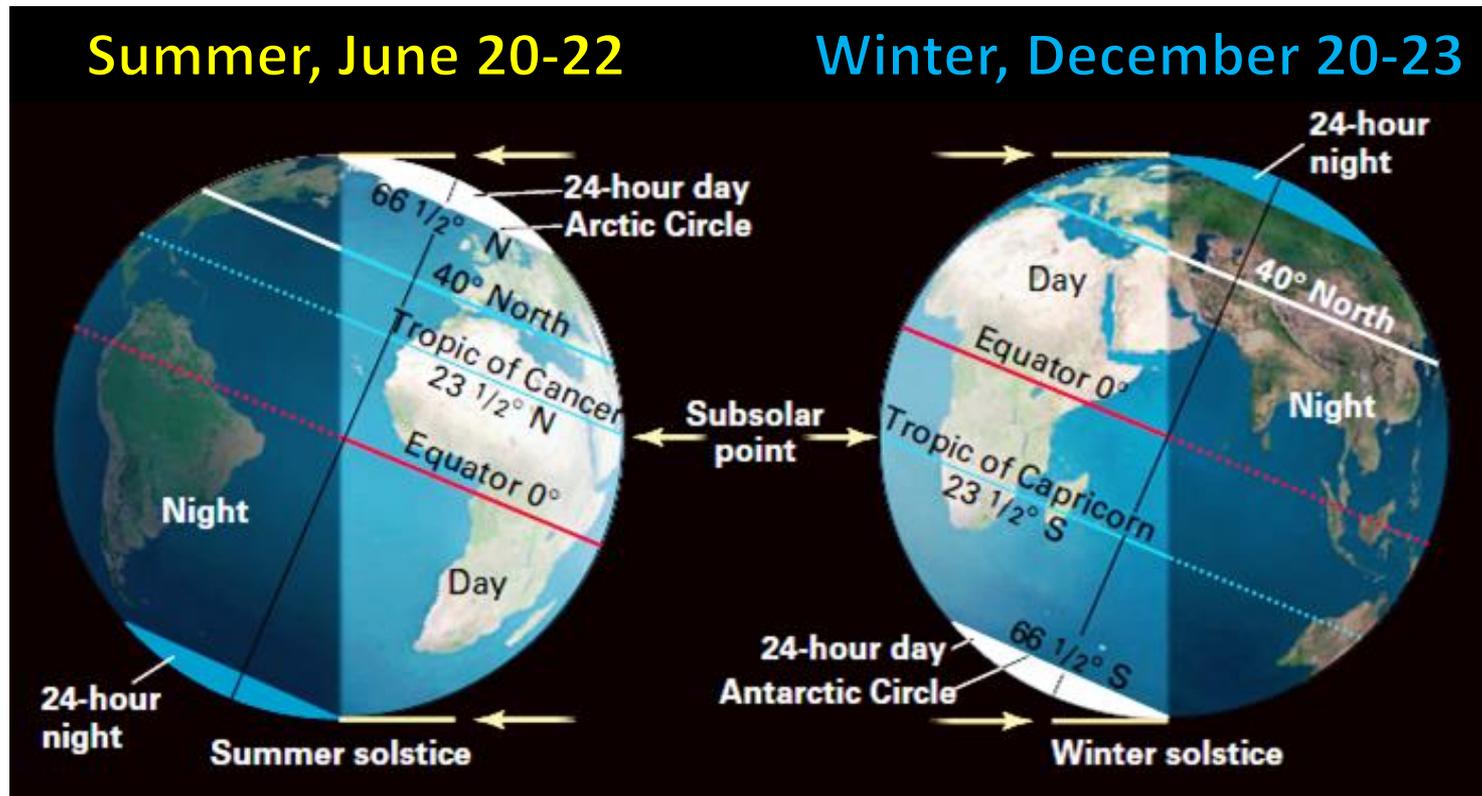
Autumnal (Fall), September 21-24

Vernal (Spring), March 20-23



- At **equinox** (Latin: “equal”+”night”), the Earth’s **axis of rotation is exactly at right angle** to the direction of solar illumination.
- The **circle of illumination** passes through the North and South Poles.
- At noon, the Sun is directly overhead on the Equator.
- At both poles the Sun is seen at the horizon.
- Both hemispheres are equally illuminated.

Solstice conditions (Northern Hemisphere)



- At **solstice** (Latin: “sun”+”stand still”), the Earth’s **axis of rotation is fully tilted either toward or away** from the Sun.
- Polar regions experience either 24-hour day or 24-hour night.
- The Sun is directly overhead at noon on one of the tropics.

December Solstice

Seasons in the Southern Hemisphere are opposite to those in the Northern Hemisphere.

Fairbanks, Alaska



← On December solstice, **1st day of Winter**, daylight length in Fairbanks, Alaska is just **3 hr 41 min 48 sec!**

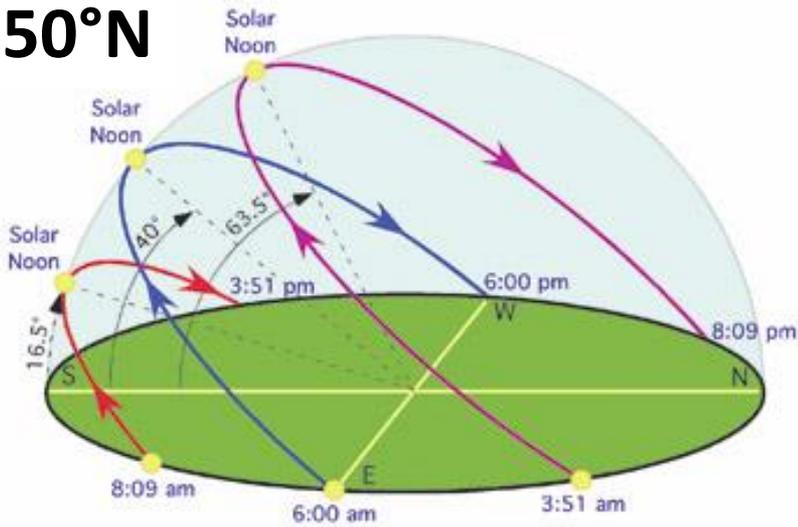
At the same time, on the **1st day of Summer**, the Sun at East Antarctica coast dips to the horizon but doesn't set! →



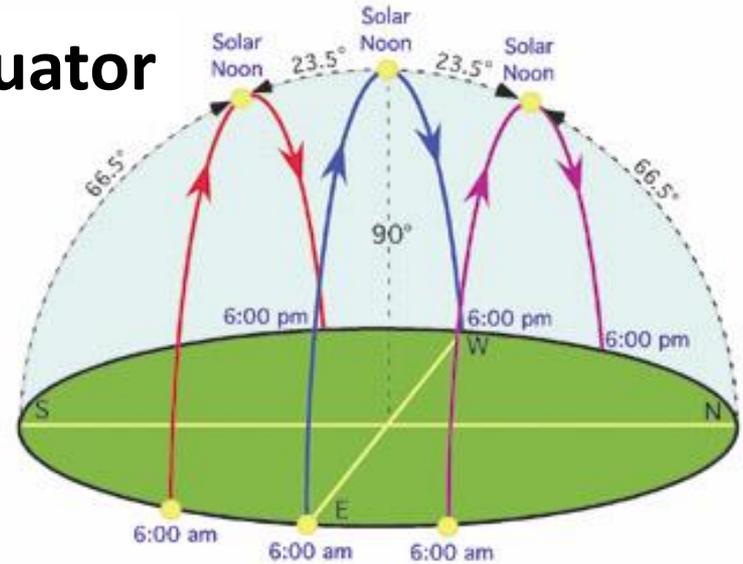
Midnight Sun in Antarctica

Observed Path of the Sun

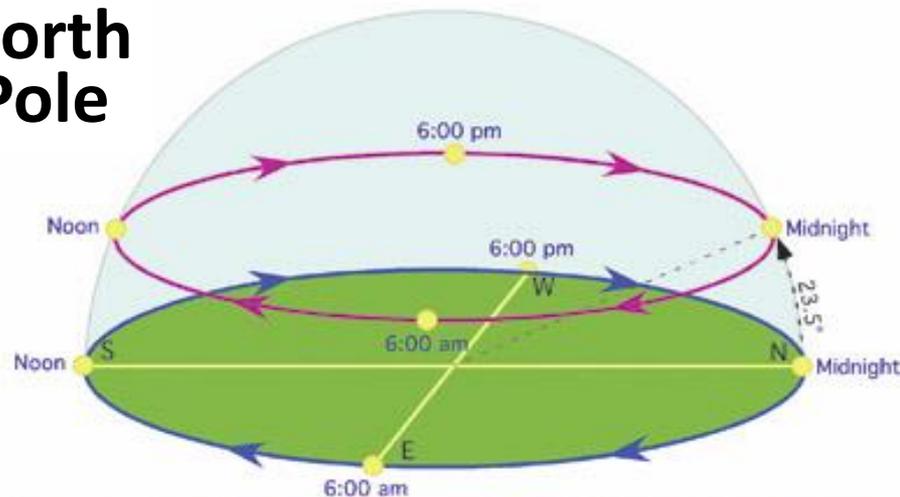
50°N



Equator



North Pole



June Solstice — Equinoxes — December Solstice —

Additional Info

Change of Seasons video:

http://www.youtube.com/watch?v=DD_8Jm5pTLk

Animation:

astro.unl.edu/naap/motion1/animations/seasons_ecliptic.html