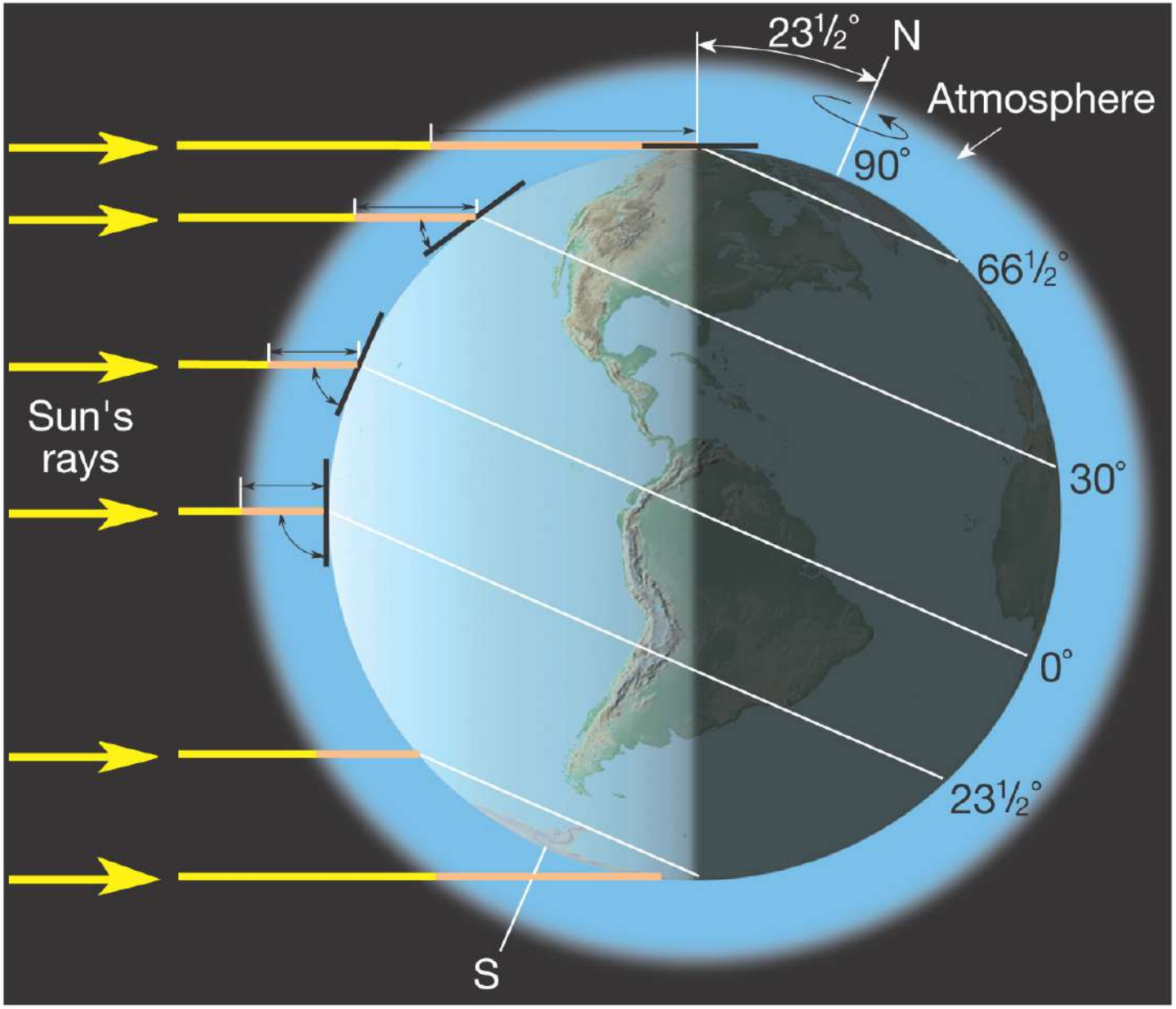
The Sun-Earth-Moon System

Will it go ‘round in circles?

Earth's Rotation

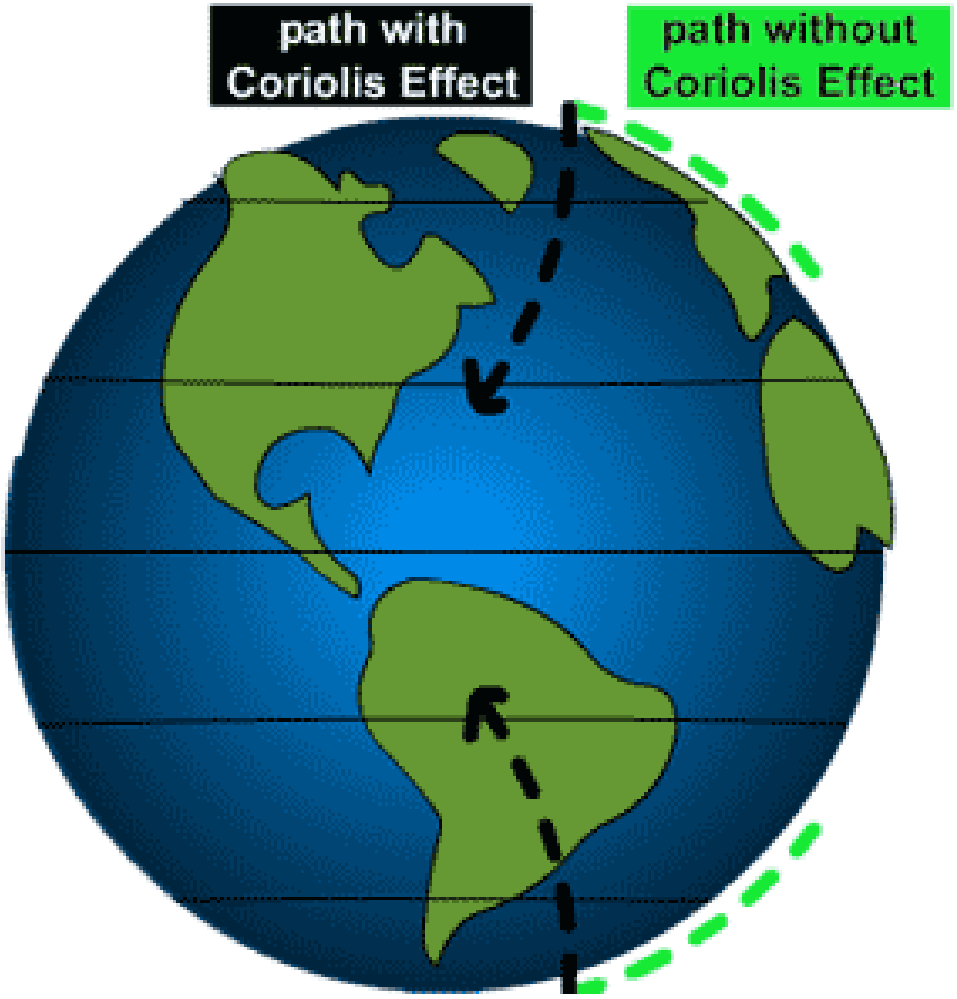
- Earth rotates on an imaginary axis that runs through its pole.
- Earth's axis is tilted 23.5^{o} to the ecliptic, the plane in which Earth orbits the Sun.
- Earth's rotation gives us our day. Earth makes one complete rotation in 24hrs, 15^{o} every hour.


23½°
N
Atmosphere
90°
66½°
Sun's
rays
30°
0°
23½°
S

Evidence of Earth's Rotation

- Foucault Pendulum – a free swinging pendulum that would swing in the same direction if not for Earth's rotation.

Coriolis effect



Daily Motion and Stars

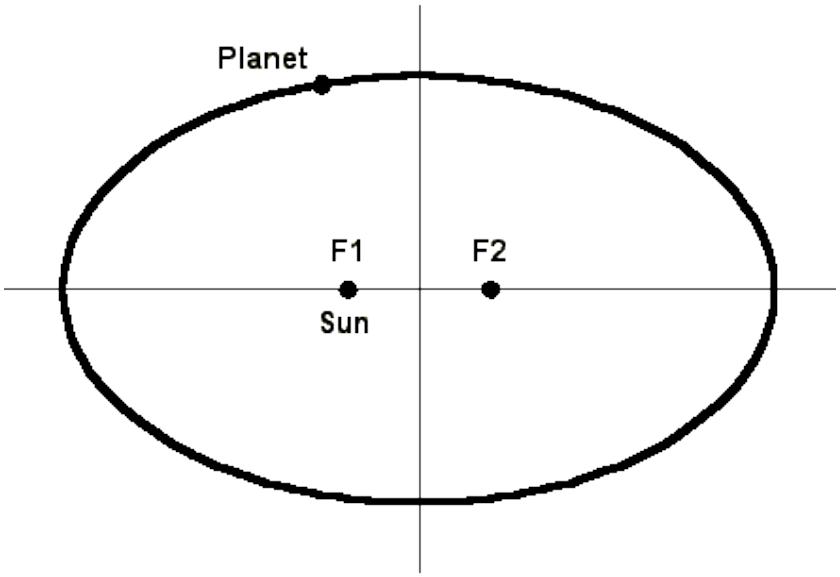
- In New York State stars appear to rise in the east and set in the west.
- The stars around Polaris actually make a circle and do not rise or set.

Earth's Rotation and Time

- Earth rotates 360^{o} every 24 hours.
- Therefore, Earth rotates at a rate of 360^{o}/24 hours = 15^{o} every hour.
- Earth is divided into 24 time zones.
- Because Earth rotates counterclockwise, east is later and west is earlier.
- When it is 4pm in Chicago it is 5pm in New York City.

Earth's Revolution

- Earth revolves around the Sun in an elliptical orbit.
- The Sun is at one foci of the ellipse.
- The shape of a planet's elliptical orbit is its eccentricity.



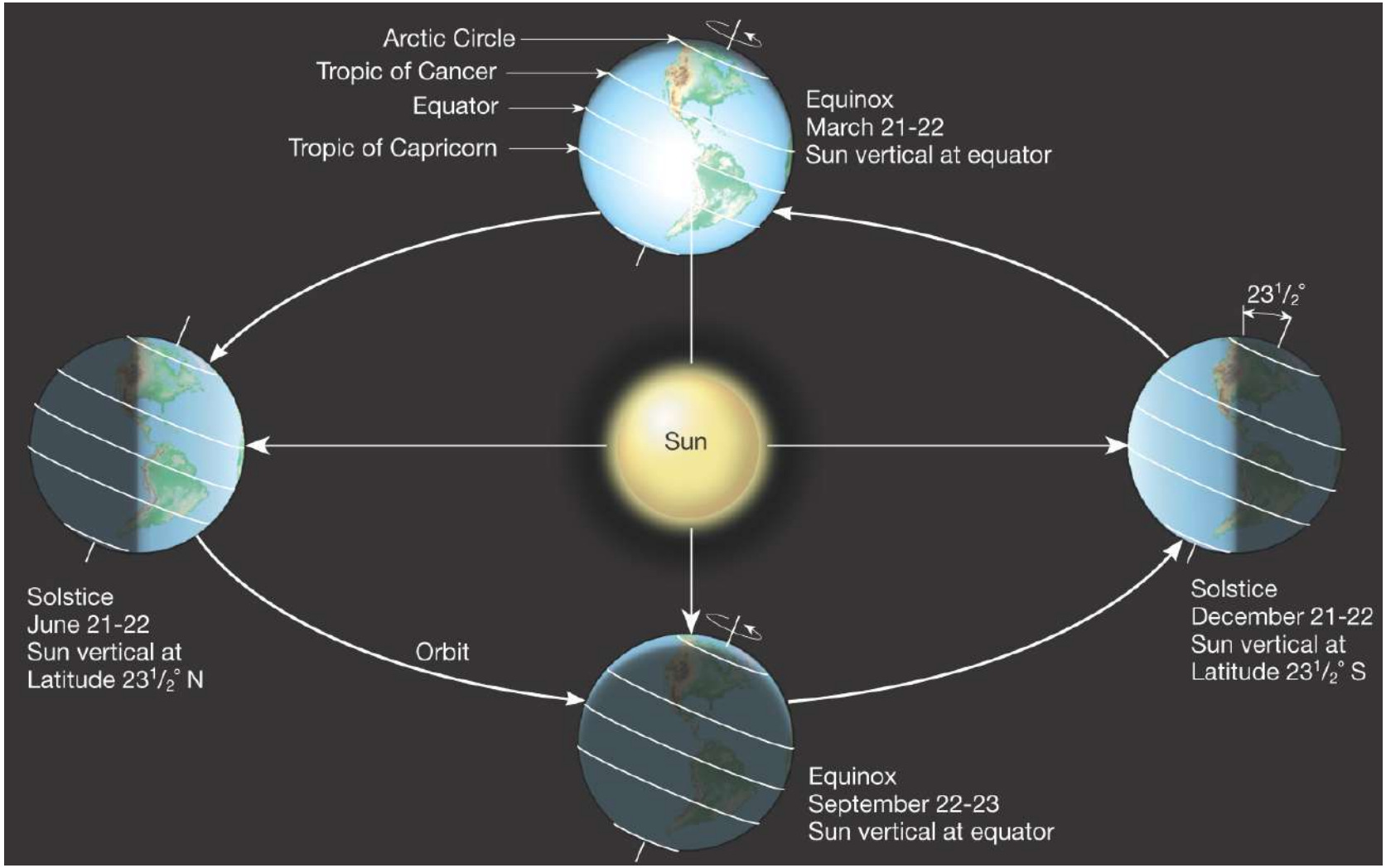
Proximity to Sun

- The closer a planet is to the Sun in its orbit the faster it moves.
- Also planets closest to the Sun revolve faster than planets farther away. In other words closer planets have a shorter year.
- Mercury's year is 88 days, Earth's is 365.

Earth's Revolution and Seasons

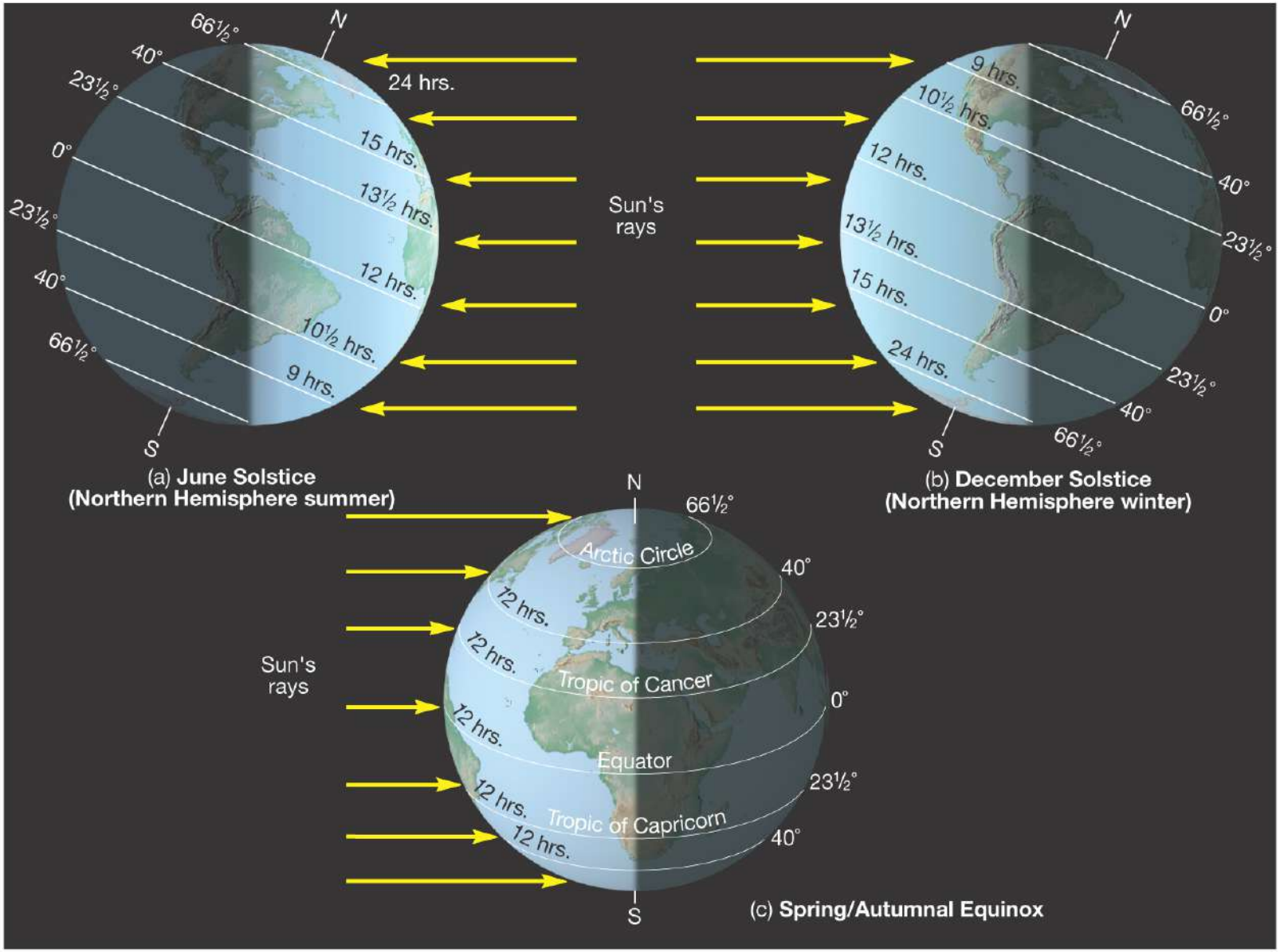
- In most places on Earth the climate changes throughout the year.
- This is due to Earth's movement as it revolves around the Sun.
- The orientation of Earth's axis changes with relation to the Sun throughout the year and the altitude of the sun in the sky changes because of this.
- This gives us our seasons.

- When it is Summer in the N. Hemisphere it is Winter in the Southern Hemisphere.



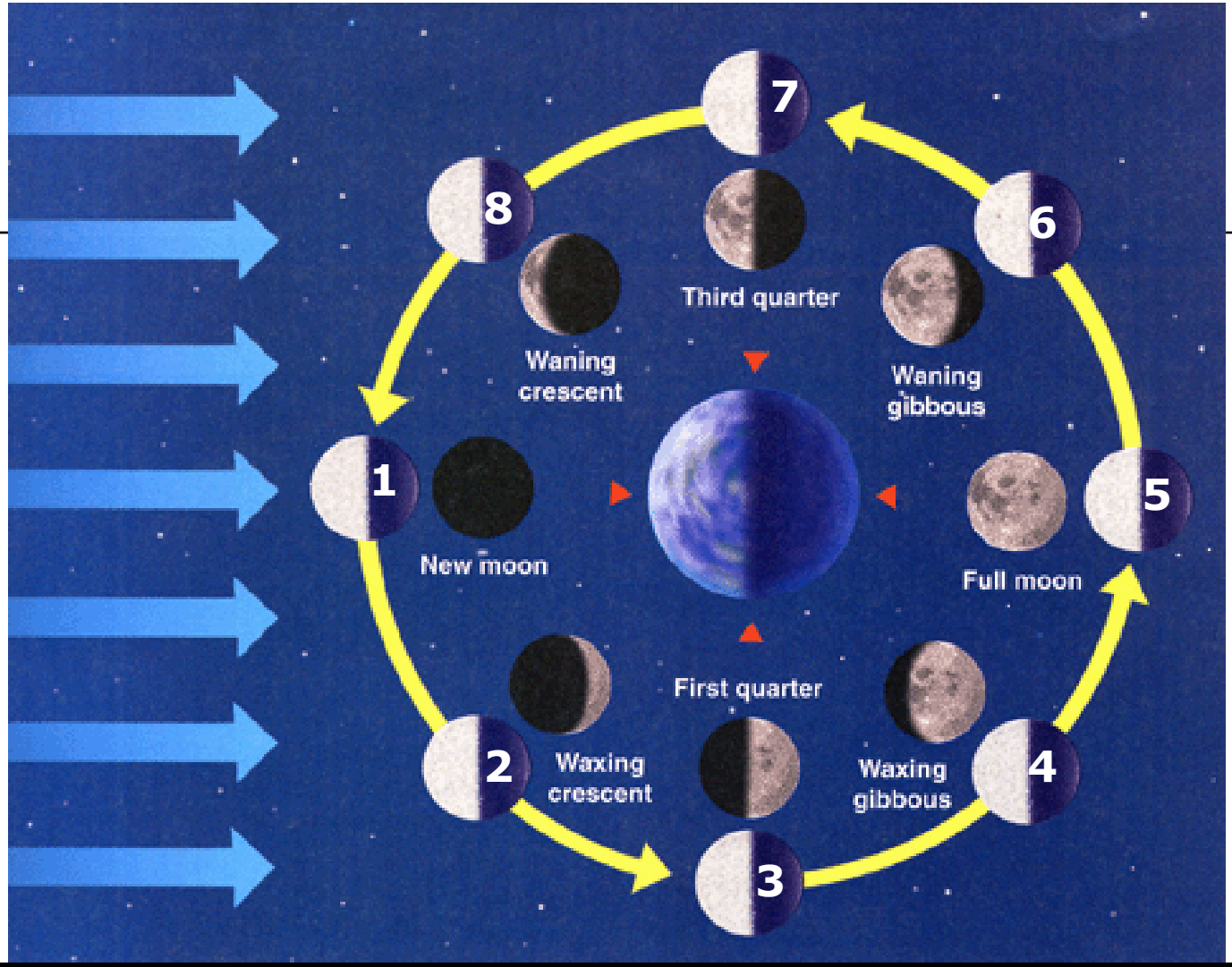
Length of Day

- The length of our day in New York depends on the season we are in.
- It is approximately 16 hours at the Summer Solstice and only 9 hours at the Winter Solstice.
- At the Equinoxes it is even at 12 hours of day and 12 hours of night.
- The Equator always has 12 and 12.


66½°
N
40°
23½°
0°
23½°
40°
66½°
S
24 hrs.
15 hrs.
13½ hrs.
12 hrs.
10½ hrs.
9 hrs.
Sun's rays
(a) June Solstice
(Northern Hemisphere summer)
N
9 hrs.
10½ hrs.
12 hrs.
13½ hrs.
15 hrs.
24 hrs.
66½°
40°
23½°
0°
23½°
40°
66½°
S
(b) December Solstice
(Northern Hemisphere winter)
Sun's rays
N
66½°
Arctic Circle
40°
23½°
Tropic of Cancer
0°
Equator
23½°
Tropic of Capricorn
40°
S
12 hrs.
12 hrs.
12 hrs.
12 hrs.
12 hrs.
(c) Spring/Autumnal Equinox

Phases of the Moon

- Although it appears bright in the night sky, the Moon produces no light of its own.
- The light we see is reflected from the Sun.
- Due to the Moon's revolution around Earth we see that light as different shapes called phases.


7
8
6
Third quarter
Waning crescent
Waning gibbous
1
5
New moon
Full moon
First quarter
2
Waxing crescent
Waxing gibbous
4
3


How the Moon appears from Earth
1
2
3
4
5
6
7
8

Waxing and Waning

- After the new Moon, for the next two weeks its phases are waxing.
- This means the illuminated side of the Moon increases each day.
- Half way through its orbit is the full moon.
- For the next two weeks its phases are waning.
- This means the illuminated side of the Moon decreases each day.

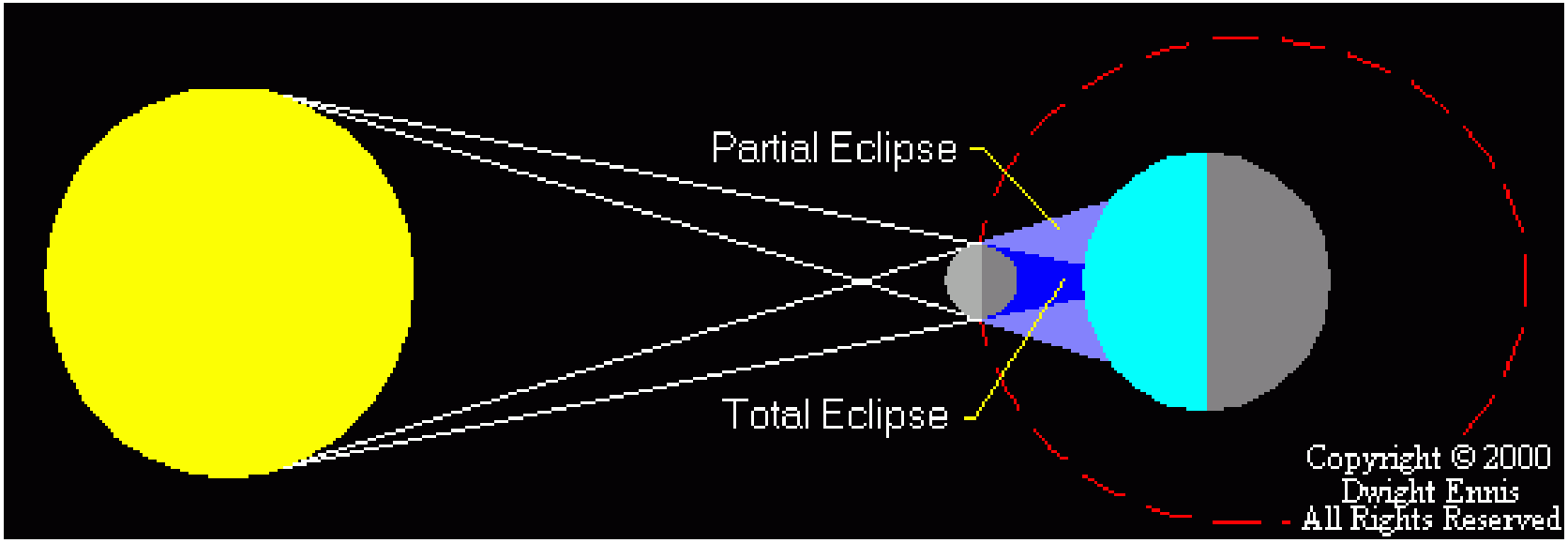
Eclipses

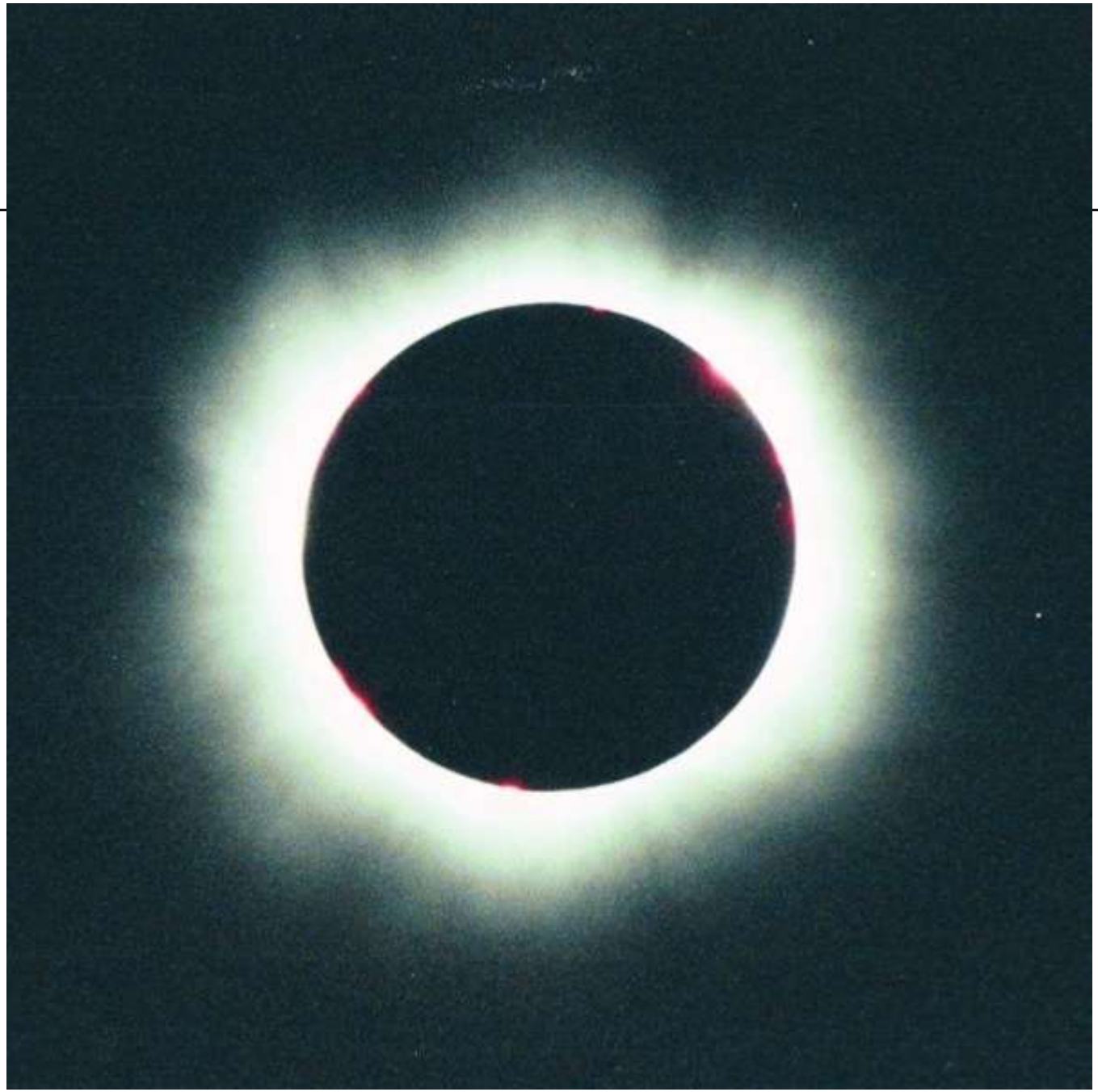
- The movement of the Earth and Moon in relation to the Sun cause solar and lunar eclipses.
- During an eclipse, either the Earth or the Moon move in front of the Sun blocking the light and casting a shadow in space.
- Eclipses only occur when the Sun, Earth and Moon are in a straight line.

Solar Eclipse

•A solar eclipse occurs when the Moon passes between the Sun and the Earth.

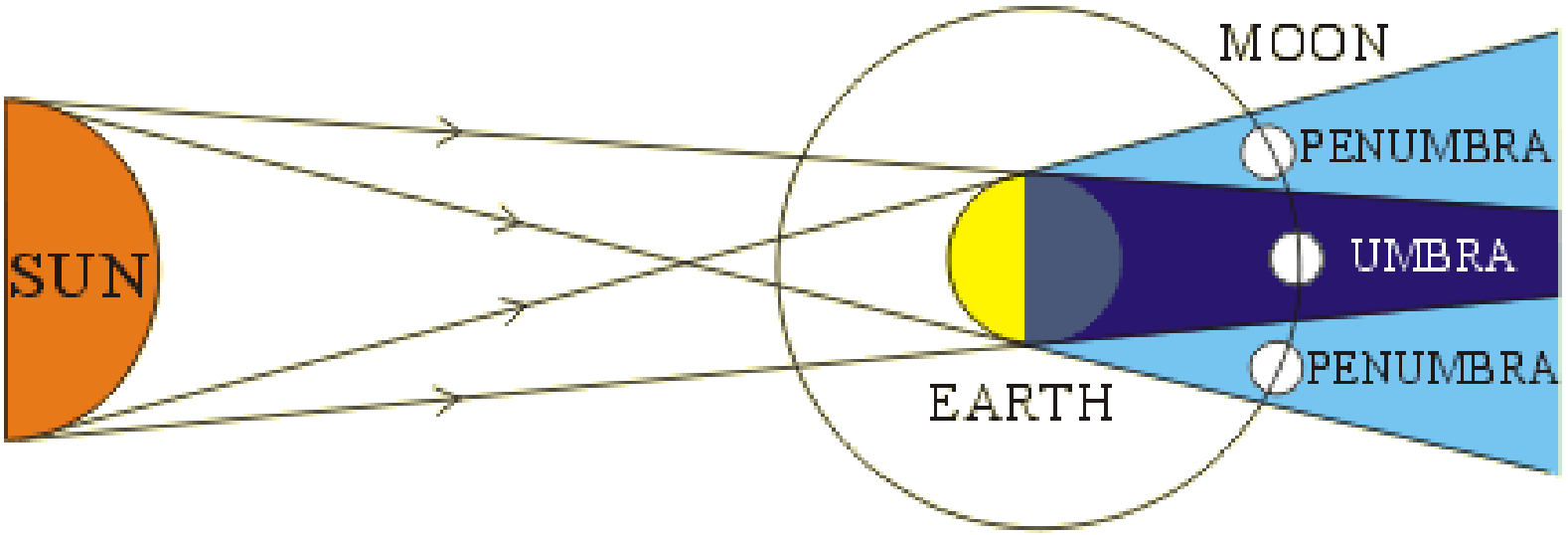
• This only happens occasionally because the Moon's orbit is inclined 5° to Earth's ecliptic so it usually passes above or below the Sun.





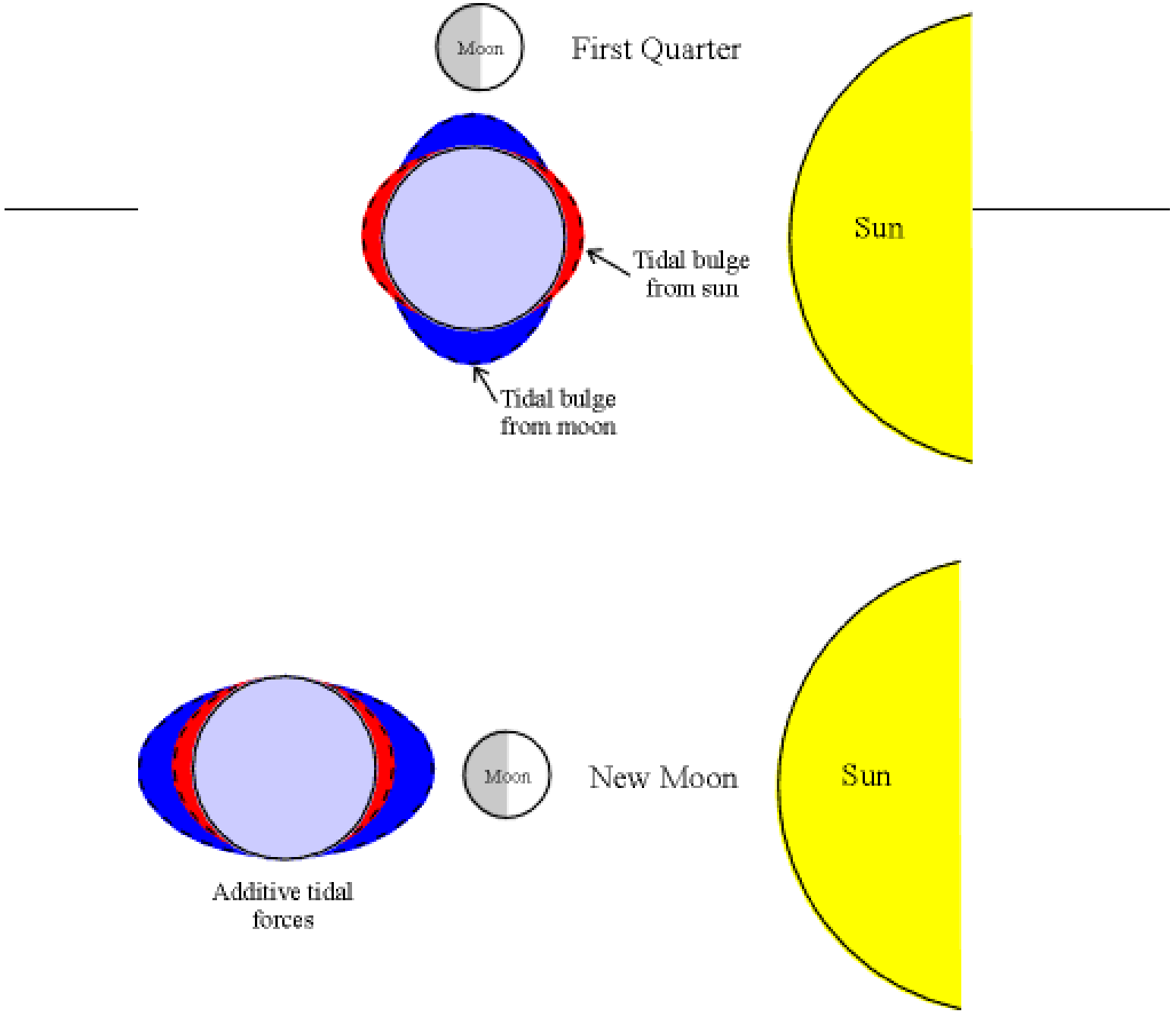
Lunar Eclipse

- A lunar eclipse occurs when the Moon passes through Earth's shadow.



Tides

- A tide is the daily rise and fall of oceans that cover about 70% of Earth.
- Tides are the result of gravitational forces of the Moon and to a lesser extent the Sun.
- The cycle of tides is about 12hrs. and 25min. from high tide to high tide or low tide to low tide.


Moon
First Quarter
Sun
Tidal bulge
from sun
Tidal bulge
from moon
Additive tidal
forces
Moon
New Moon
Sun