

**The Sun was shining on the sea,
Shining with all his might;
He did his very best to make
The billows smooth and bright-
And this was odd because it was
The middle of the night.**

**from “The Walrus and the Carpenter”
Through the Looking-Glass
-- Lewis Carroll**



Homework #1:

Chapter 1:

end of chapter “problems” 1-10,

odd-numbered only,

due Wednesday, September 7, beginning of class

Summer Triangle

Labor Day: September 5th

Last Day to Drop: September 6

Last Day to Add: September 13



Outline

I. The Stars

A. Constellations

B. The Names of the Stars

C. The Brightness of Stars

D. Magnitude and Intensity

II. The Sky as a Dome Overhead

A. The Celestial Sphere

B. Sky Charts

III. Cycles in the Sky

A. Diurnal Motion

B. Annual Motion: Stars, Sun

C. The Seasons

D. The Moving Planets

Review

- 1) How many constellations are there?
- 2) What's the name of one of the brightest stars in Orion?
- 3) What is the name of the star closest to the North Celestial Pole? How can you find it in the sky?
- 4) How many degrees does your hand width span when held at arm's length? your thumb?



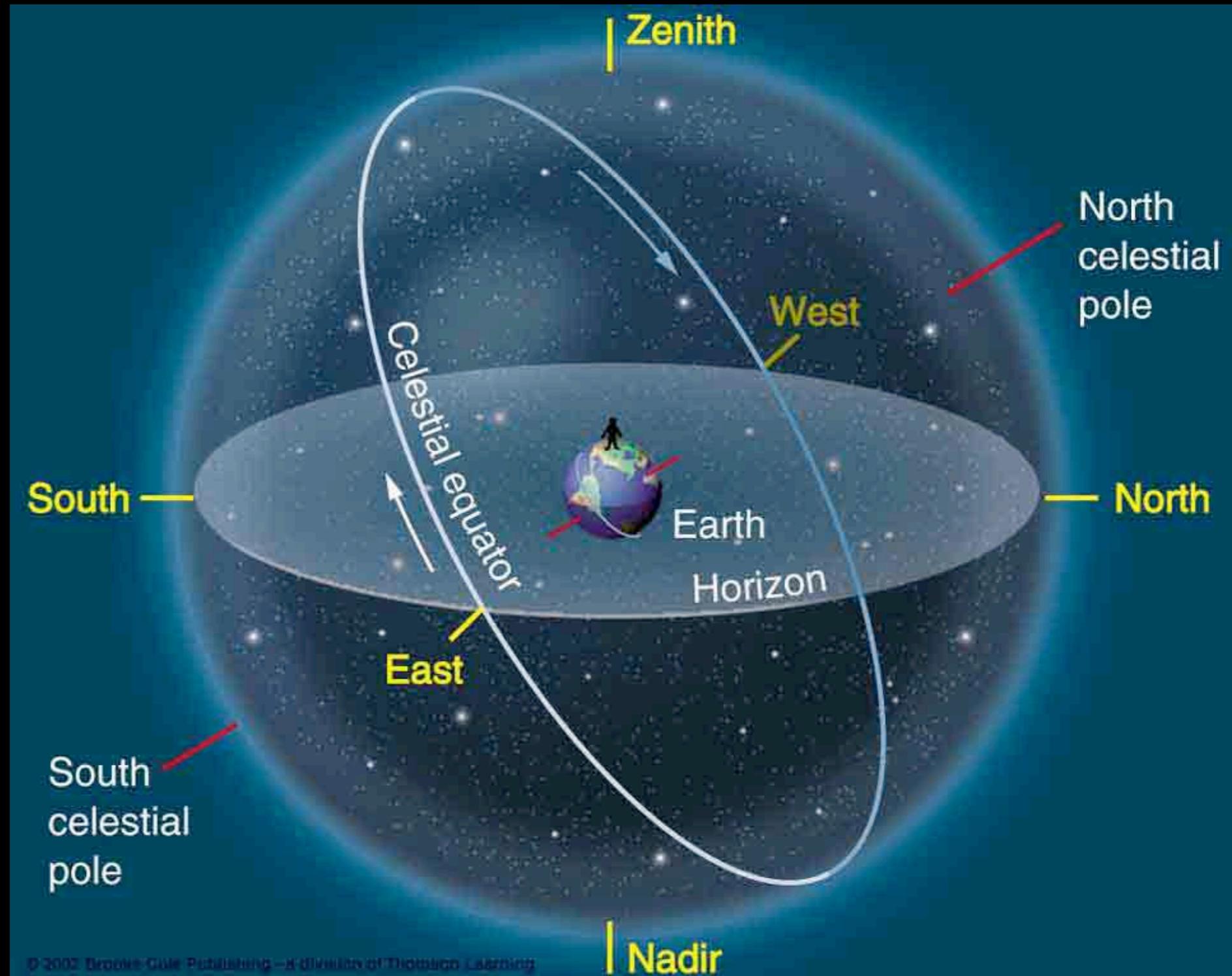
The Celestial Sphere

Vocabulary:

- longitude/latitude
- celestial sphere
- celestial pole/equator
- horizon/zenith
- constellation
- ecliptic/zodiac
- equinox
- solstice



Celestial Pole/Equator



© 2002 Brooks/Gale Publishing — a division of Thomson Learning

Motion in the Celestial Sphere

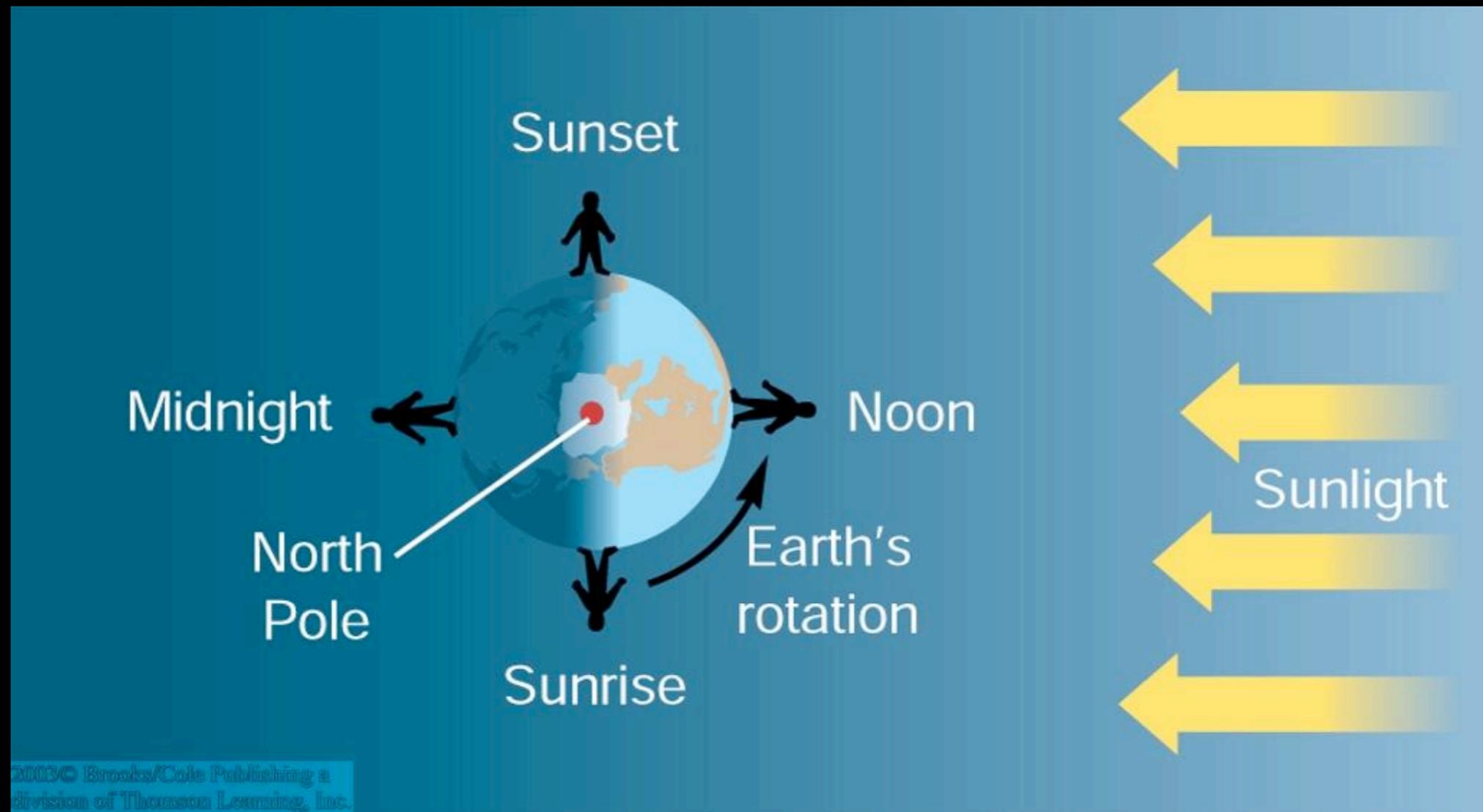
- 
- ➔ **Daily:** Objects rise in the East and set in the West.
 - ➔ **Monthly:** Moon seen at different “phases”.
 - ➔ **Yearly:** Different constellations visible at different times of year.
 - ➔ **Other:**

Diurnal Motion

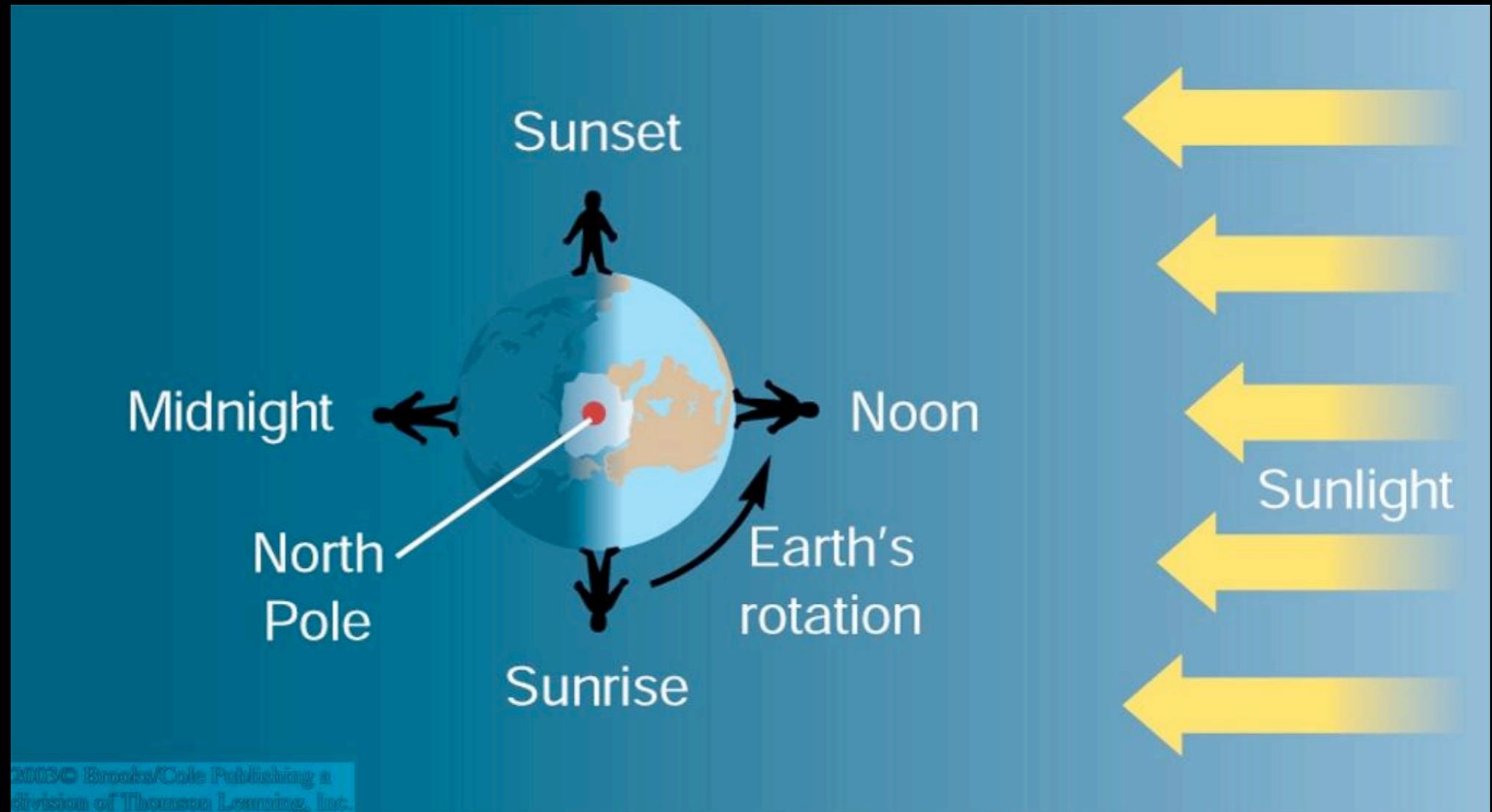


Picture taken of Earth/Moon from 6.2 million km away on December 16, 1992, by Galileo spacecraft on its way to Jupiter.

Diurnal Motion



Diurnal Motion



Earth's rotation is causing the day/night cycle.

Diurnal Motion



The division between daylight and darkness is at the right side of this image of the Earth. How do you know this is the sunset line and not the sunrise line?

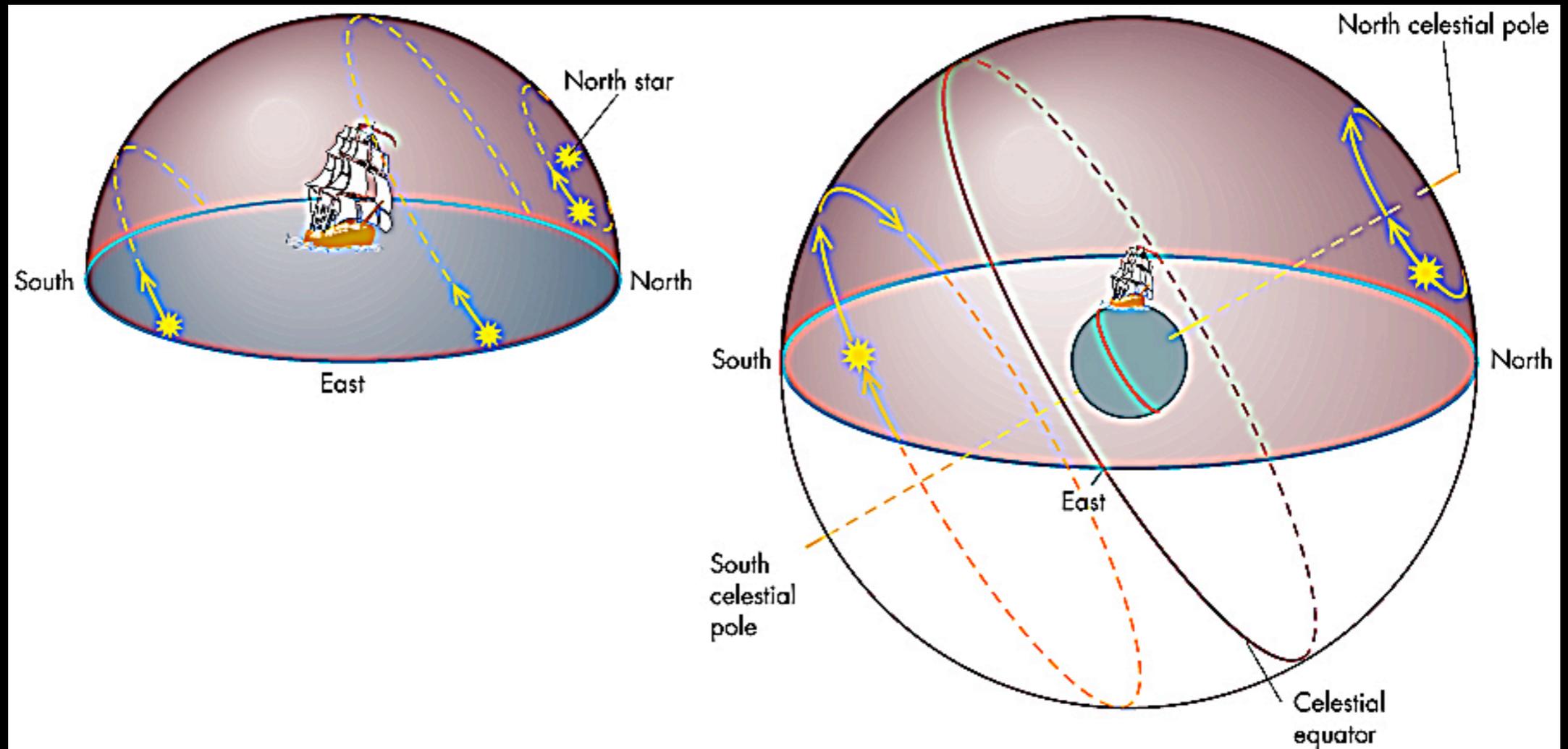
Diurnal Motion

If you could hover over the Earth's north rotational pole and look down at the Earth as it spins, you would see that the Earth spins in a _____ direction.

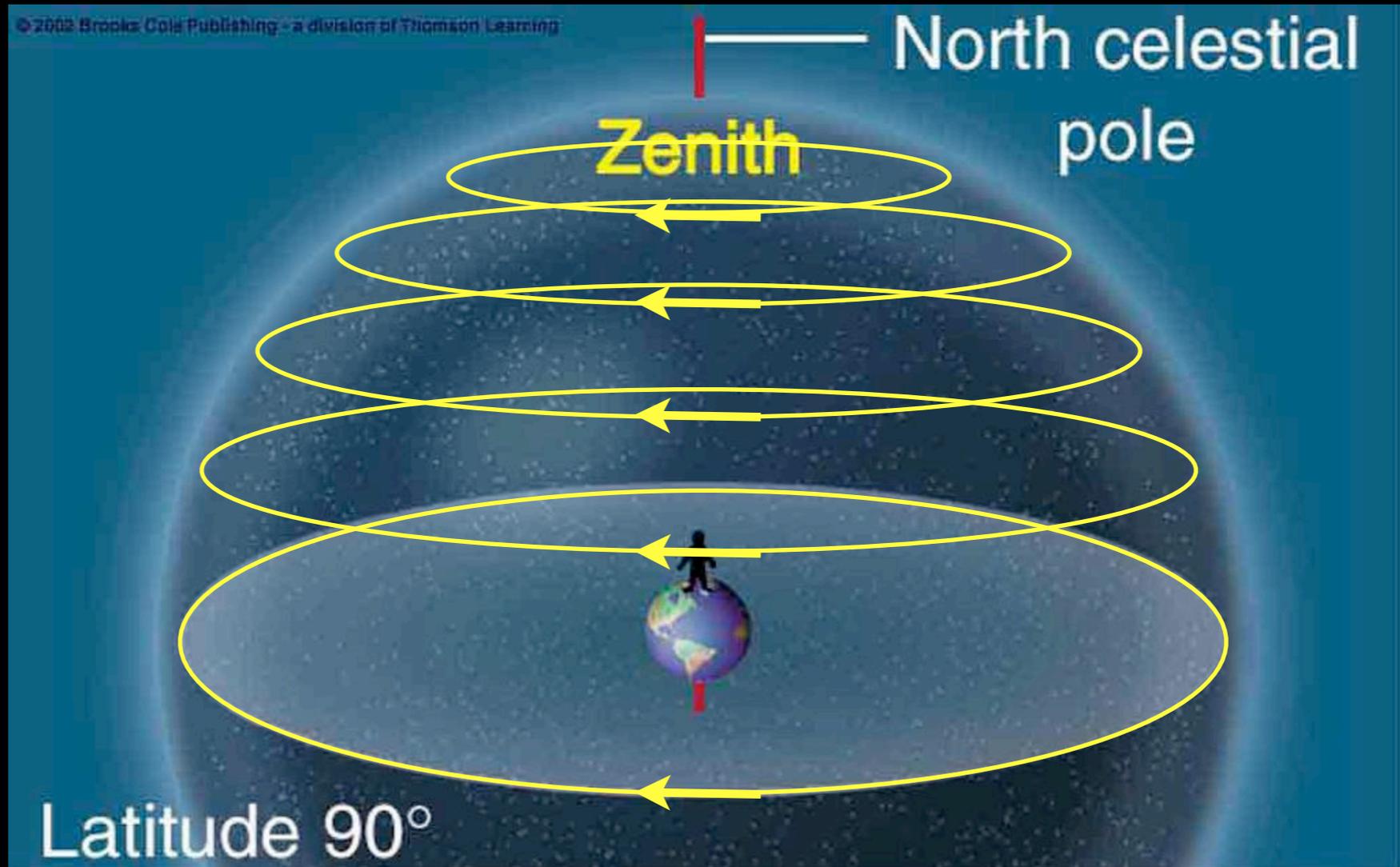
- a) clockwise
- b) counter-clockwise



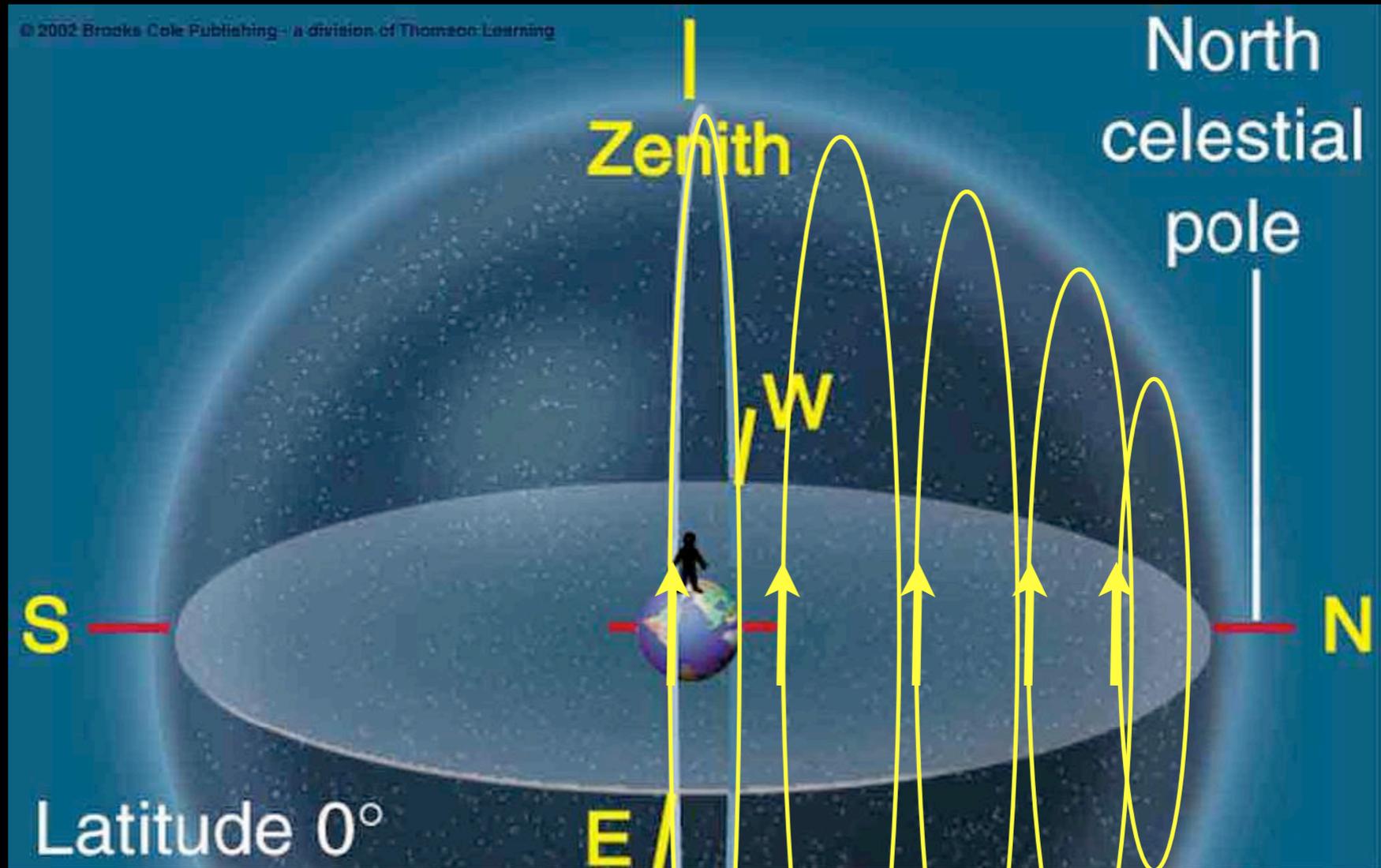
Diurnal Motion



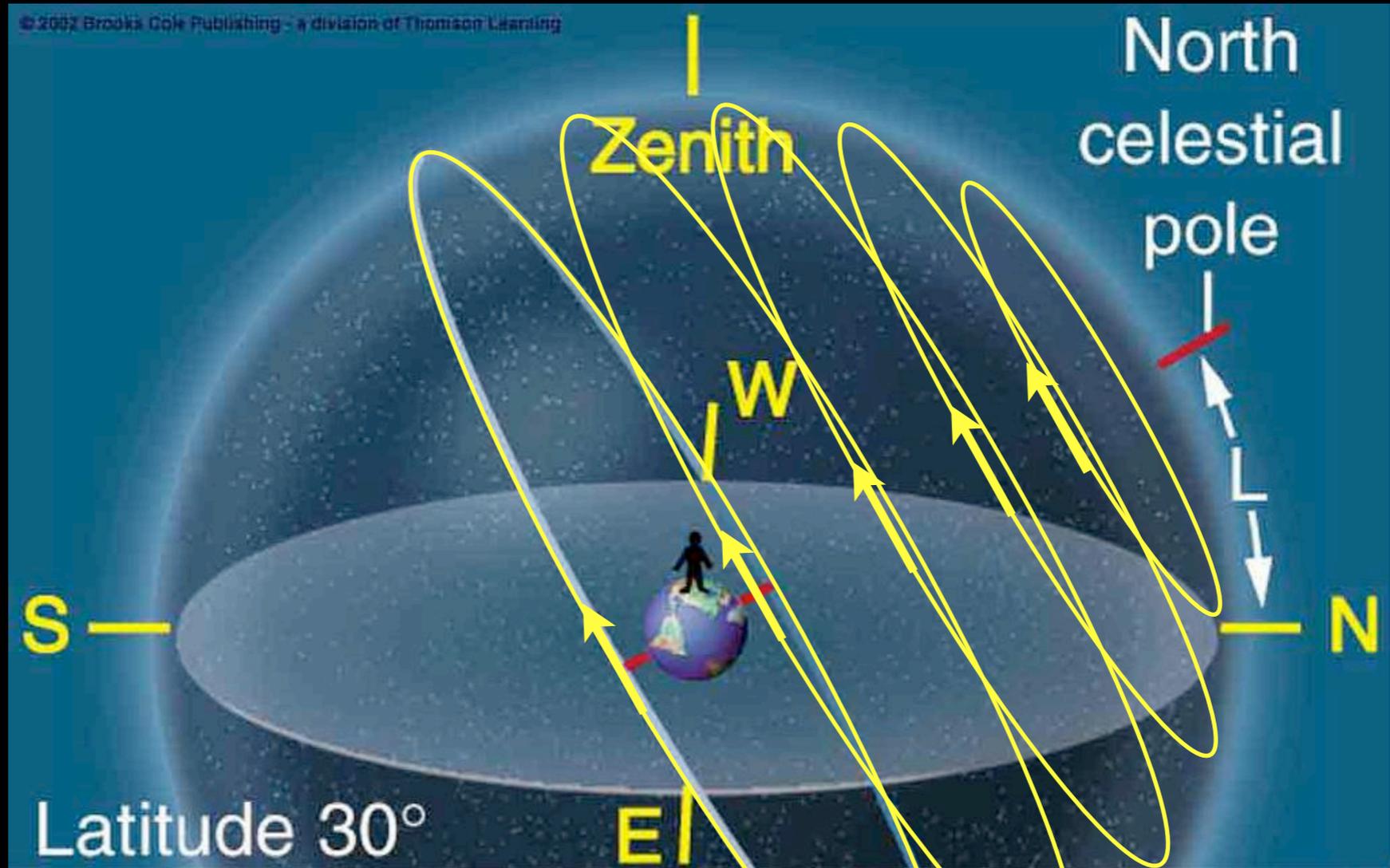
Diurnal Motion: 90° latitude



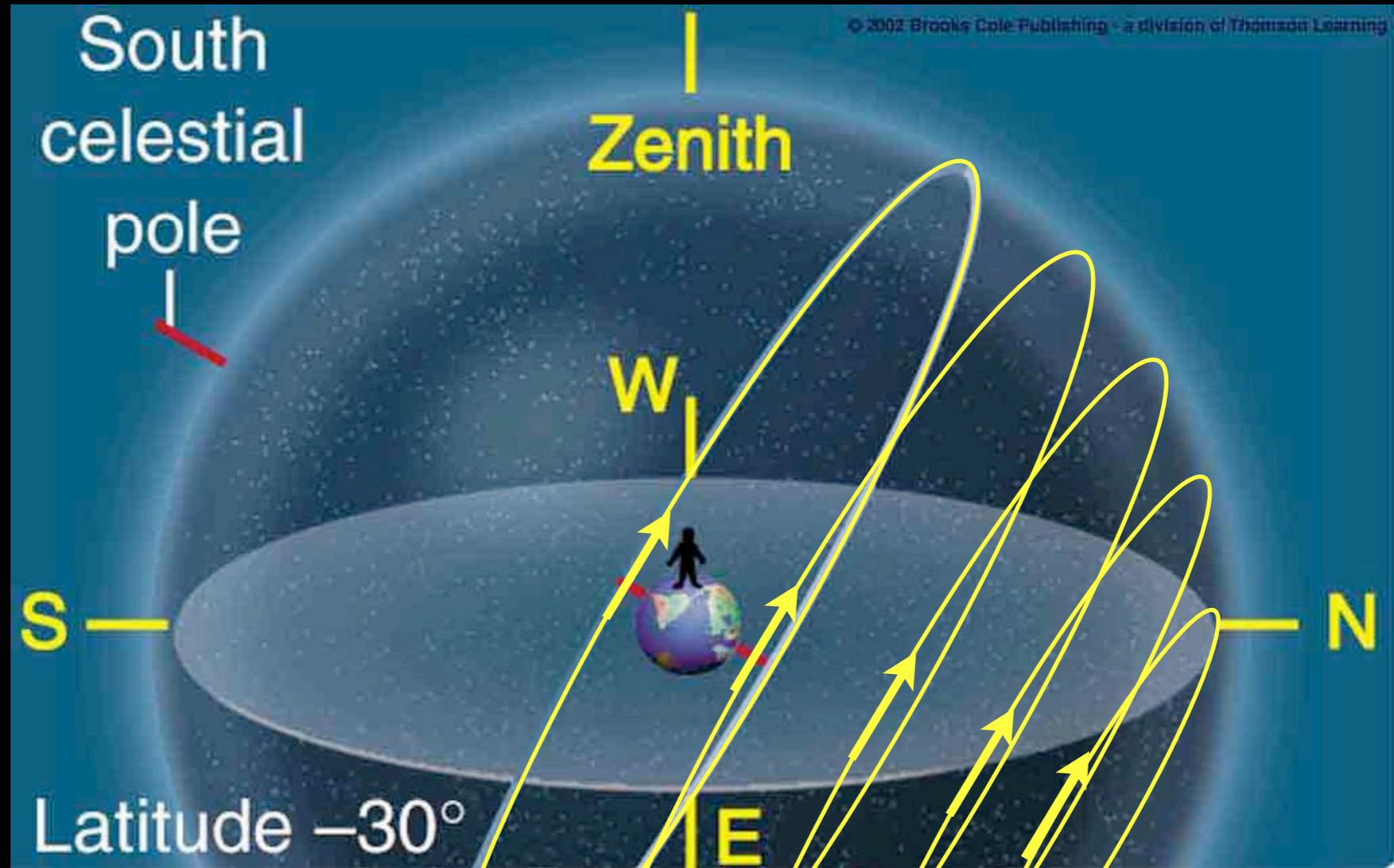
Diurnal Motion: 0° latitude



Diurnal Motion: 30° latitude



Diurnal Motion: -30° latitude

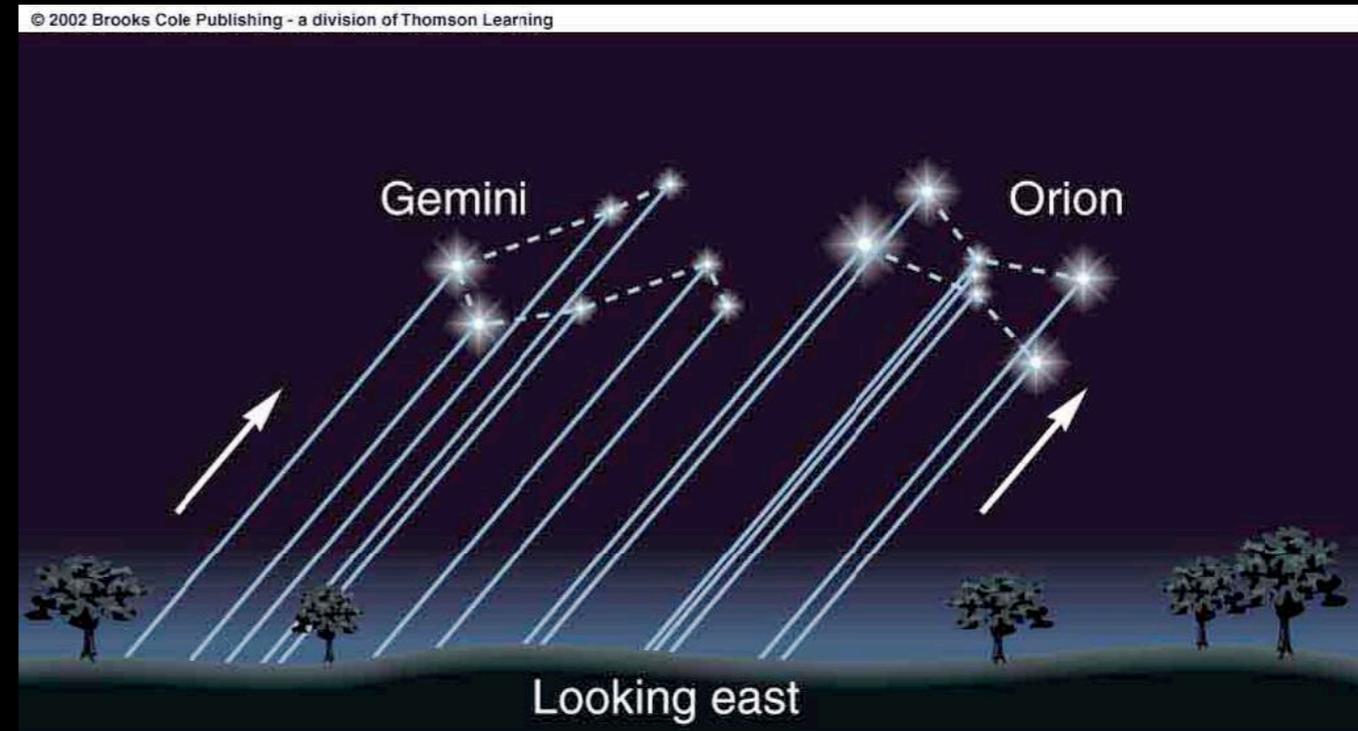


Path of the stars across the sky



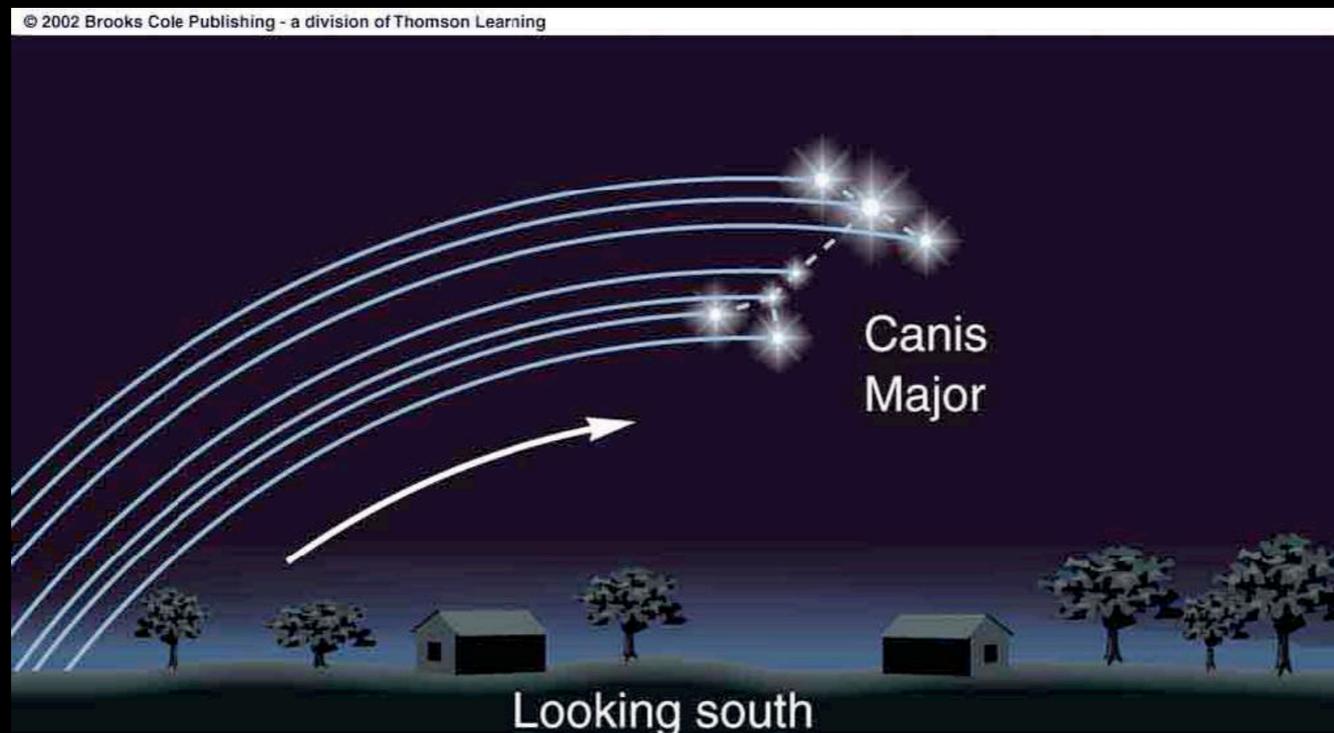
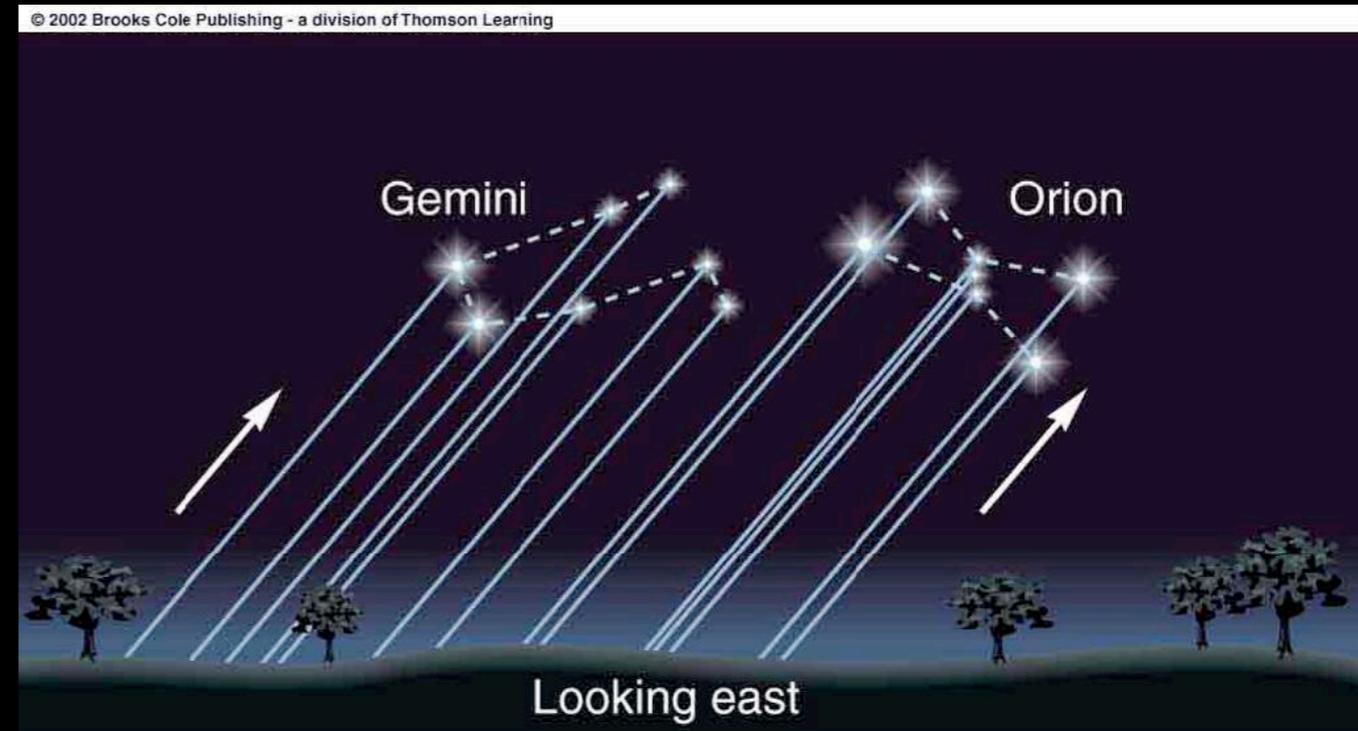
Path of the stars across the sky

Looking east, you see stars rising and moving to the upper right (south)



Path of the stars across the sky

Looking east, you see stars rising and moving to the upper right (south)



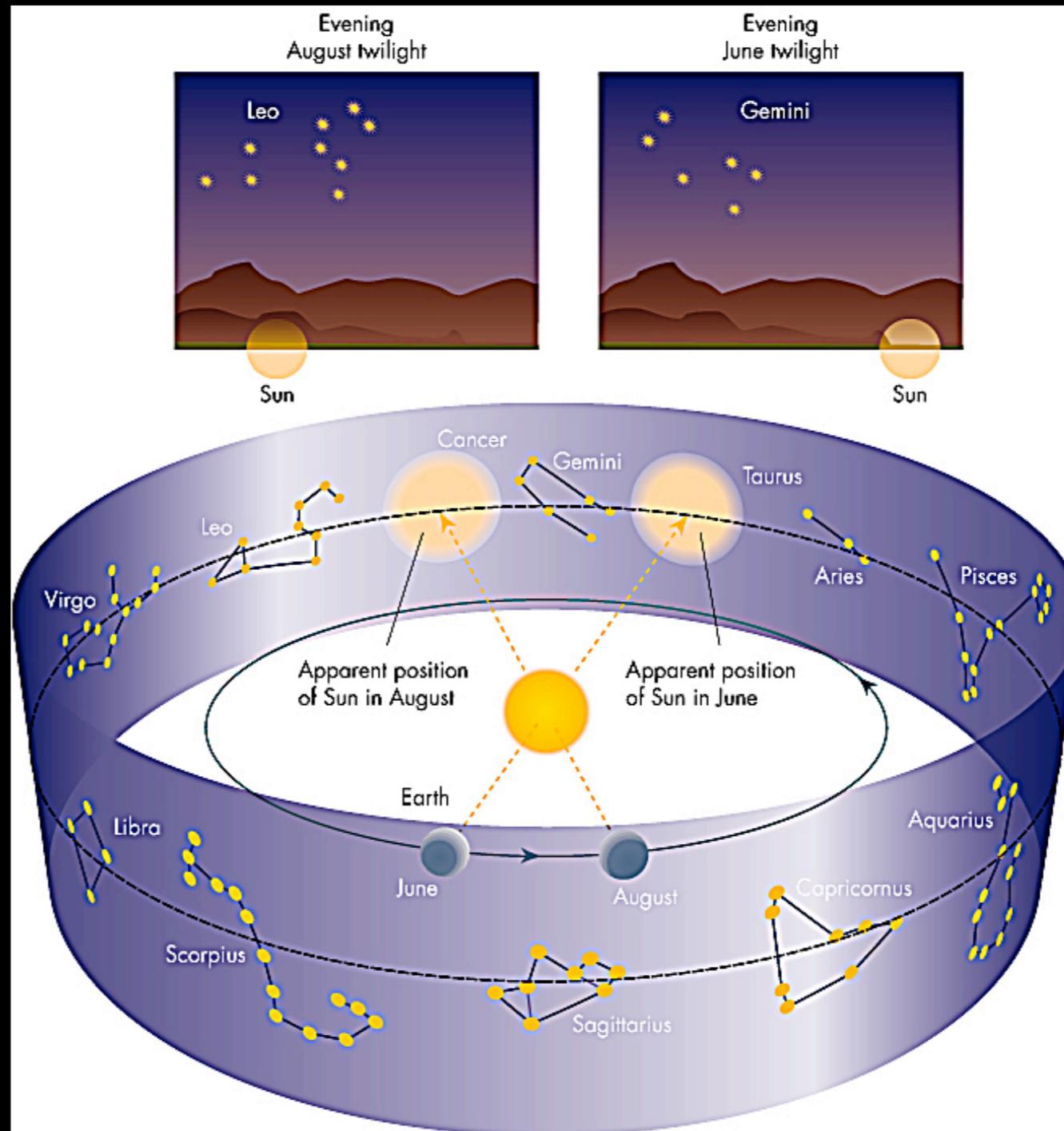
Looking south, you see stars moving to the right (west)

Diurnal Motion

- Celestial objects only rise perpendicular to the horizon if you happen to be living on the equator
- In the Northern hemisphere, objects rise inclined toward the south (to the north if you are in the southern hemisphere).
- At the poles, objects will not rise or set, but circle around you!!



Annual Motion



The constellations in the night sky change over the course of the year due to the Earth's orbit about the Sun.

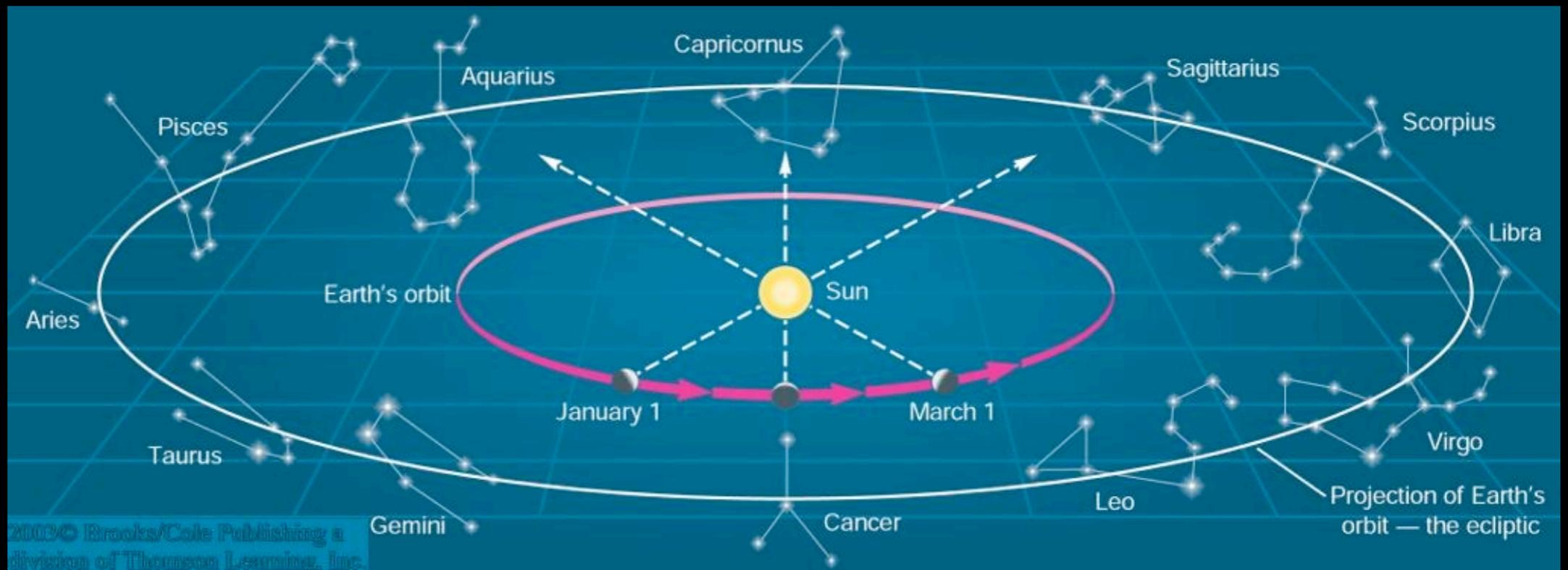
Annual Motion

Due to Earth's revolution around the sun, the sun appears to move through the **zodiacal constellations**.



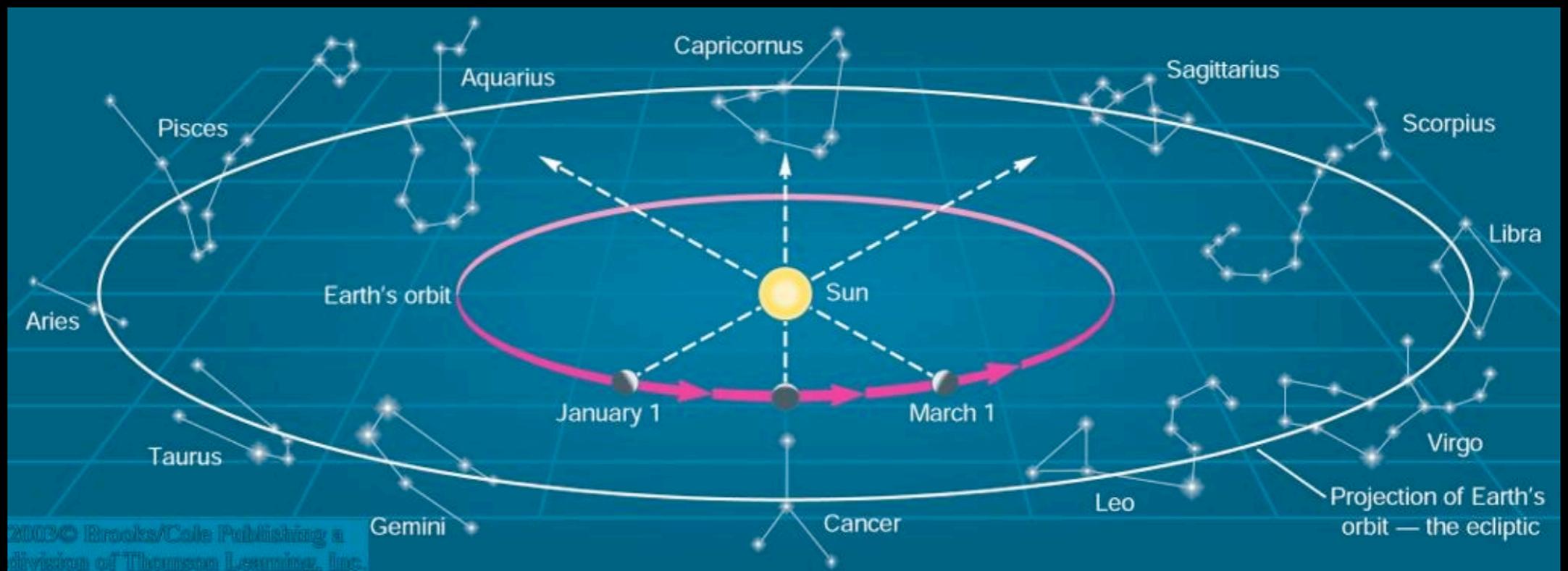
Annual Motion

Due to Earth's revolution around the sun, the sun appears to move through the **zodiacal constellations**.



Annual Motion

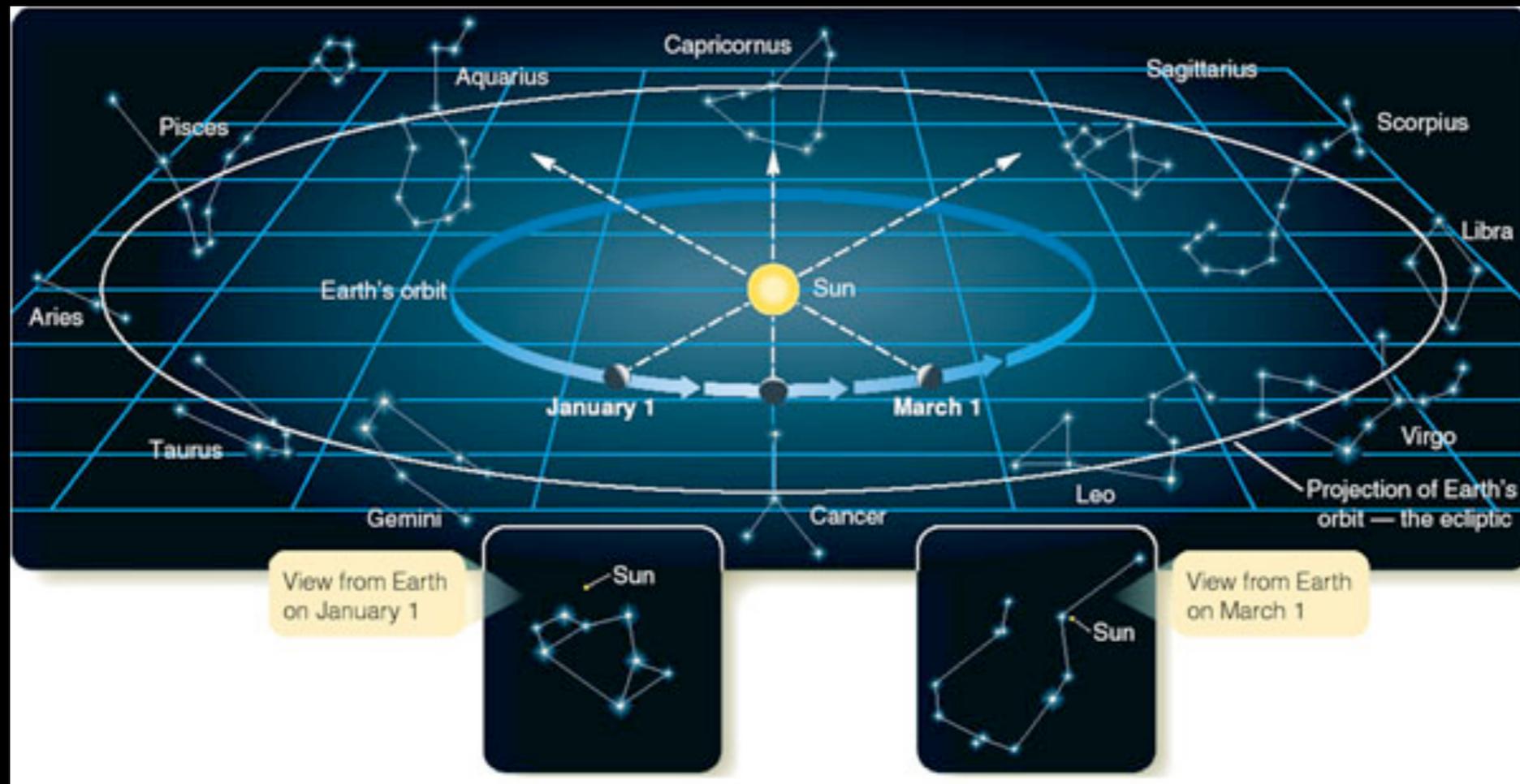
Due to Earth's revolution around the sun, the sun appears to move through the **zodiacal constellations**.



The Sun's apparent path on the sky is called the **Ecliptic**.

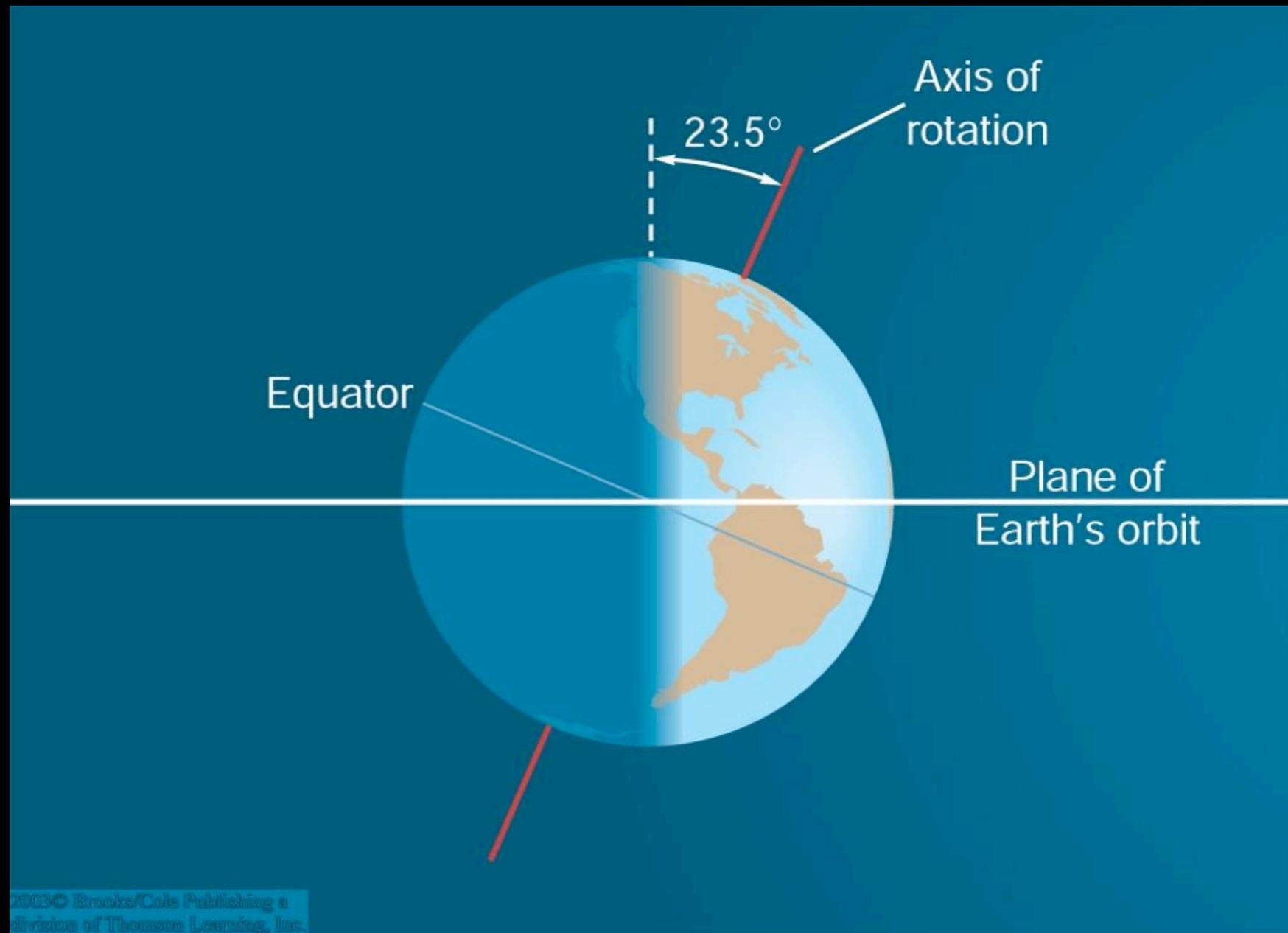
Equivalent: The Ecliptic is the projection of Earth's orbit onto the celestial sphere.

Based on this figure, in what constellation is the sun on July 1 each year?

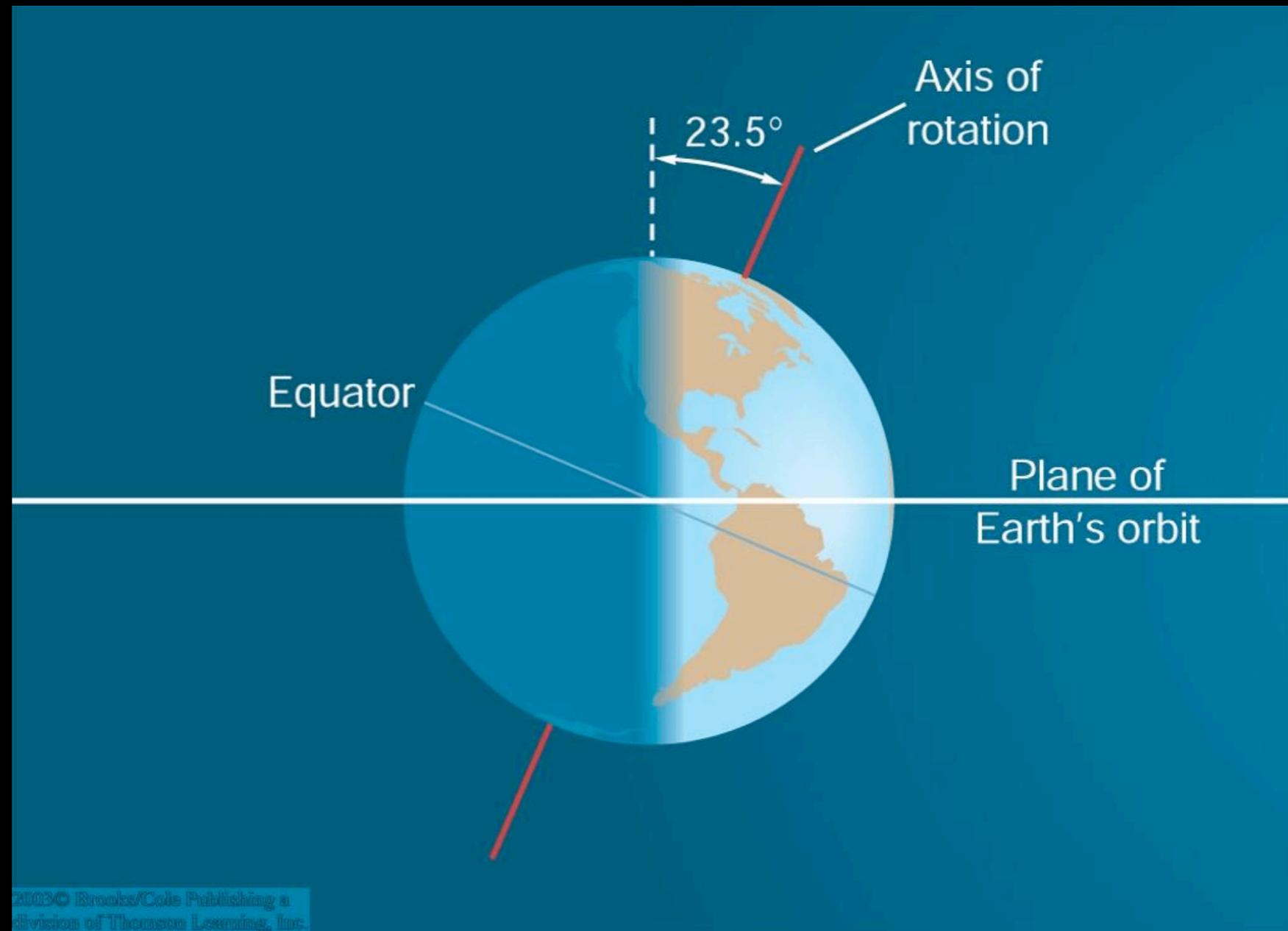


1. Gemini
2. Sagittarius
3. Cancer
4. Leo
5. Aquarius

The Seasons

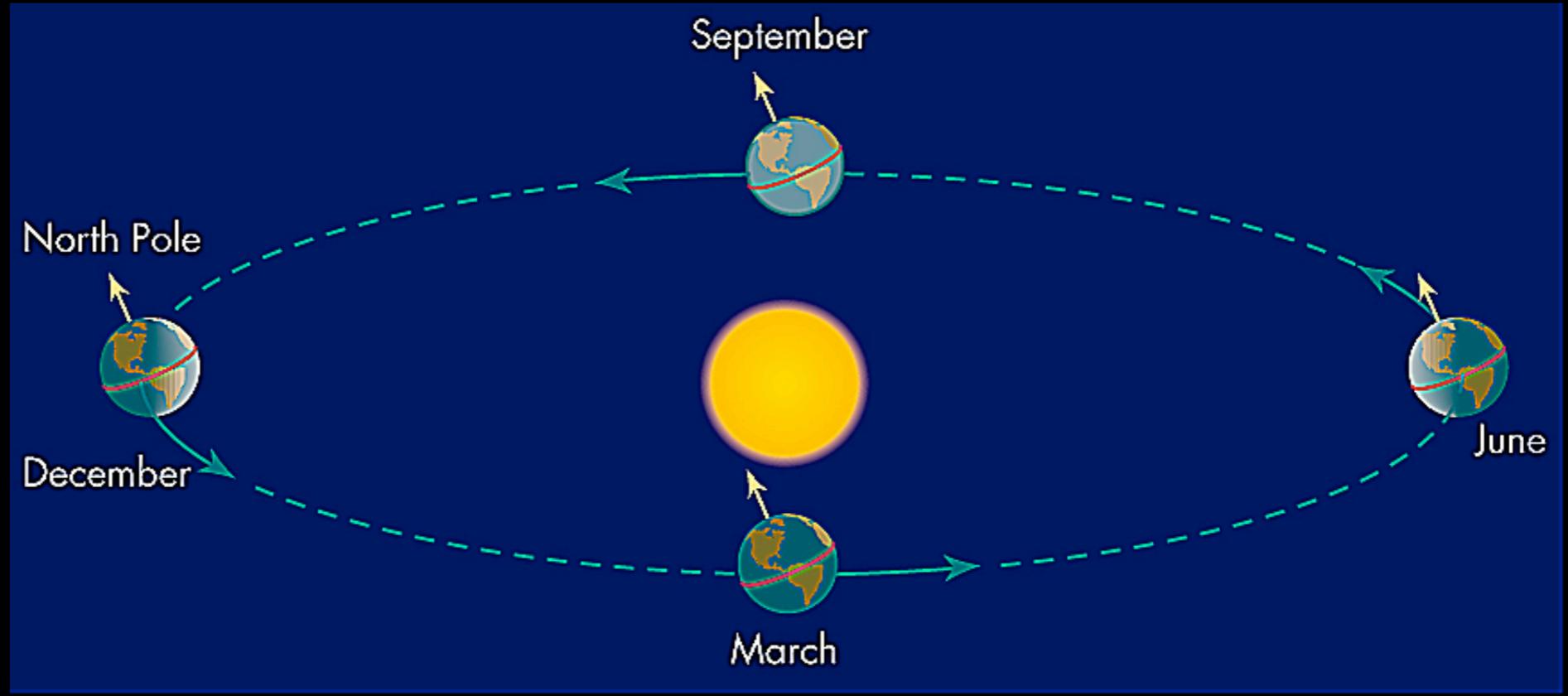


The Seasons

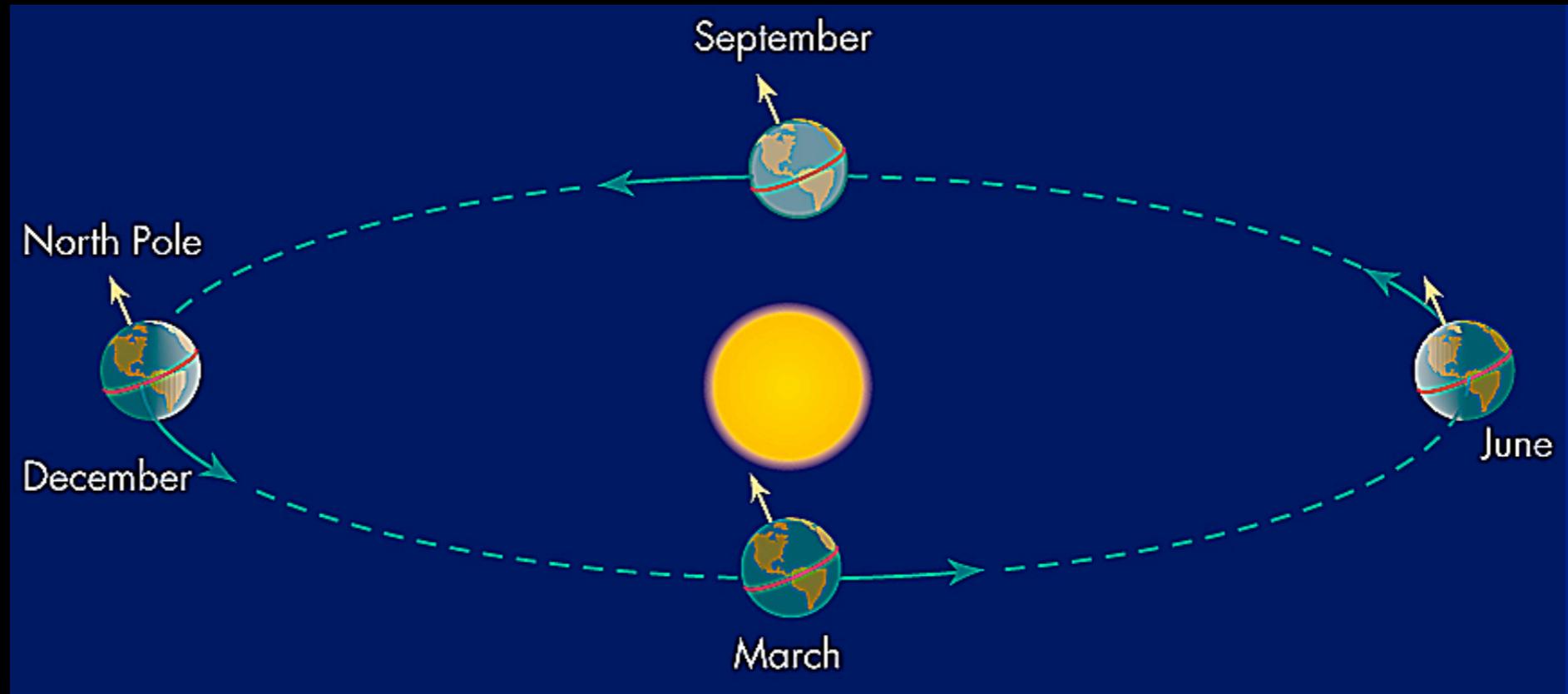


Earth's axis of rotation is inclined vs. the normal to its orbital plane by 23.5° , which causes the **seasons.**

The Seasons



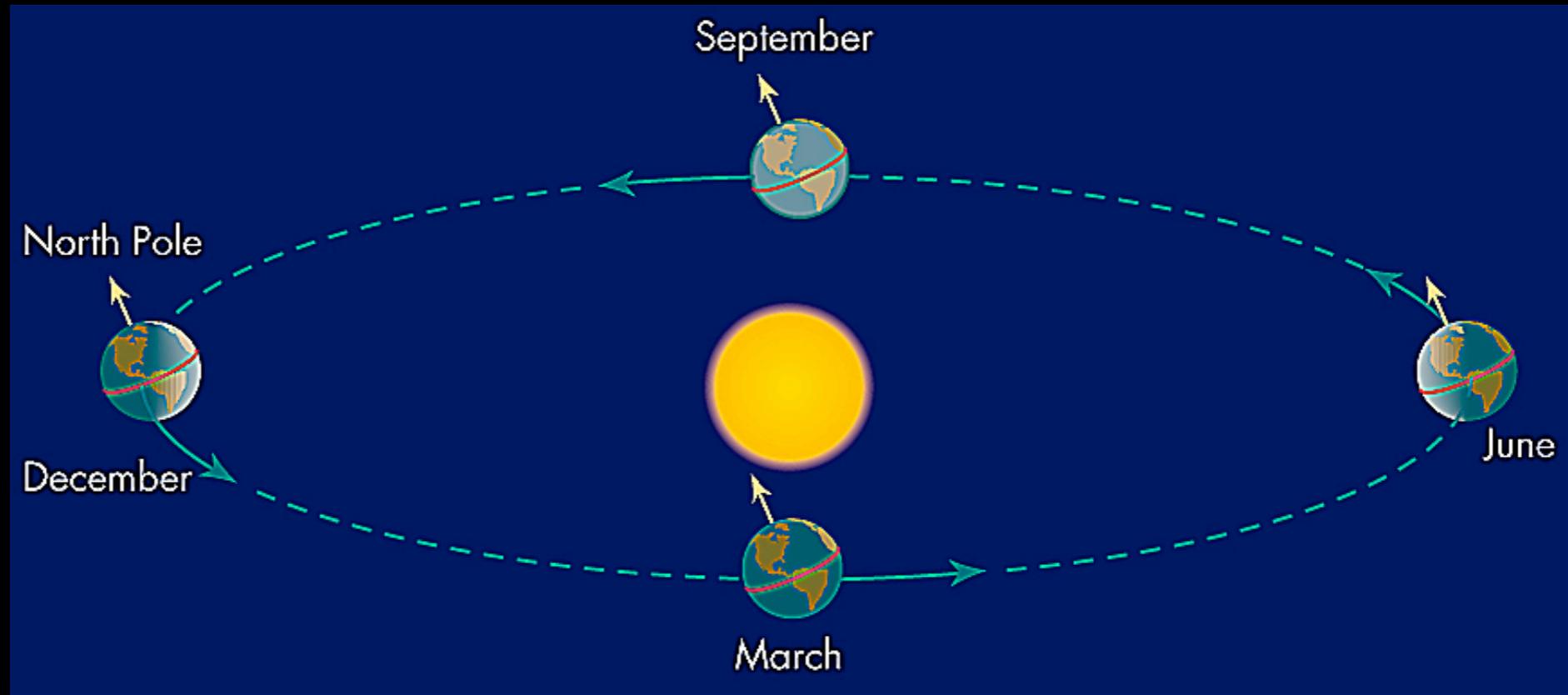
The Seasons



As it orbits the Sun, the Earth maintains its orientation, at least on timescales of hundreds of years.

The Seasons

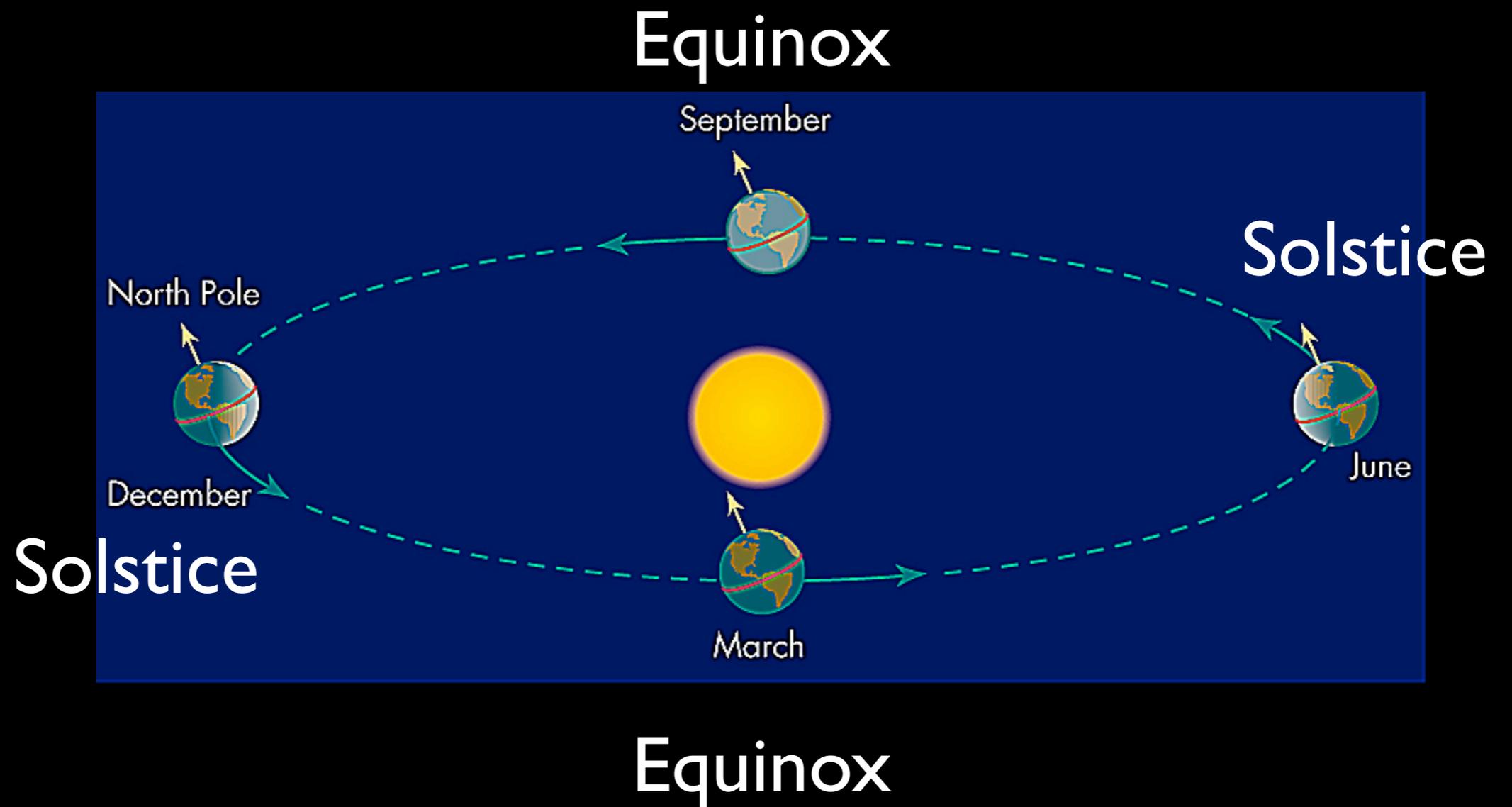
Equinox



Equinox

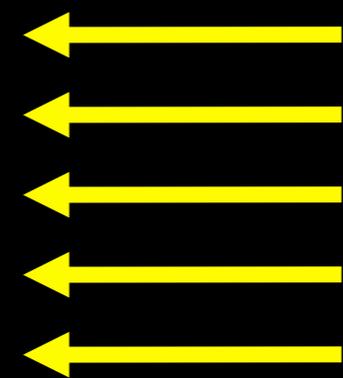
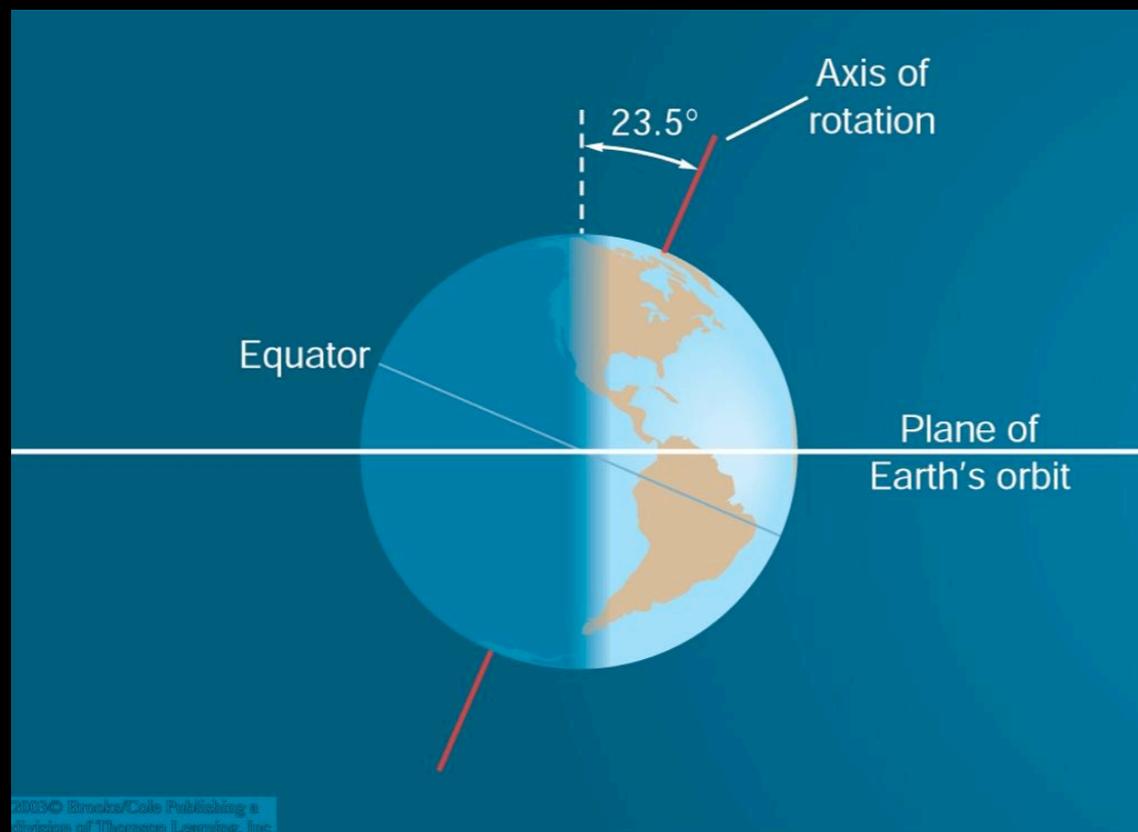
As it orbits the Sun, the Earth maintains its orientation, at least on timescales of hundreds of years.

The Seasons



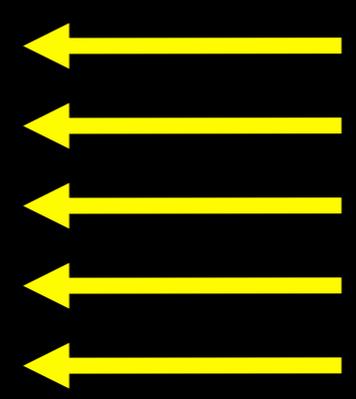
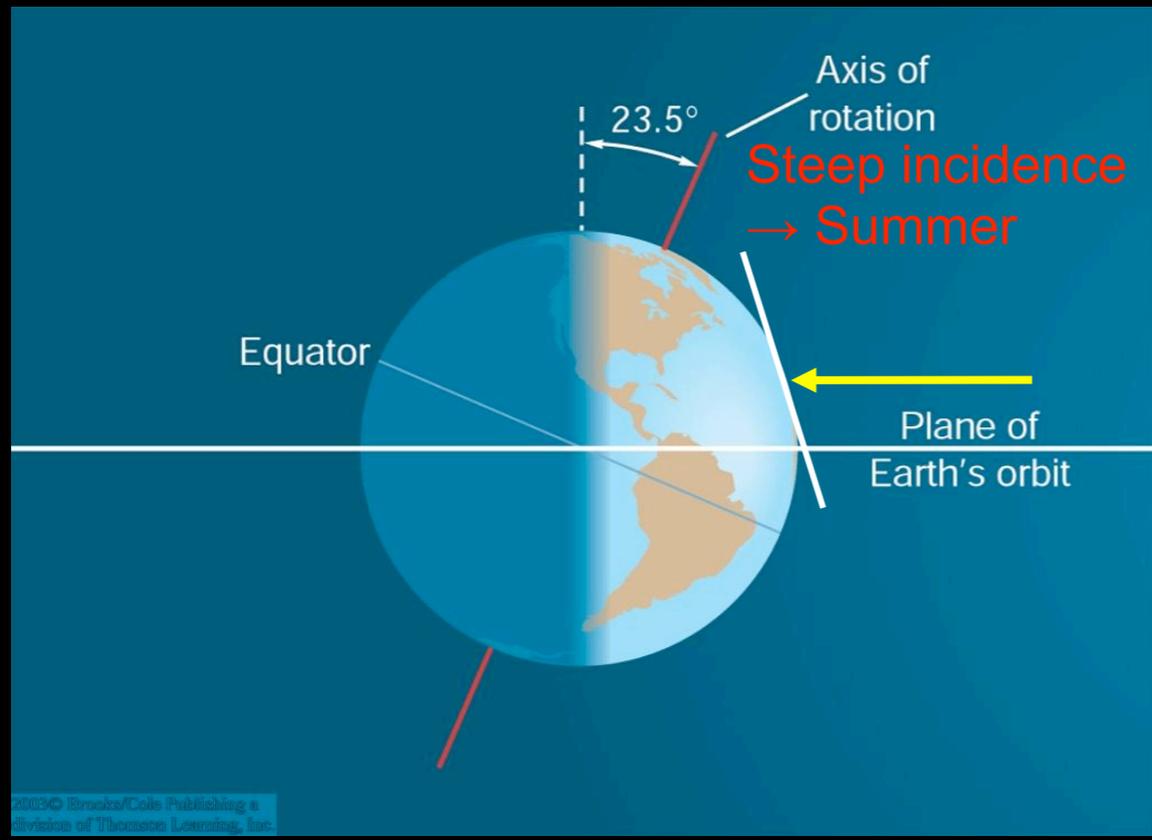
As it orbits the Sun, the Earth maintains its orientation, at least on timescales of hundreds of years.

The Seasons



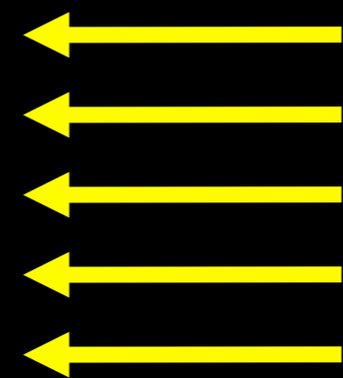
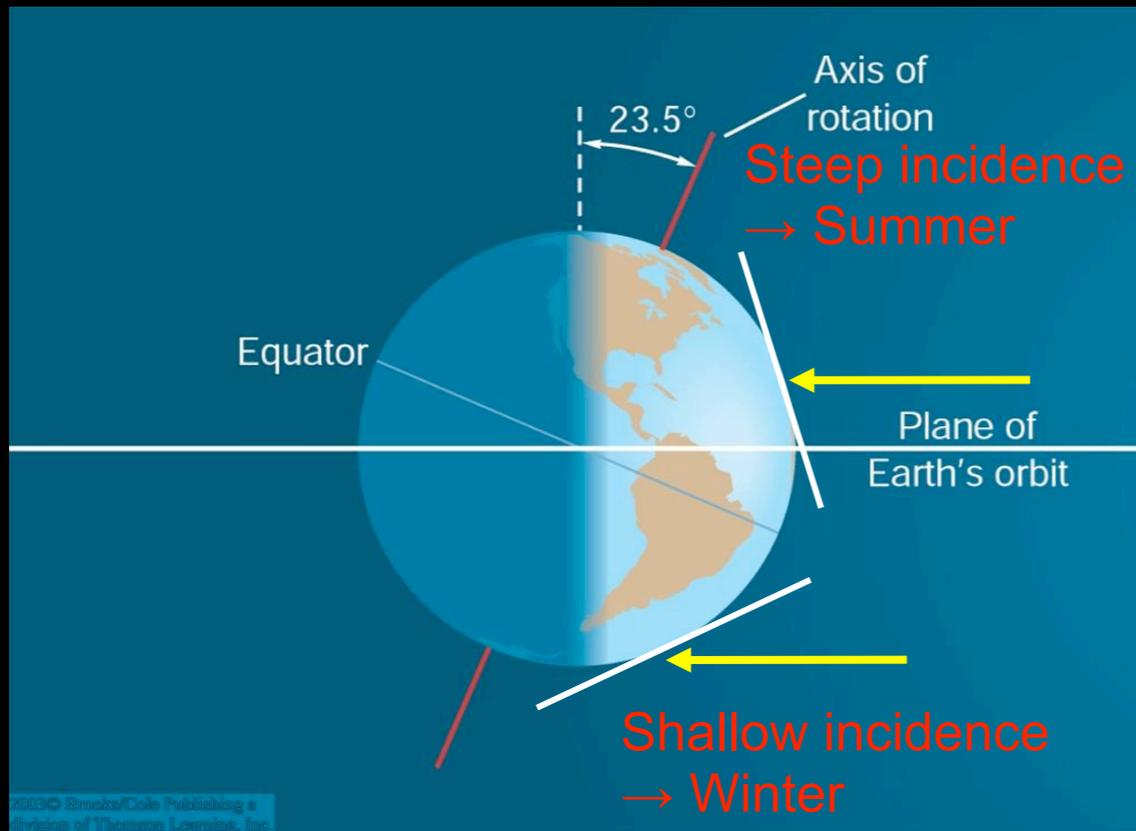
**Light
from the
sun**

The Seasons



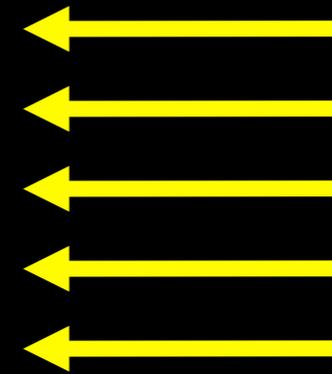
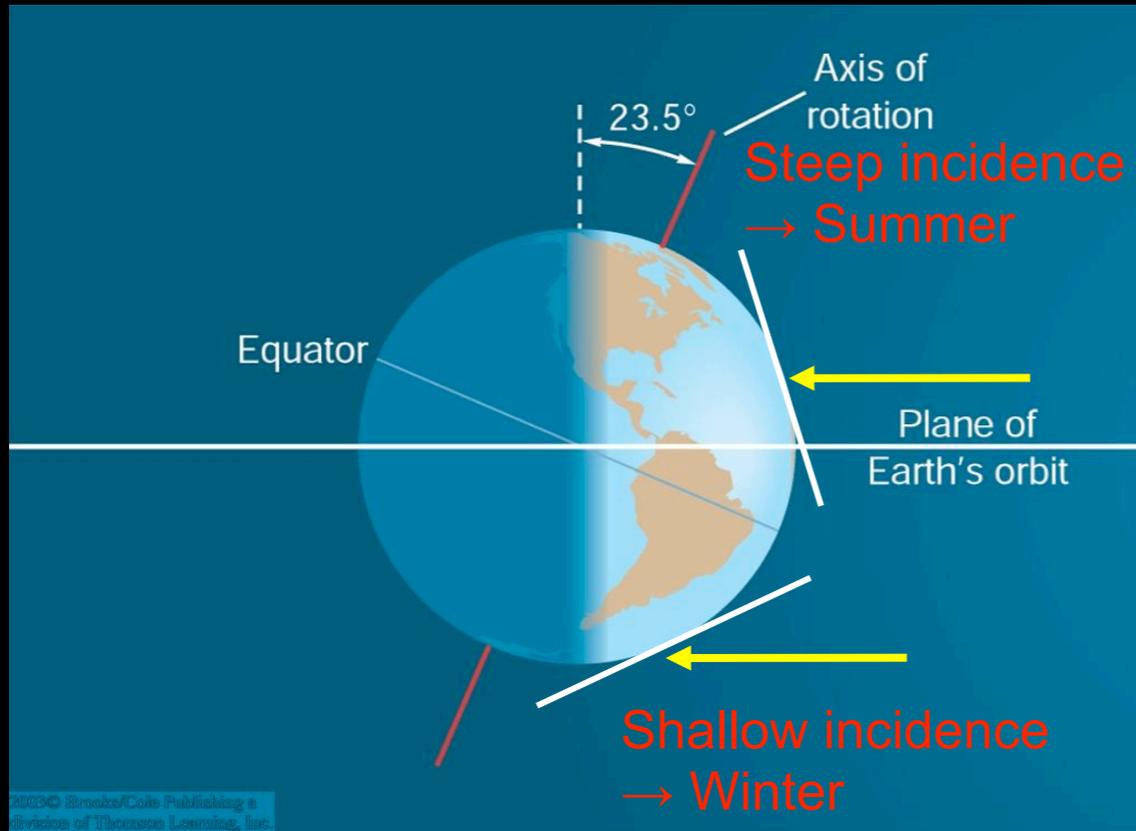
**Light
from the
sun**

The Seasons



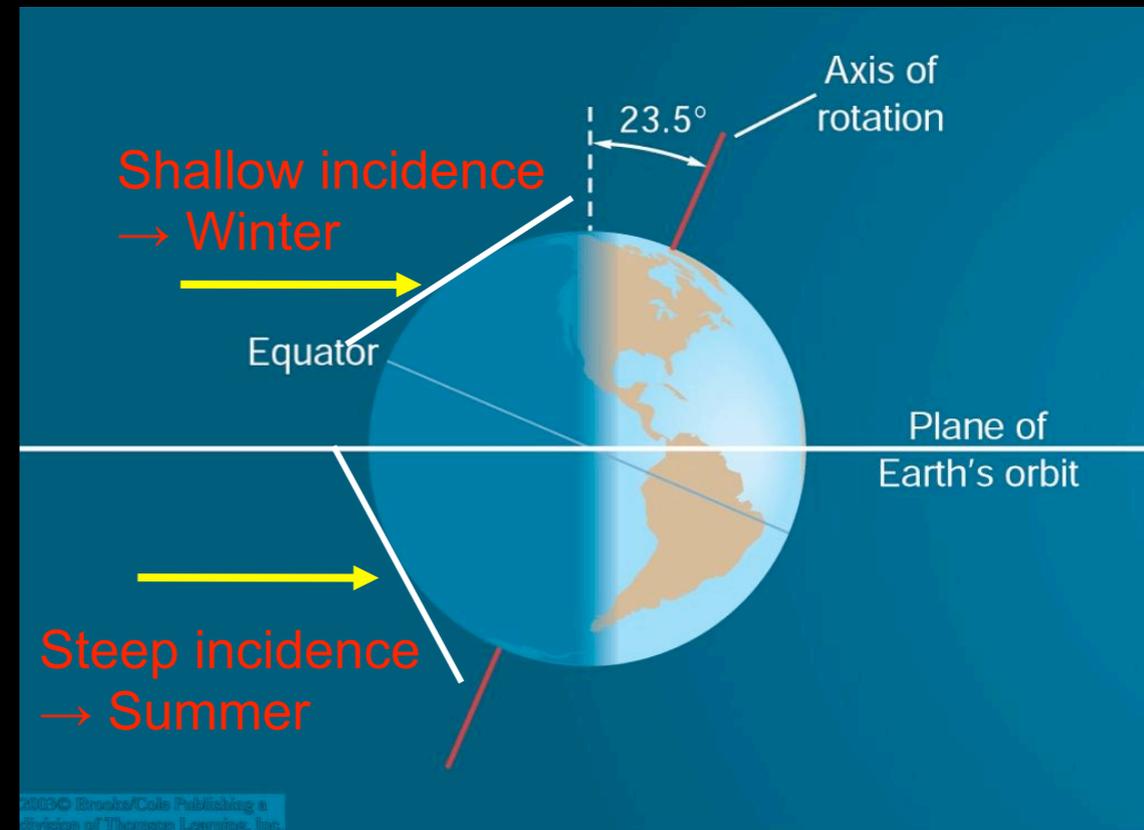
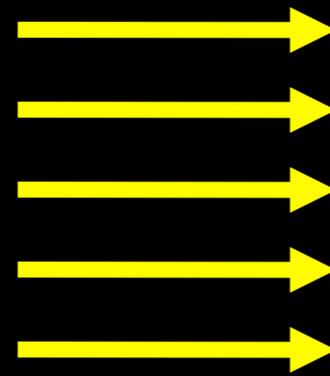
**Light
from the
sun**

The Seasons

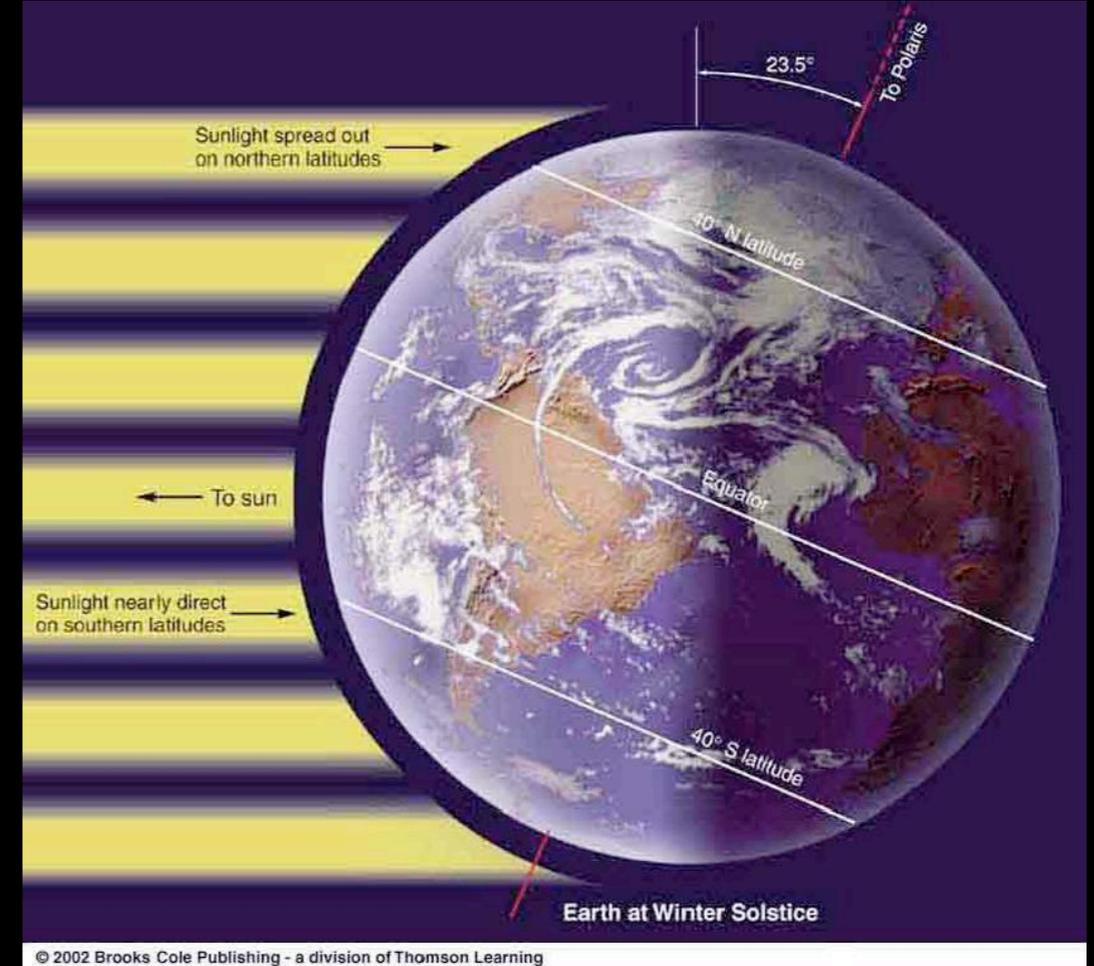
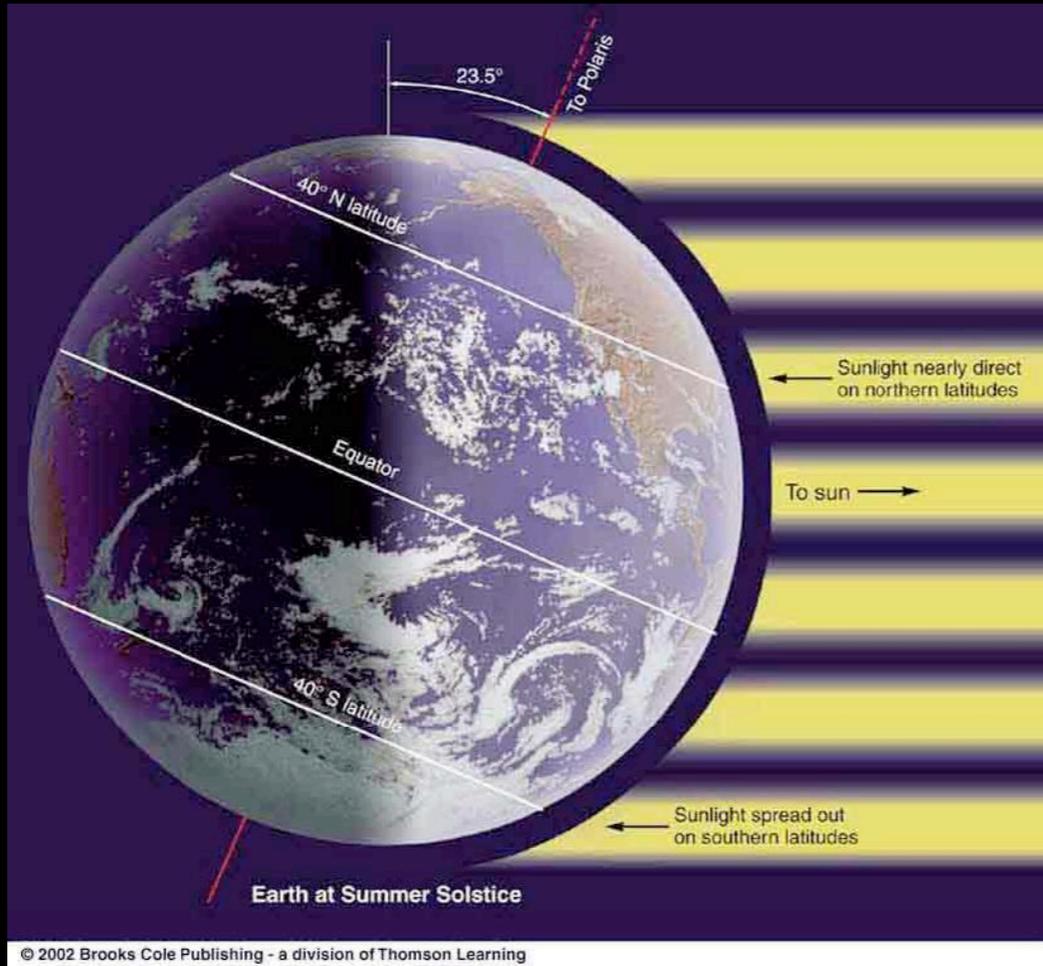


**Light
from the
sun**

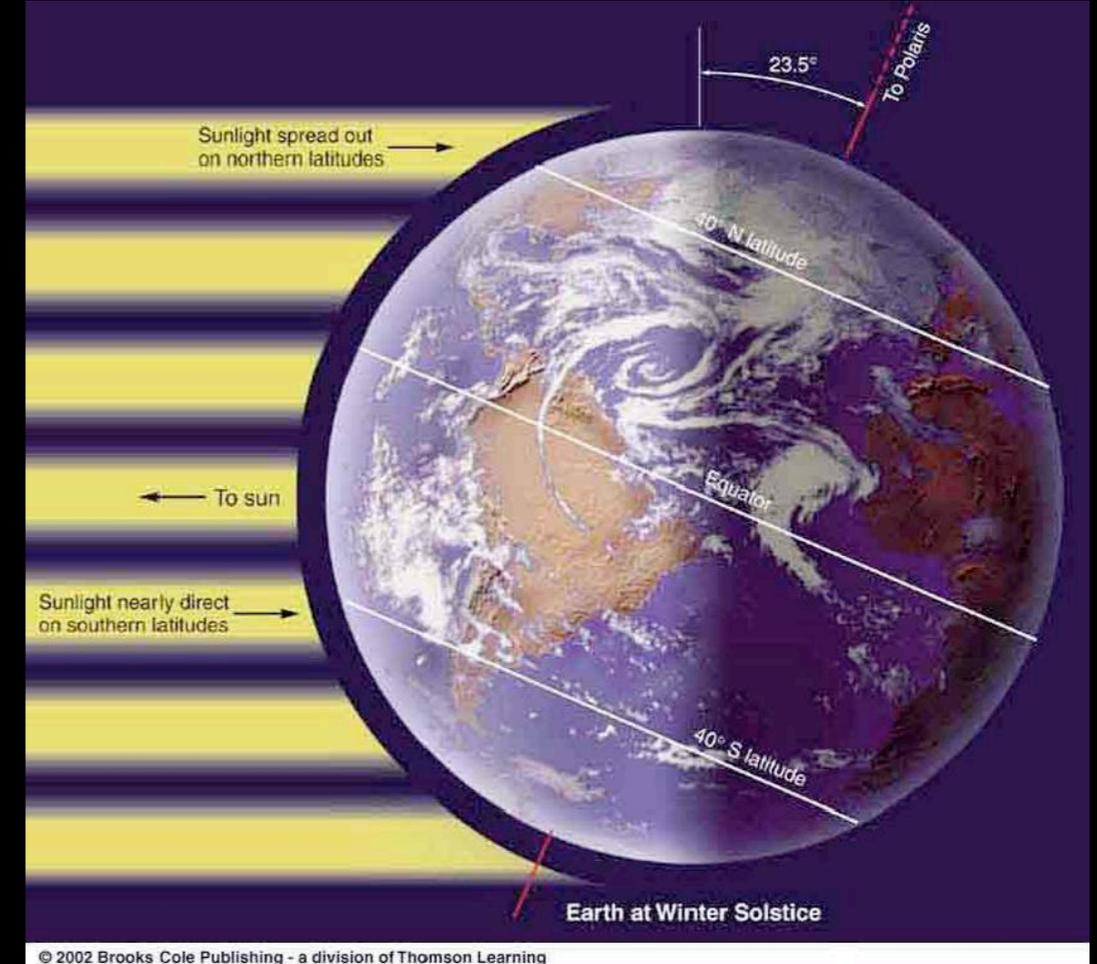
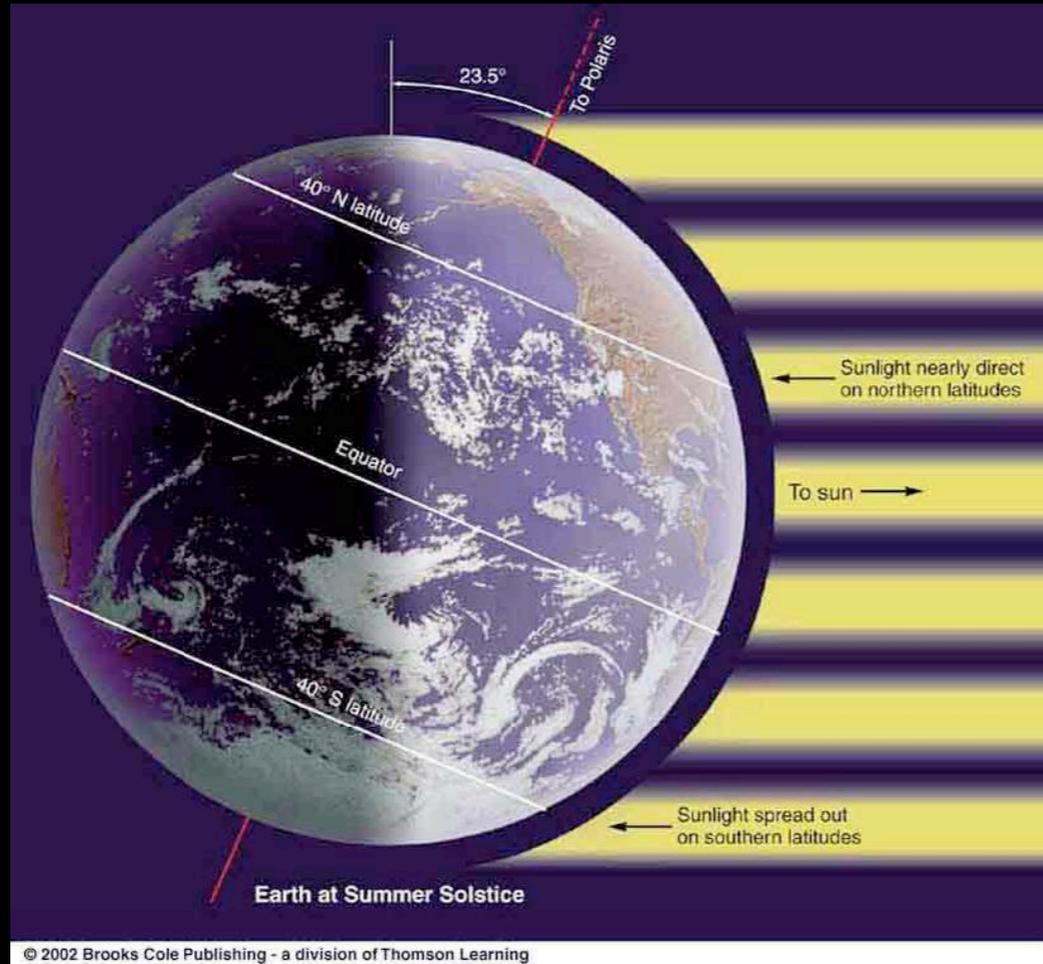
**Light
from the
sun**



The Seasons

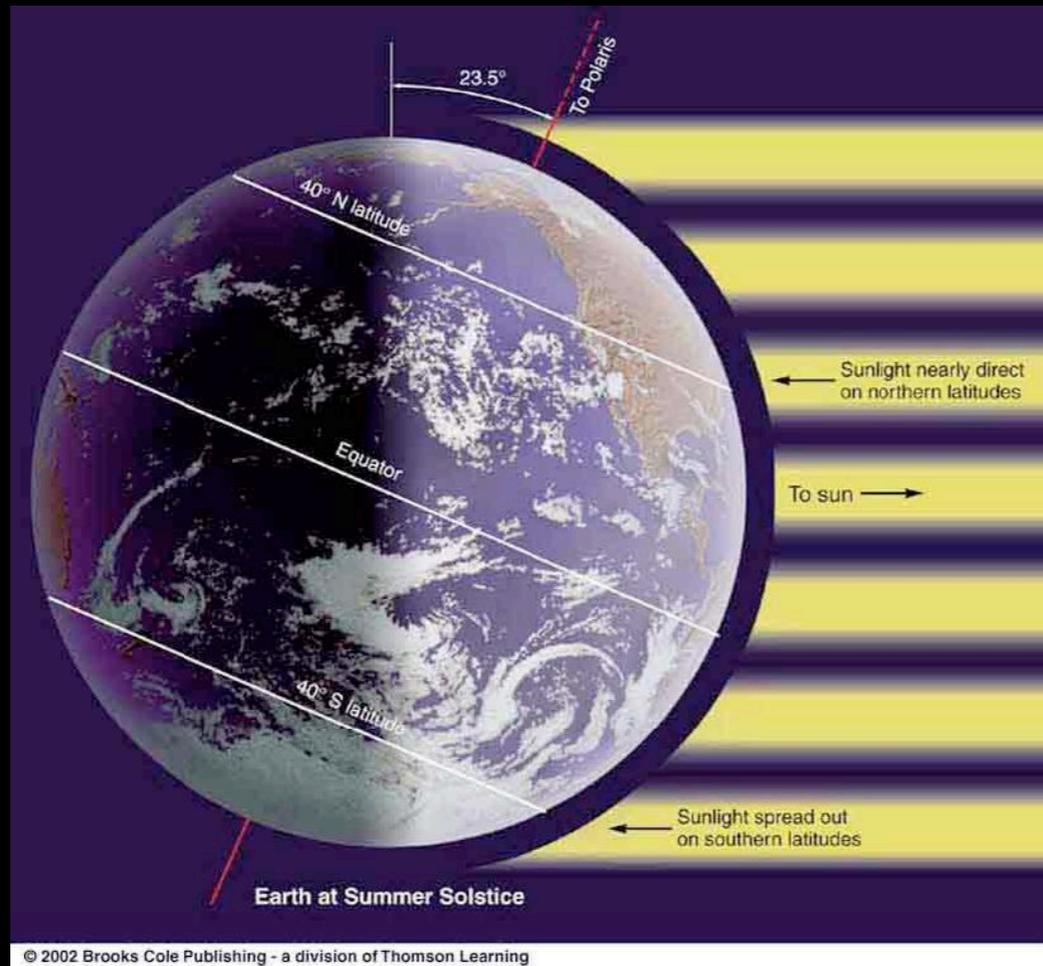


The Seasons

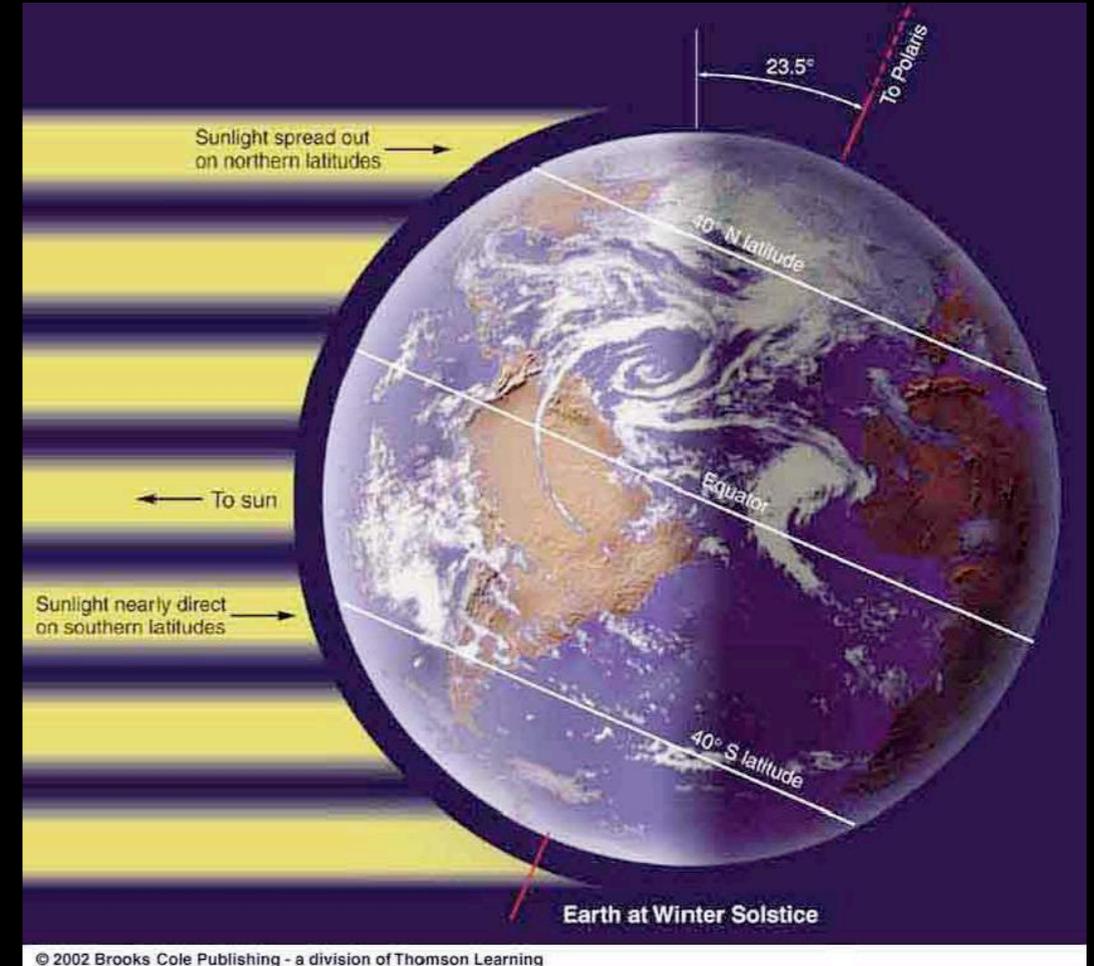


Sun is higher in the sky at noon in the summer
Day-light lasts longer

The Seasons



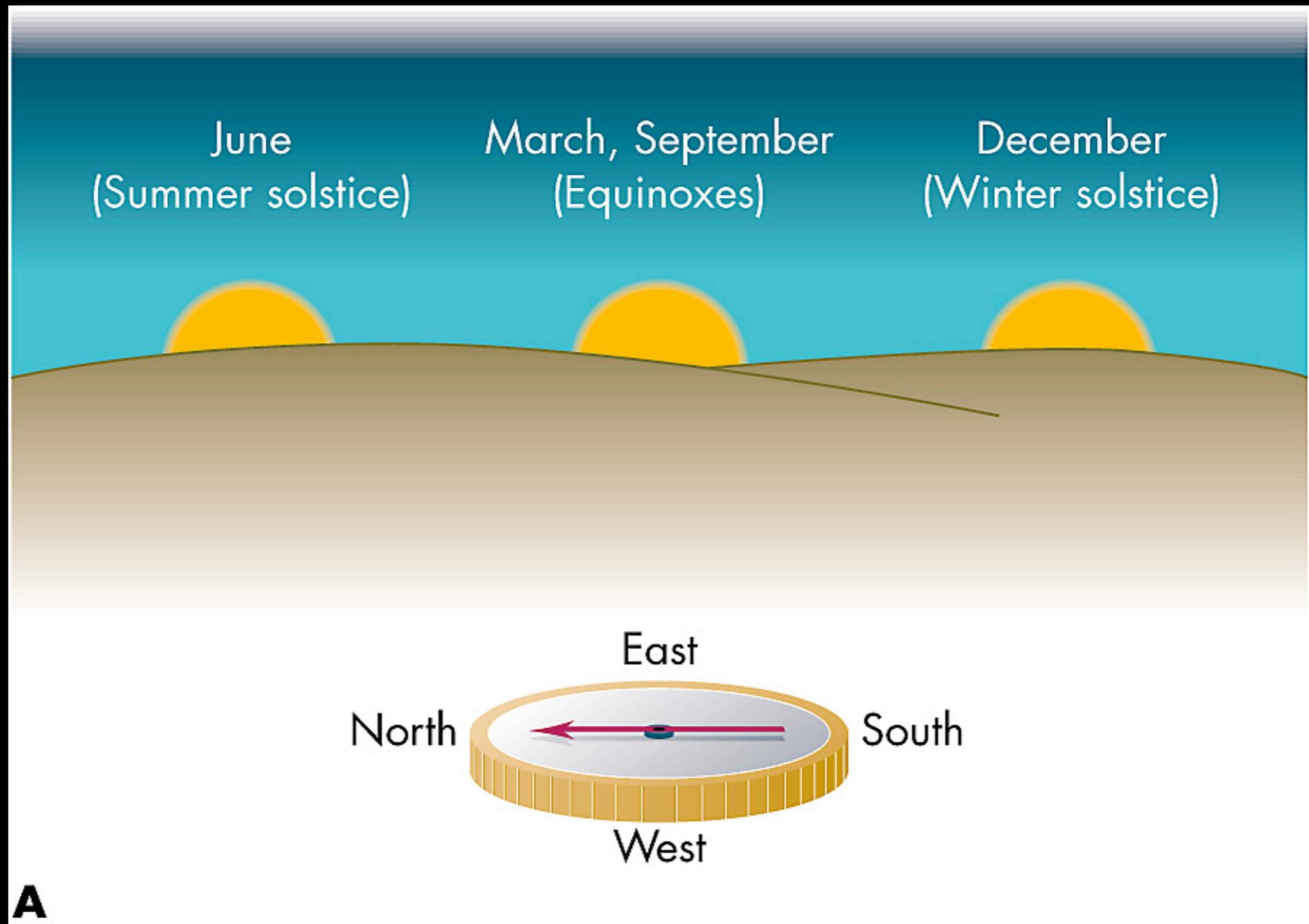
Sun is higher in the sky at noon in the summer
Day-light lasts longer



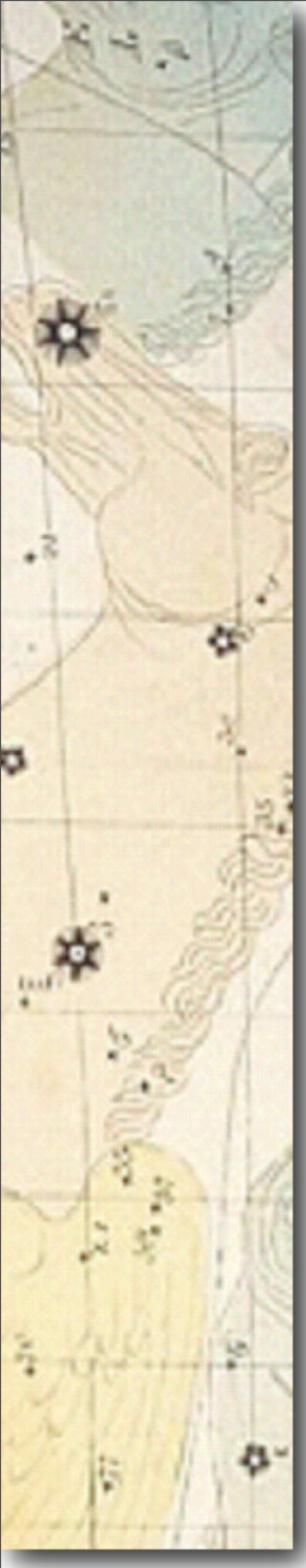
Sun is lower in the sky at noon in the winter
Night-time lasts longer

At what latitude would the Sun be directly overhead at noon at the summer solstice?

Rising/Setting Sun



Where the Sun rises and sets also changes with the seasons.



The Seasons

Equinox:

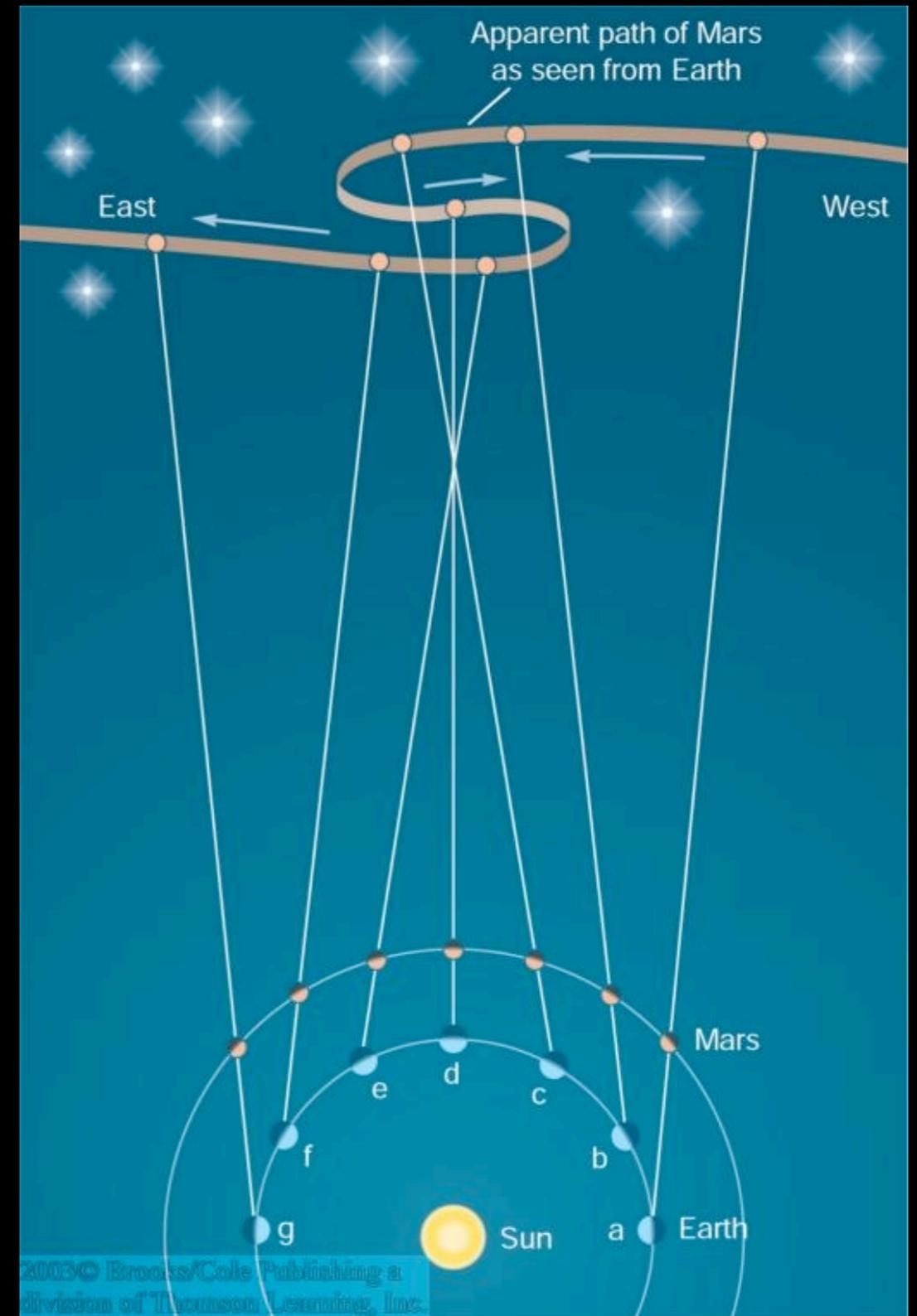
- Occurs March 21 (vernal) and September 21 (autumnal)
- length of day/night is 12/12 everywhere on Earth
- Sun rises/sets due east/west for everyone

Solstice:

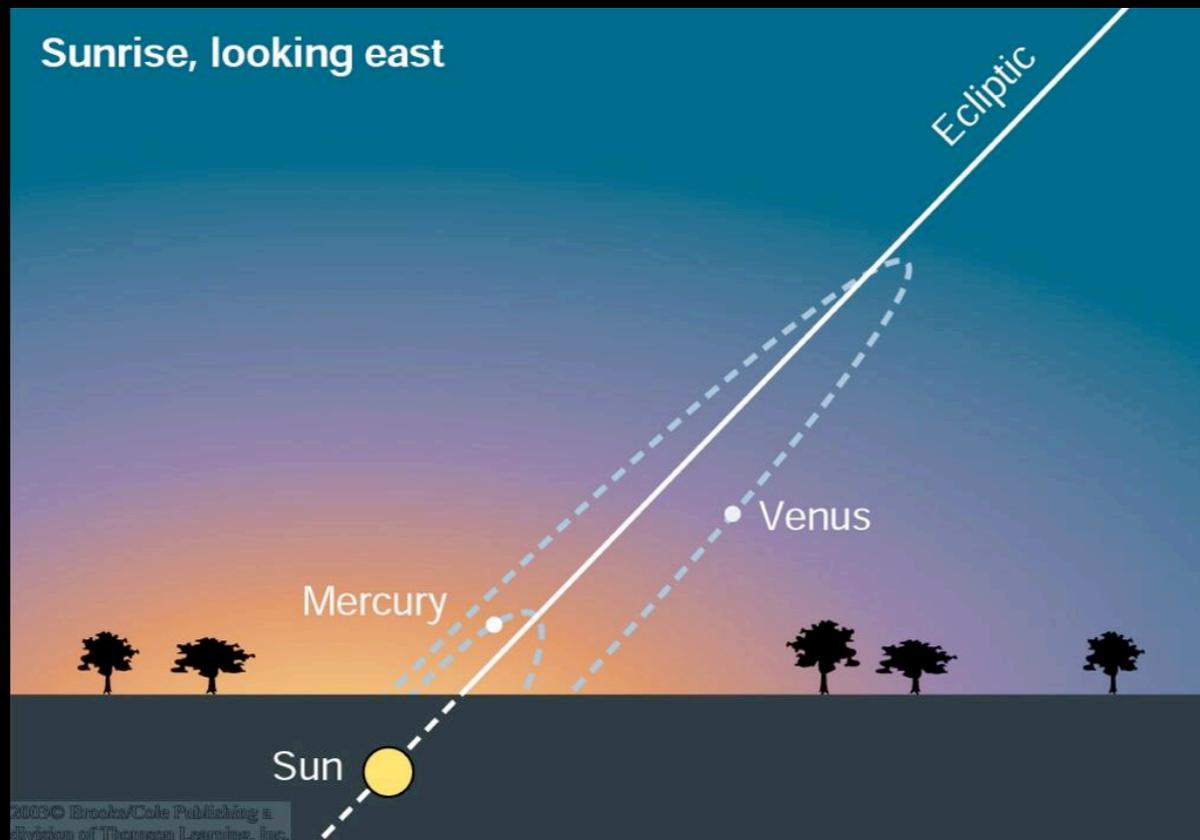
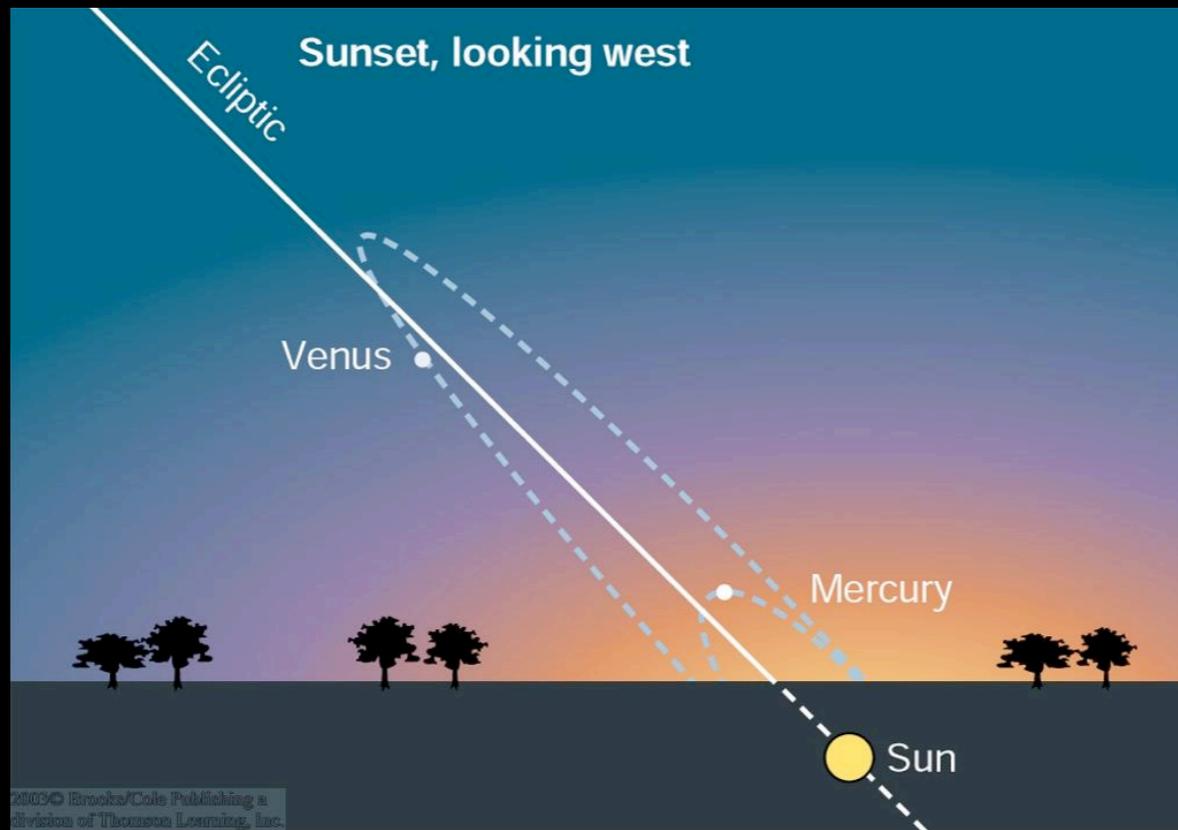
- June 21: summer solstice in northern hemisphere (longest day-light of year); Sun rises/sets north of east/west
- December 21: winter solstice in northern hemisphere (longest night-time of year); Sun rises/sets south of east/west
- swapped in southern hemisphere!

The Planets in the Sky

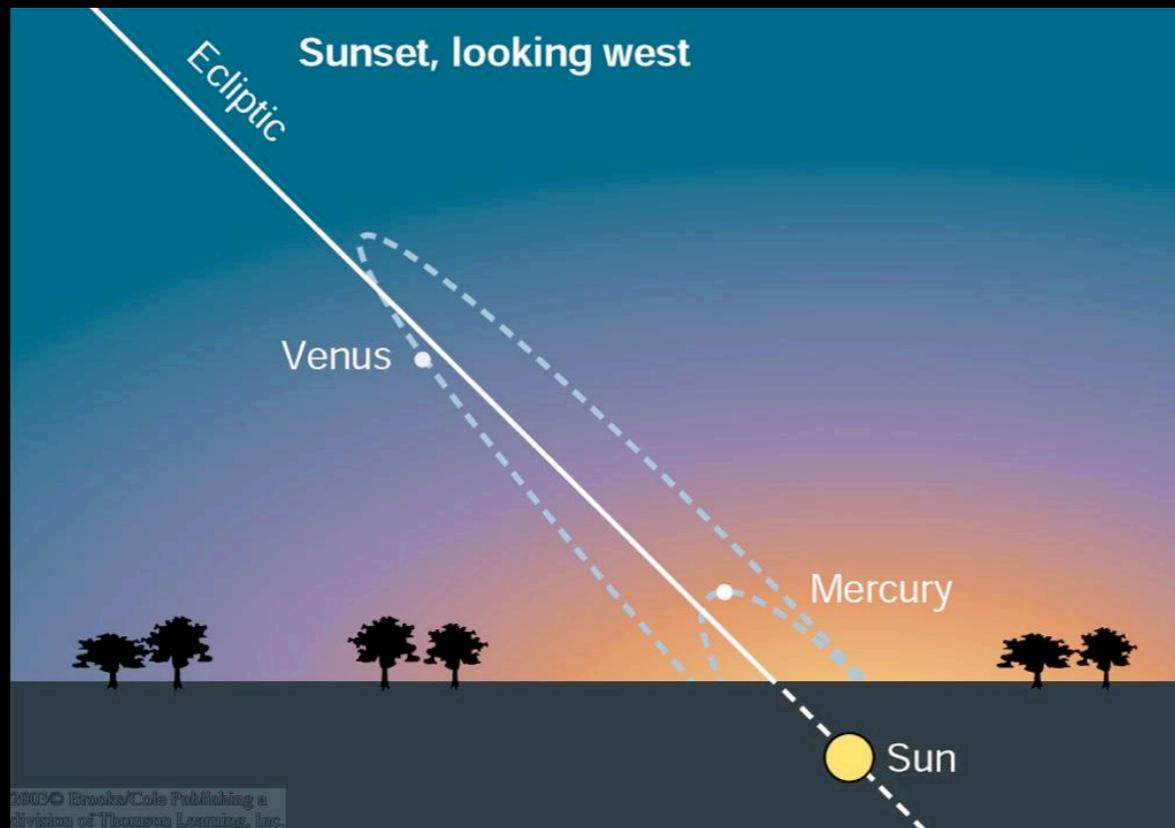
- All **outer planets** (Mars, Jupiter, Saturn, Uranus, Neptune and Pluto) generally appear to move eastward along the Ecliptic except when “retrograde”.



The Planets in the Sky

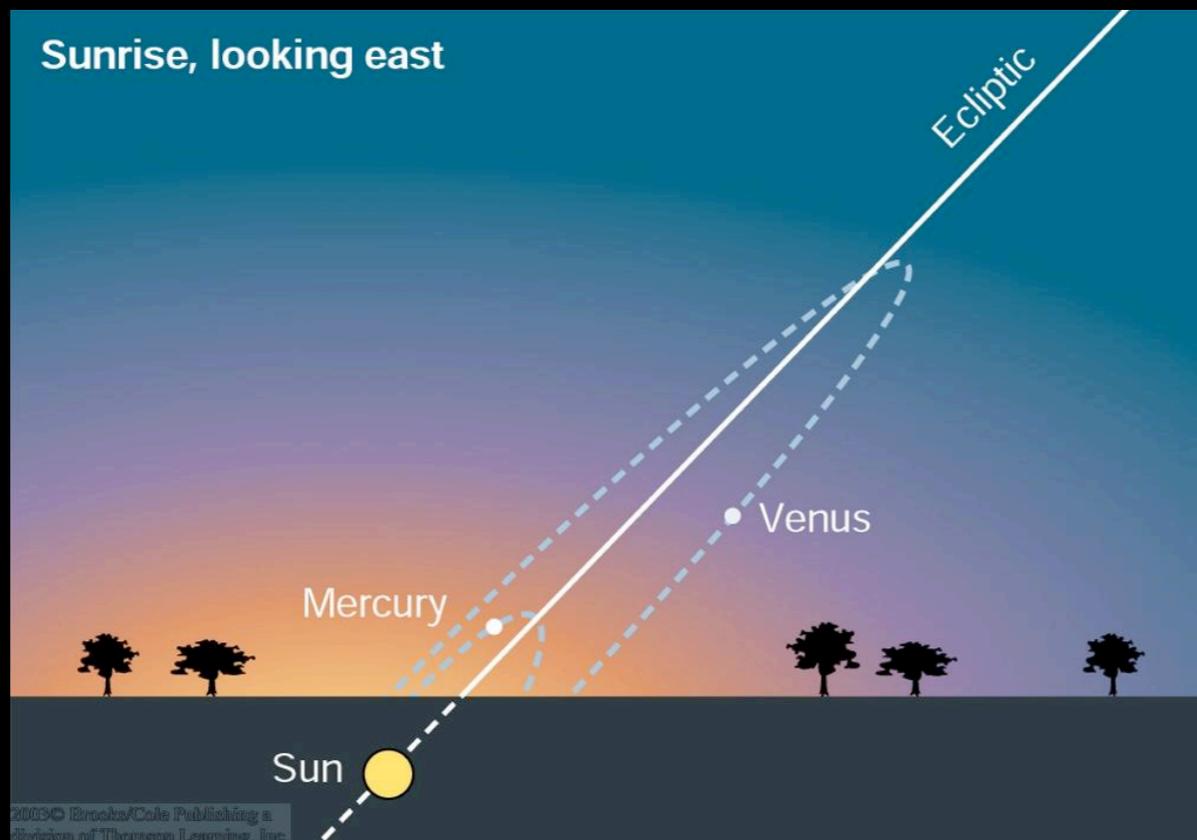


The Planets in the Sky

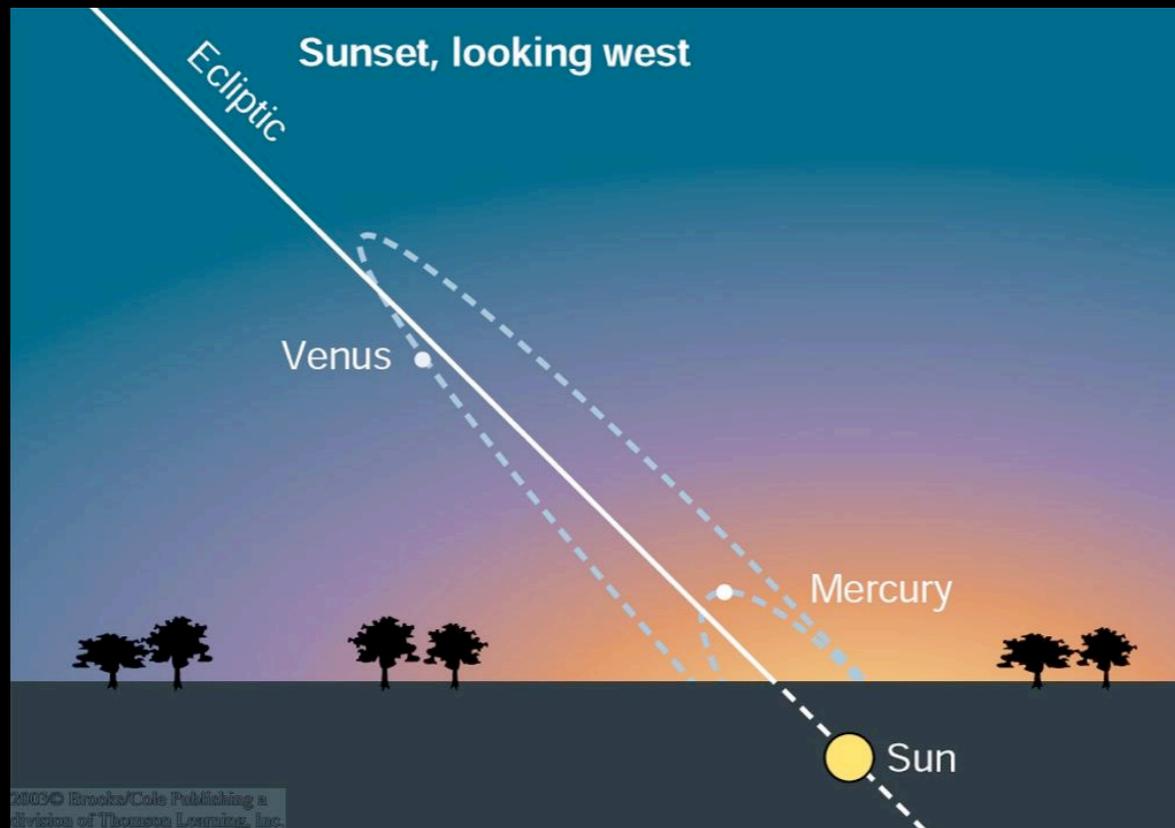


Mercury appears at most $\sim 28^\circ$ from the sun.

It can occasionally be seen shortly after sunset in the west or before sunrise in the east.

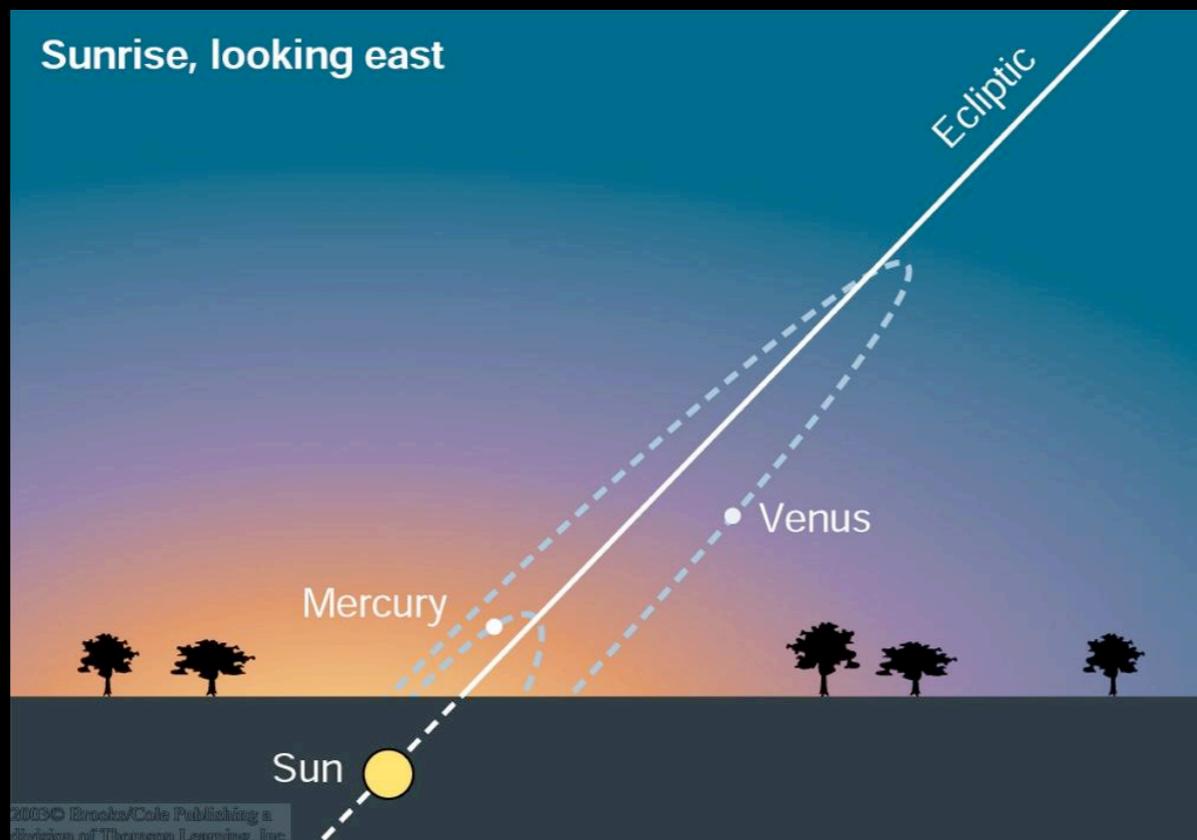


The Planets in the Sky



Mercury appears at most $\sim 28^\circ$ from the sun.

It can occasionally be seen shortly after sunset in the west or before sunrise in the east.



Venus appears at most $\sim 46^\circ$ from the sun.

It can occasionally be seen for at most a few hours after sunset in the west or before sunrise in the east.

**When I heard the learn'd astronomer,
When the proofs, the figures, were ranged in
columns before me,
When I was shown the charts and diagrams, to add,
divide, and measure them,
When I sitting heard the astronomer where he
lectured with much applause in the lecture room,
How soon unaccountable I became tired and sick,
Till rising and gliding out I wander'd off by myself,
In the mystical moist night air, and from time to time,
Look'd up in perfect silence at the stars.**

- Walt Whitman

