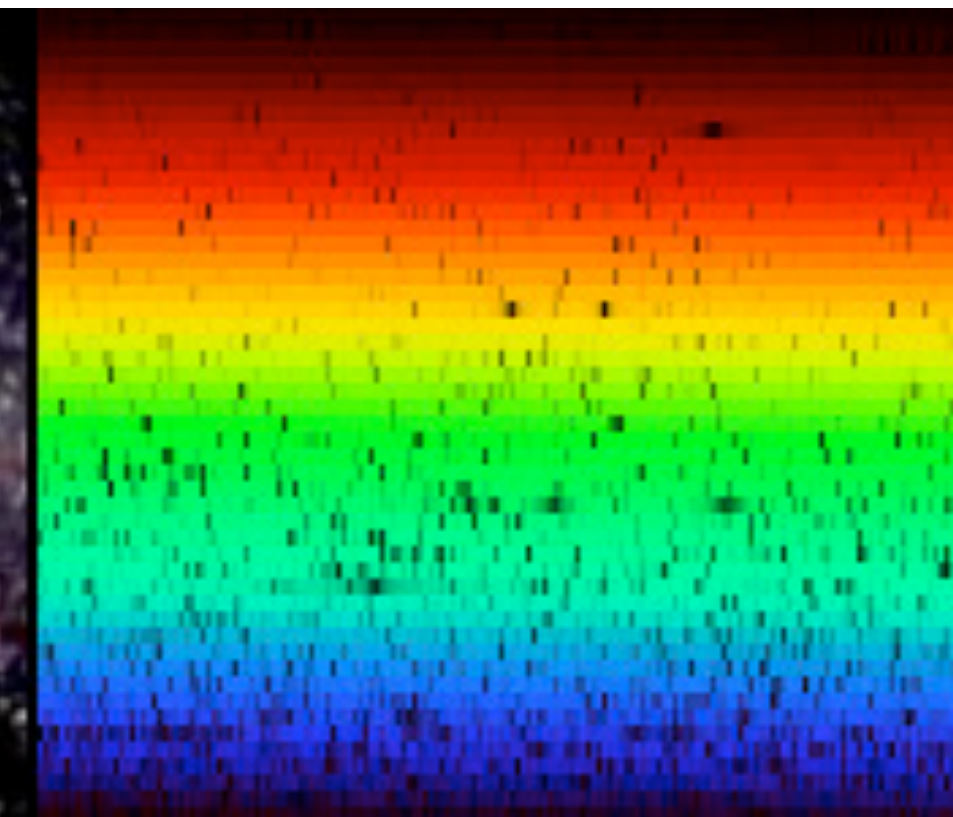




ASTR/PHYS 3070: Foundations Astronomy



Week 1 Thursday

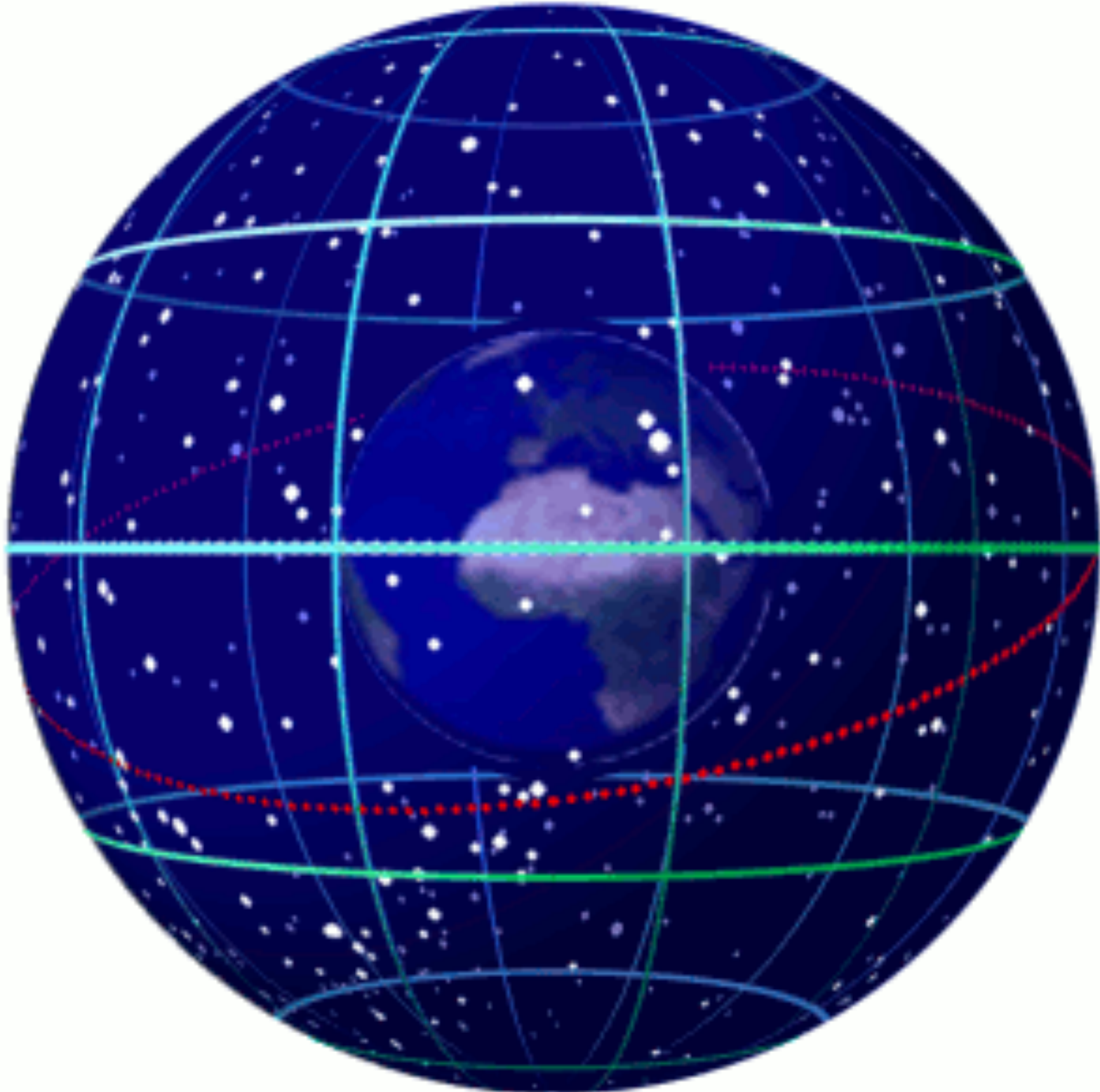
Today's Agenda

- Naked Eye Night Sky
- Coordinate Systems
- Group Work: Navigating the Sky
- Changes in the Sky

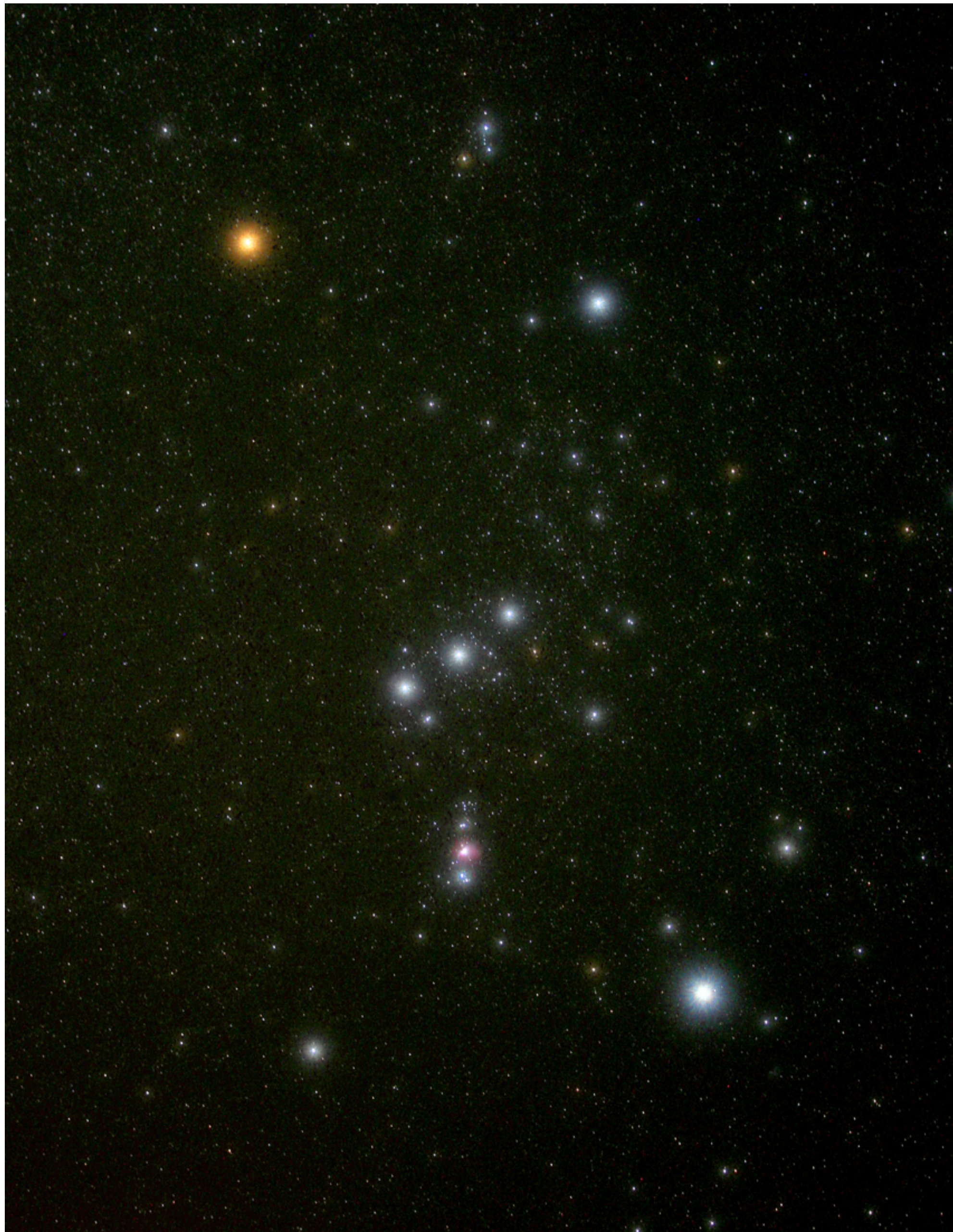
Announcements / Reminders

- Read Chapters 2.4-2.6 & 3 by next week
 - Scanned PDF available on website
 - Inclusive Access eBook now accessible
- HW 1 due September 3rd at 11:59pm via Canvas upload

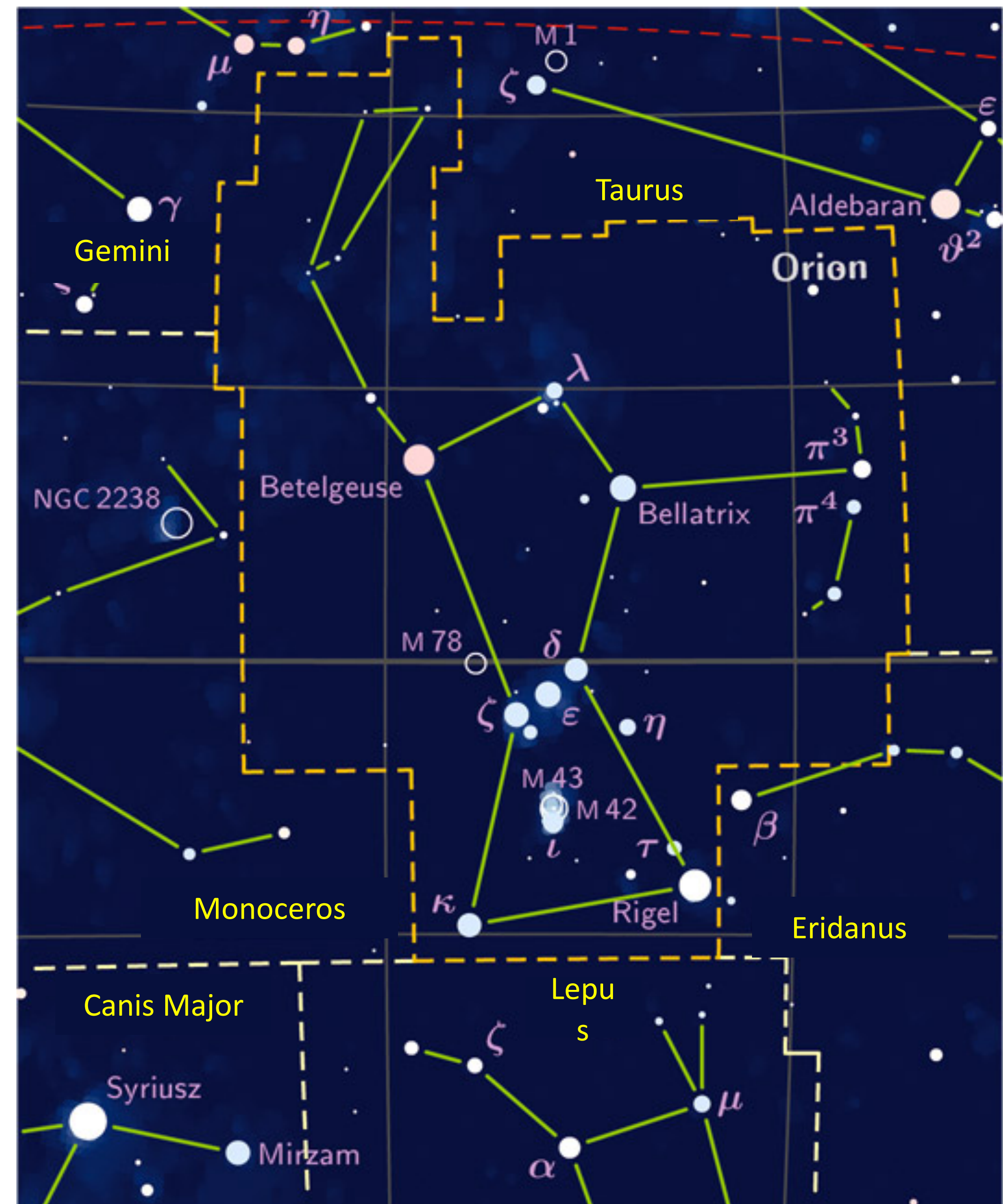
The Night Sky & Astronomical Coordinates



Star trails over the Gemini South telescope

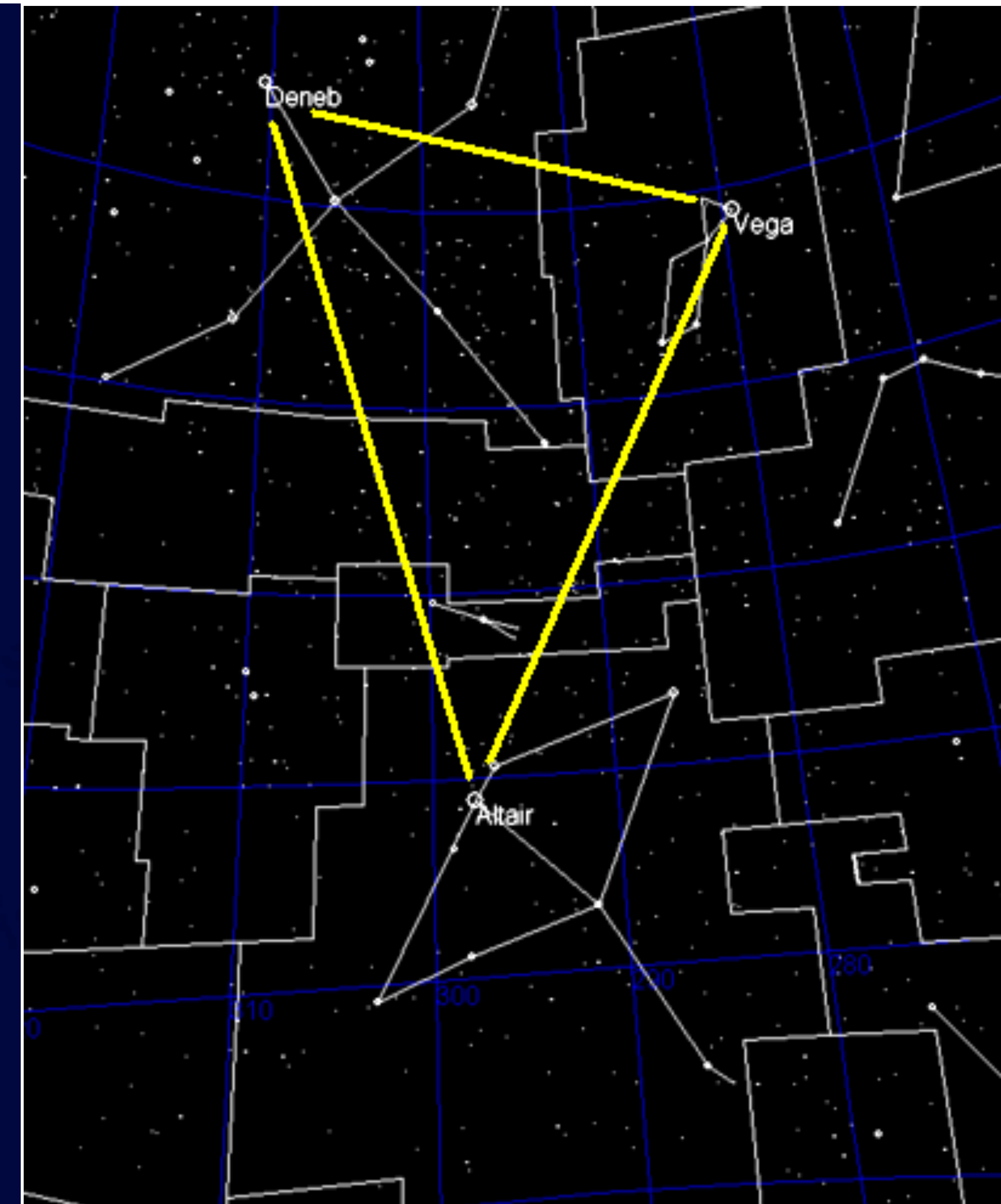
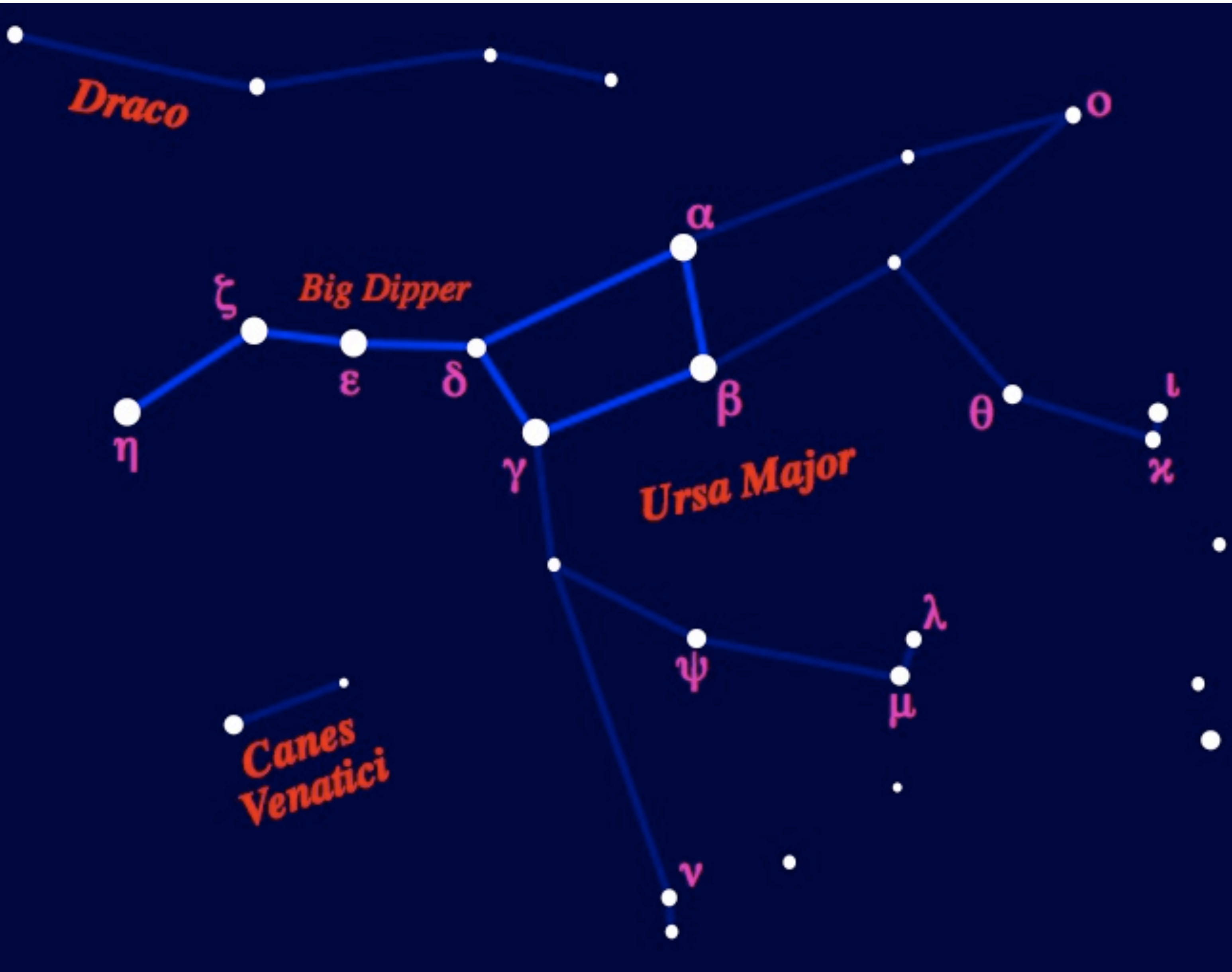


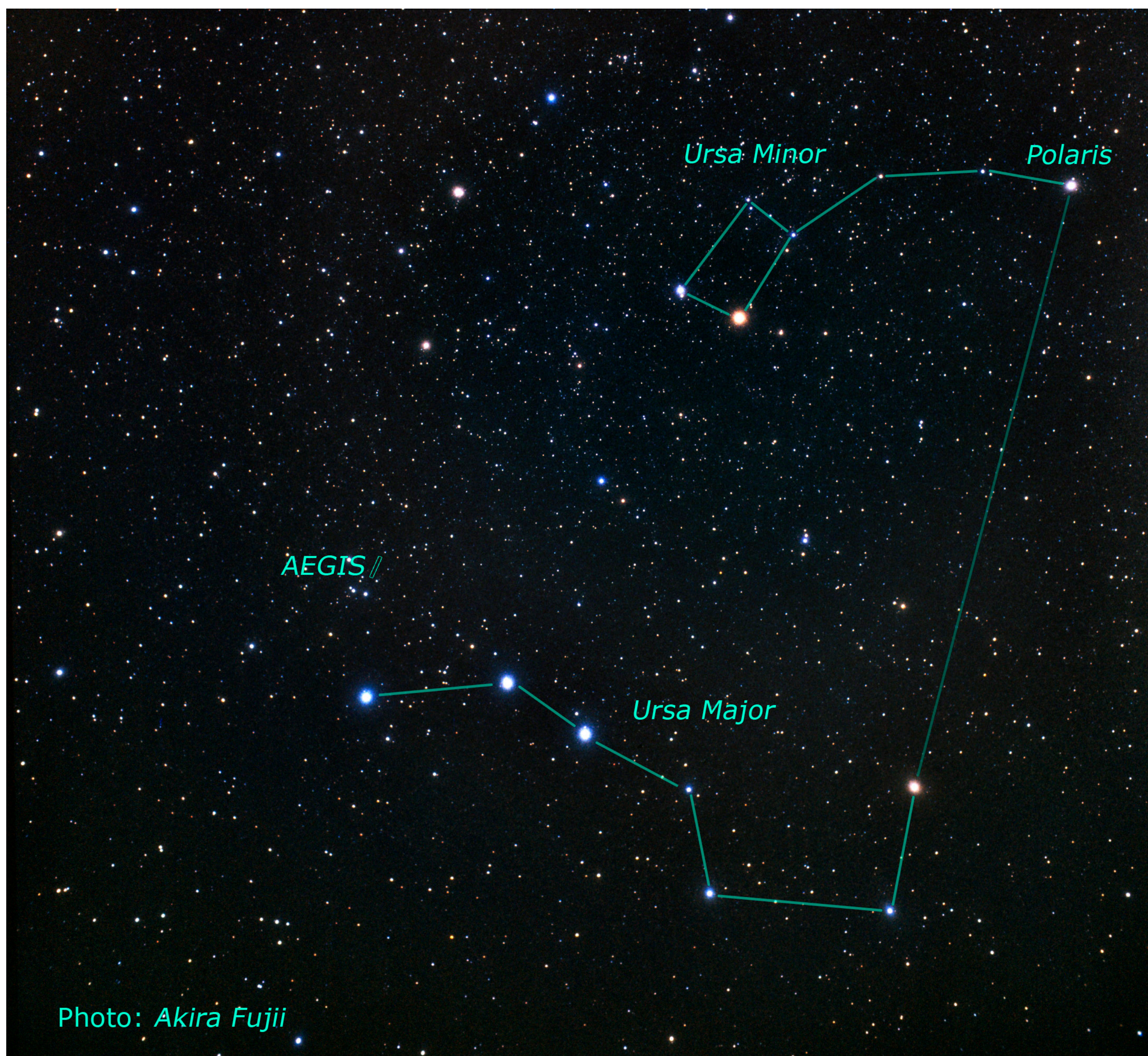
Orion



Fall 2021: Week 01b

Constellation versus Asterism





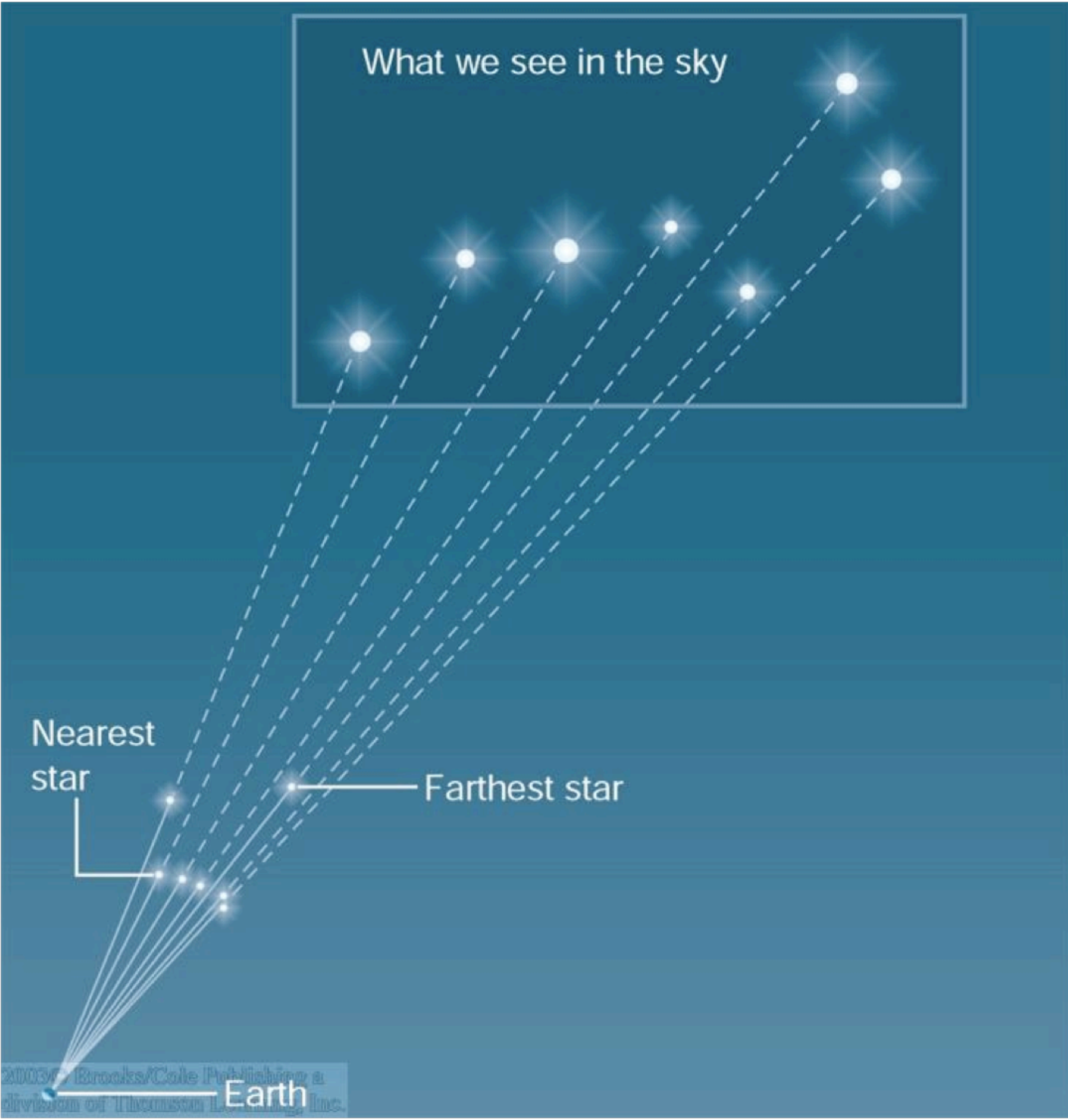
Ursa Major & Minor (Big and Little Bears)

Big & Little Dippers

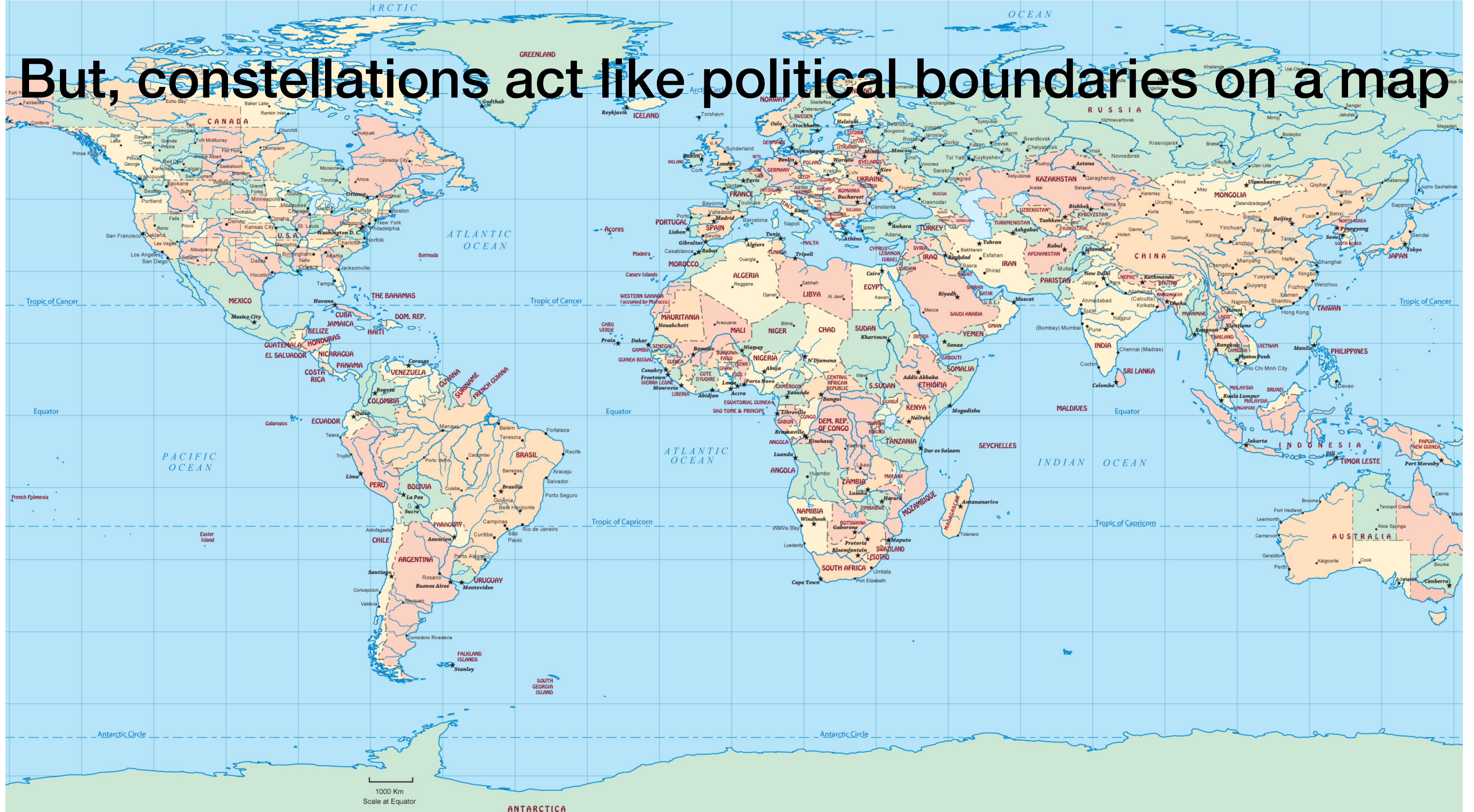
Polaris (North Star)

Photo: Akira Fujii

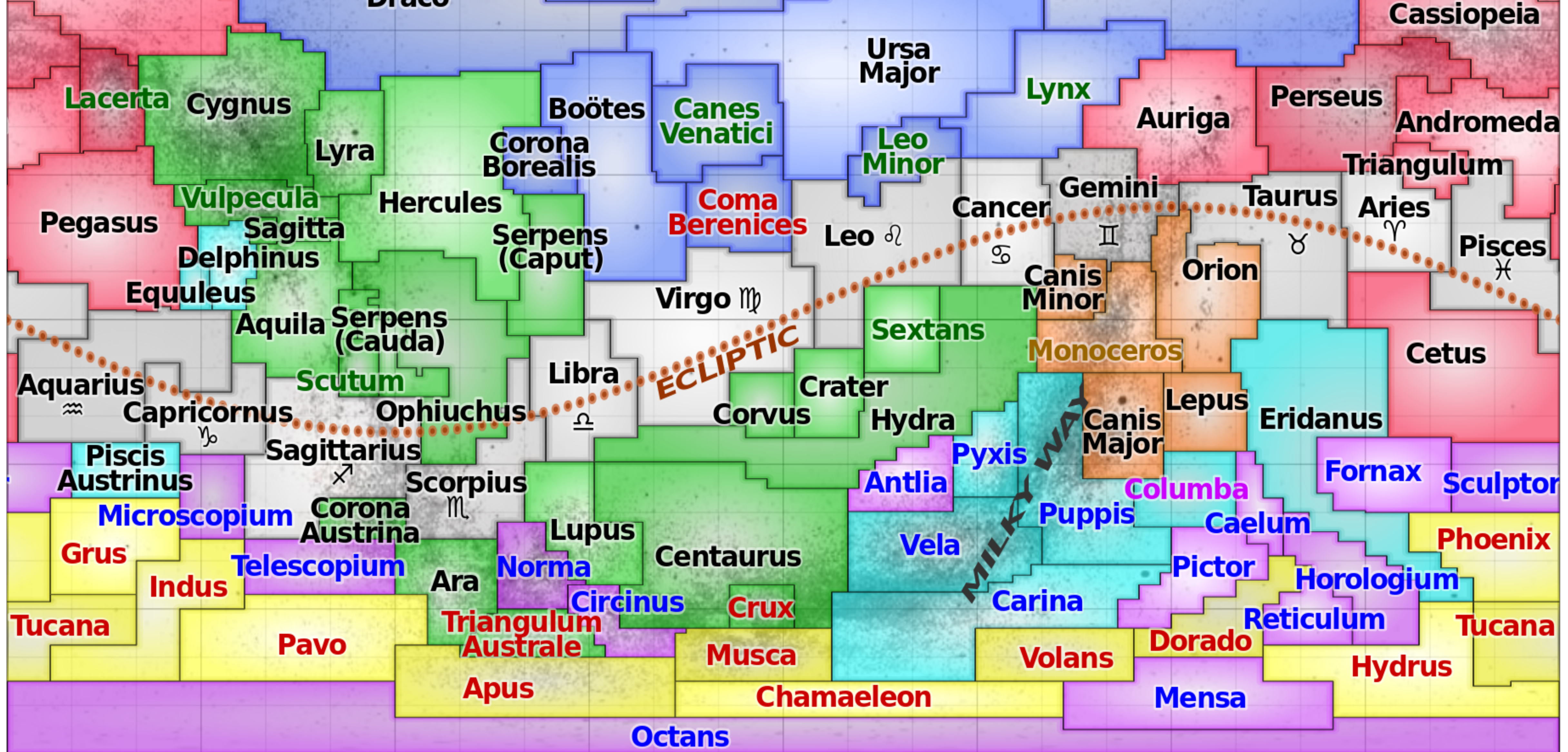
These star patterns are of little use to modern astronomers



But, constellations act like political boundaries on a map



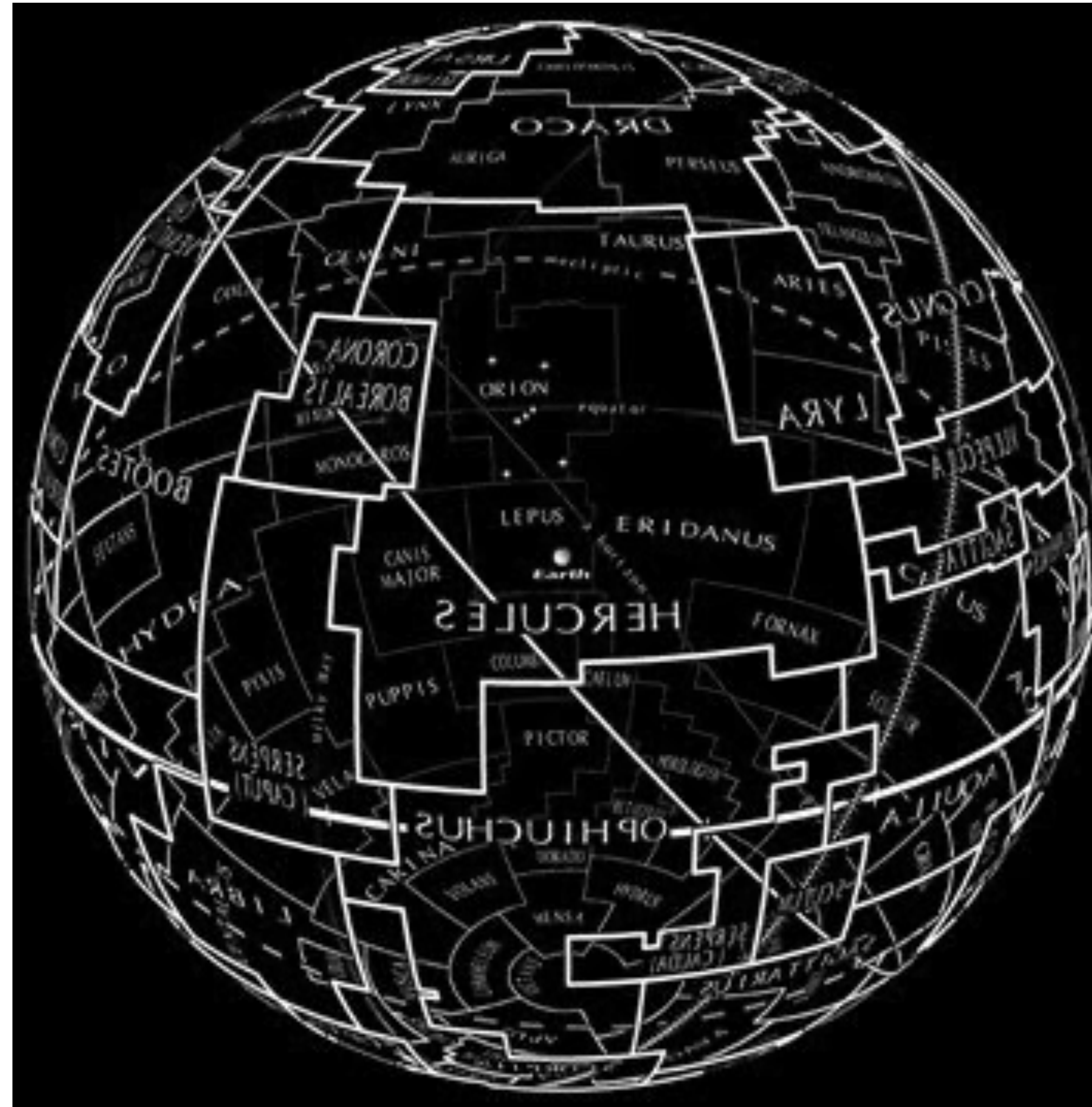
Cepheus
But, constellations act like political boundaries on a map
 Cepheus



But, constellations act like political boundaries on a map

Useful for naming objects:

Brightest stars in a constellation are ordered from brightest to faintest with Greek letters (e.g., brightest star in Centaurus is called alpha Centauri)

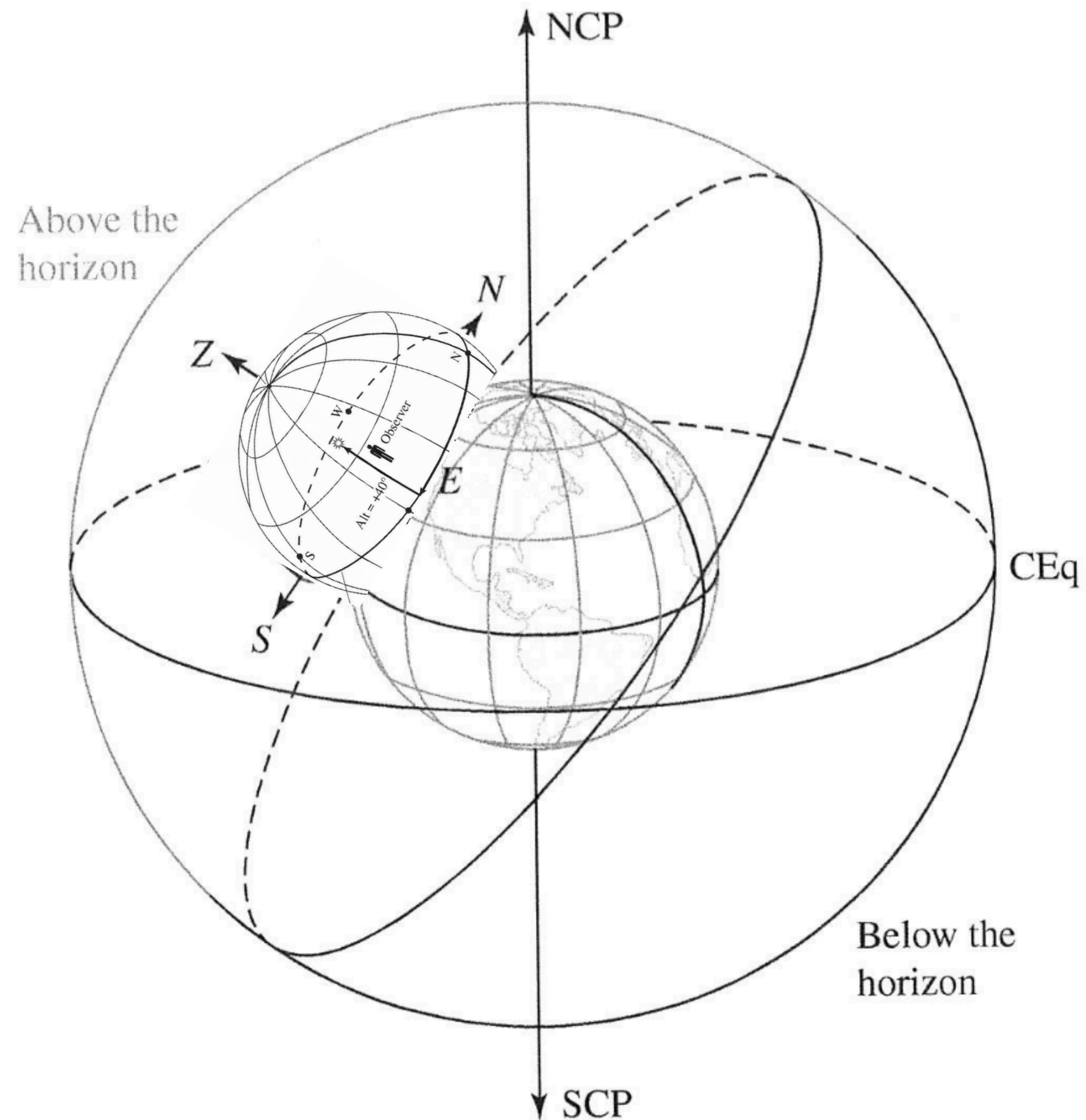


Similar convention in radio and X-ray, e.g., the radio supernova remnant Casseopia (Cas) A, the black hole systems Cygnus X-1 and X-3, the supermassive black hole at the center of the Milky Way, Sagittarius (Sgr) A*

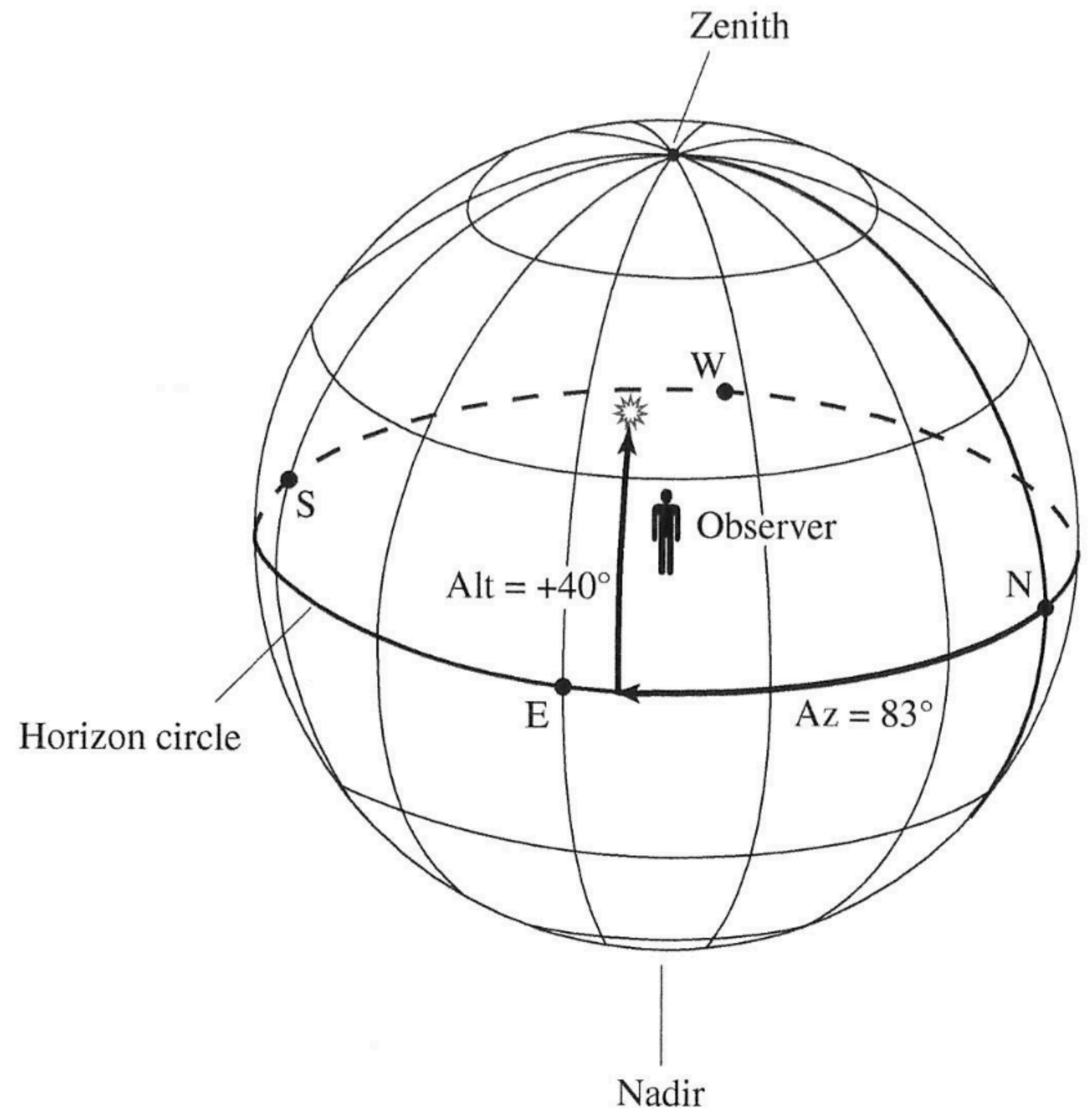
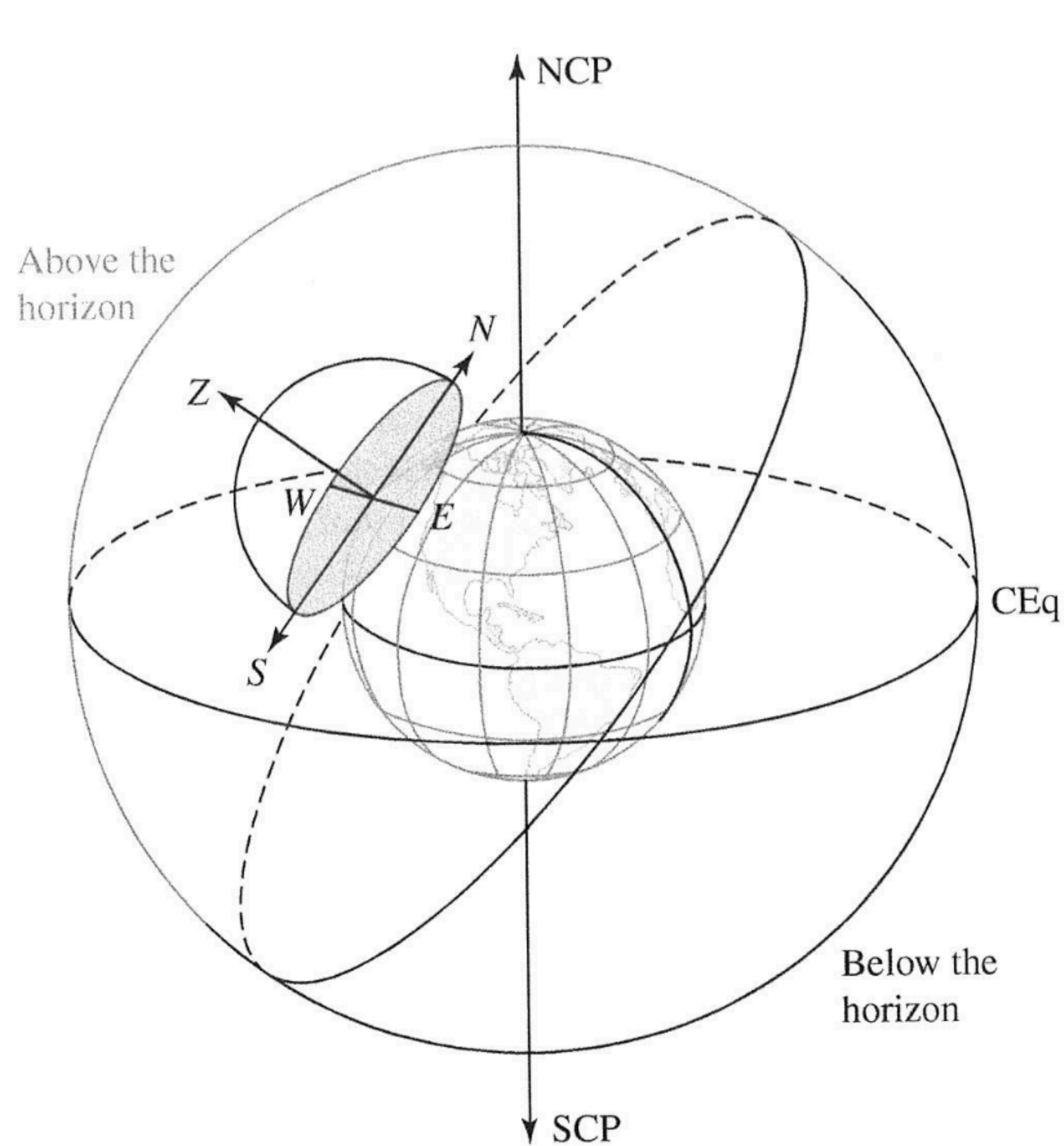
Nearby galaxies and galaxy groups and clusters also take constellation names (Andromeda Galaxy, Coma Cluster, Virgo Cluster)

Coordinate Systems

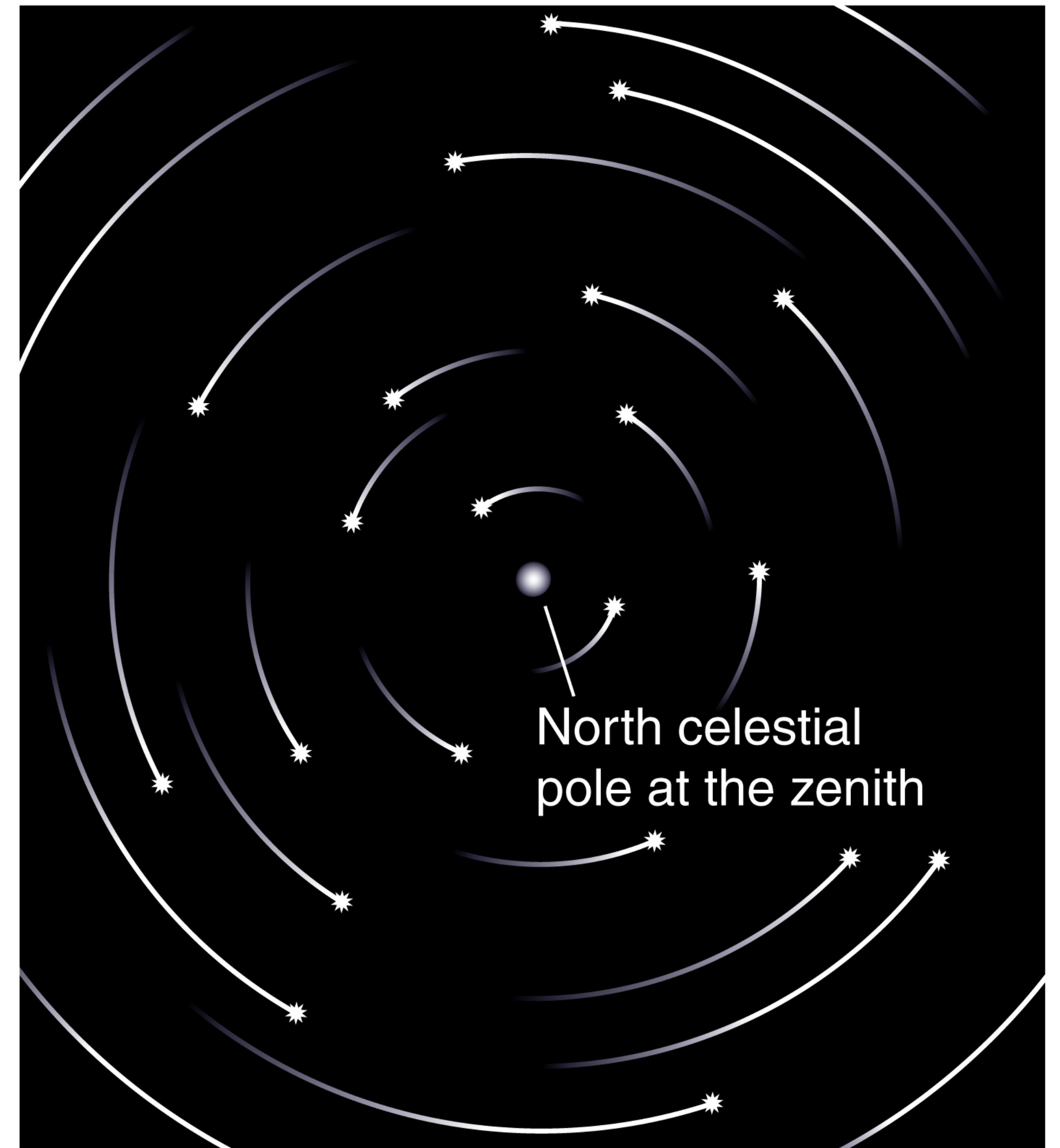
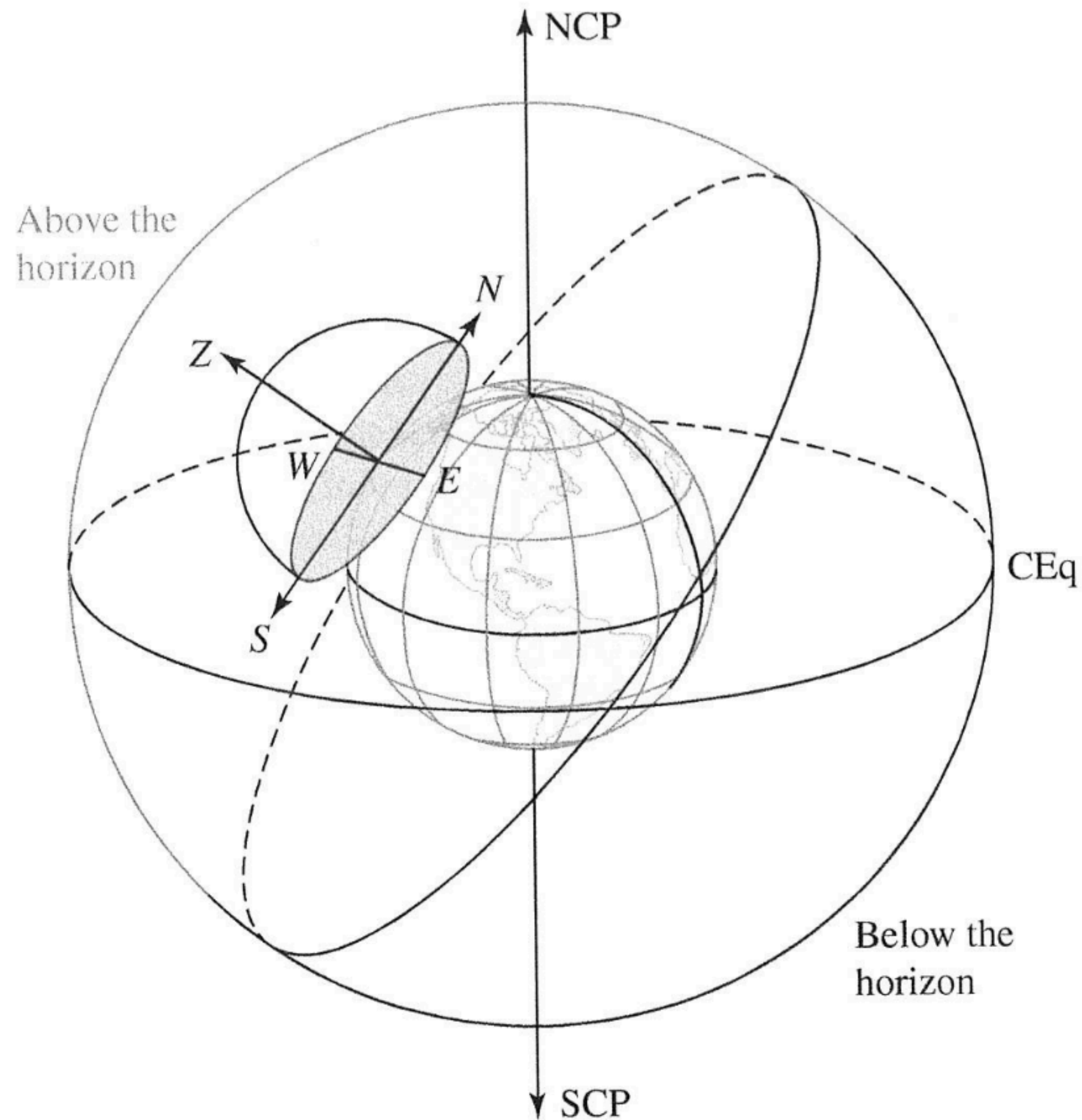
Coordinates on the Sky



Coordinates on the Sky

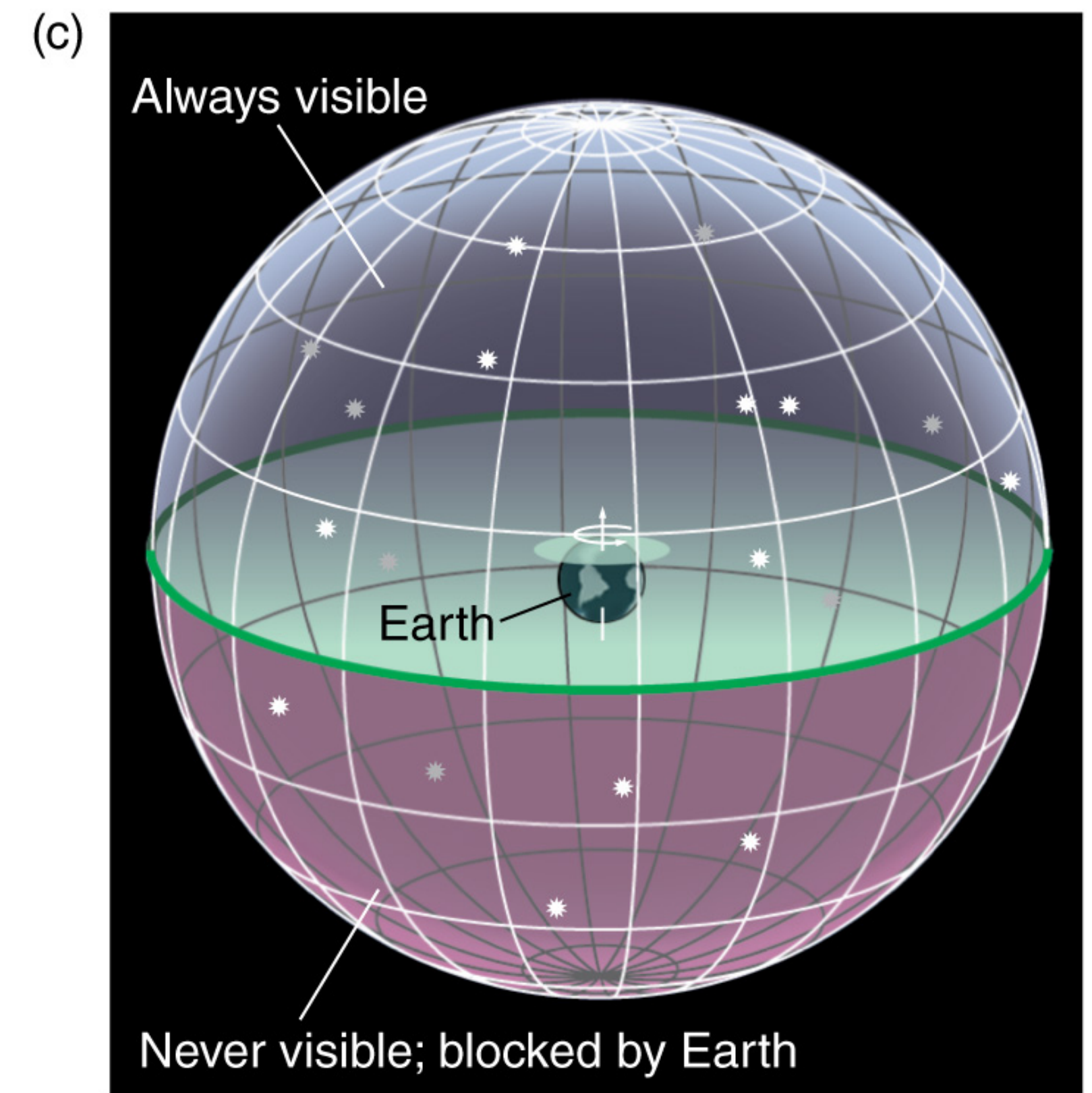
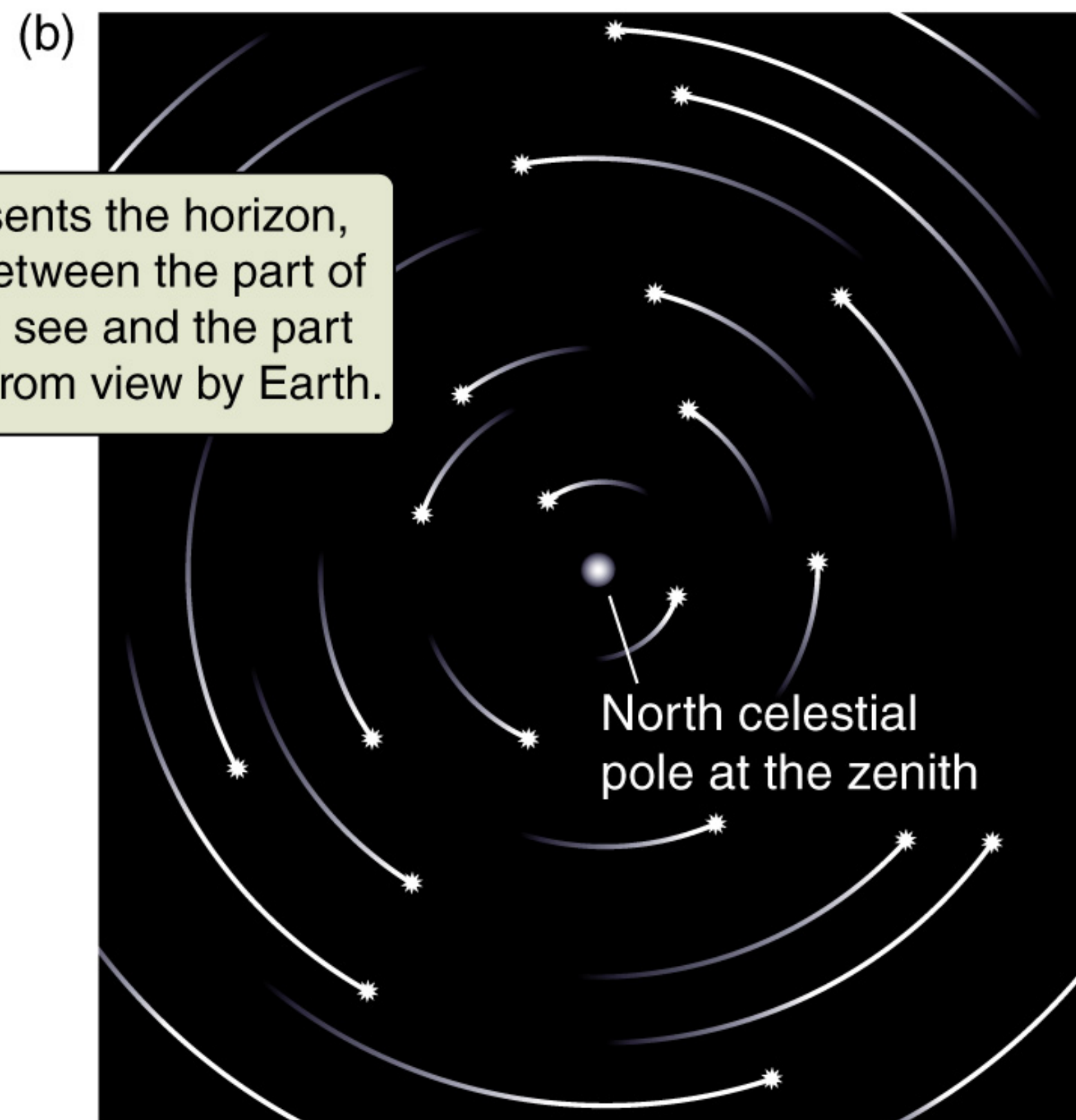
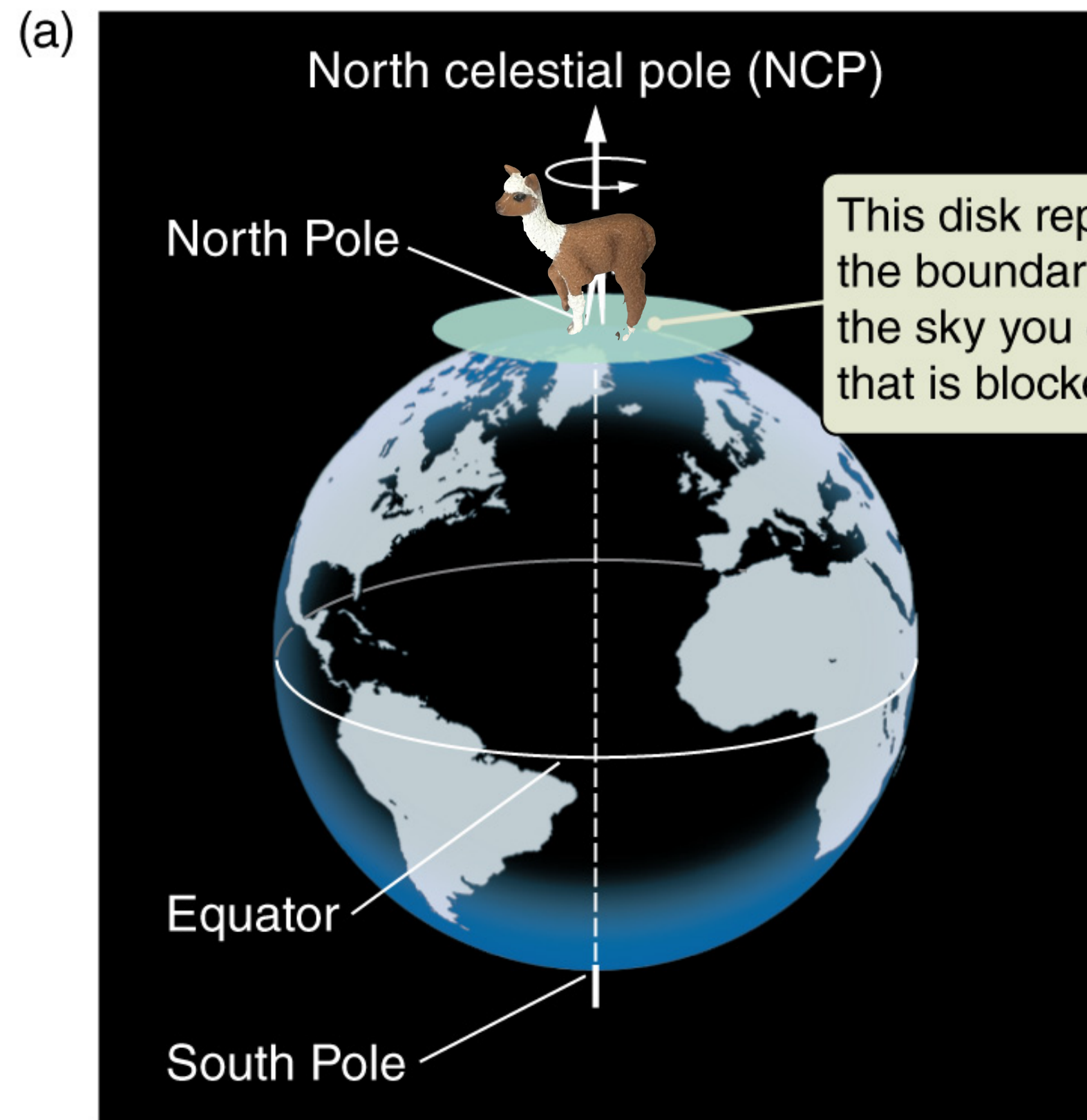


If the north star is directly above our illustrious llama (i.e., at their zenith), where are they on the Earth?



As Earth rotates, the stars appear to move in a counterclockwise direction around the **NCP**.

North Pole!

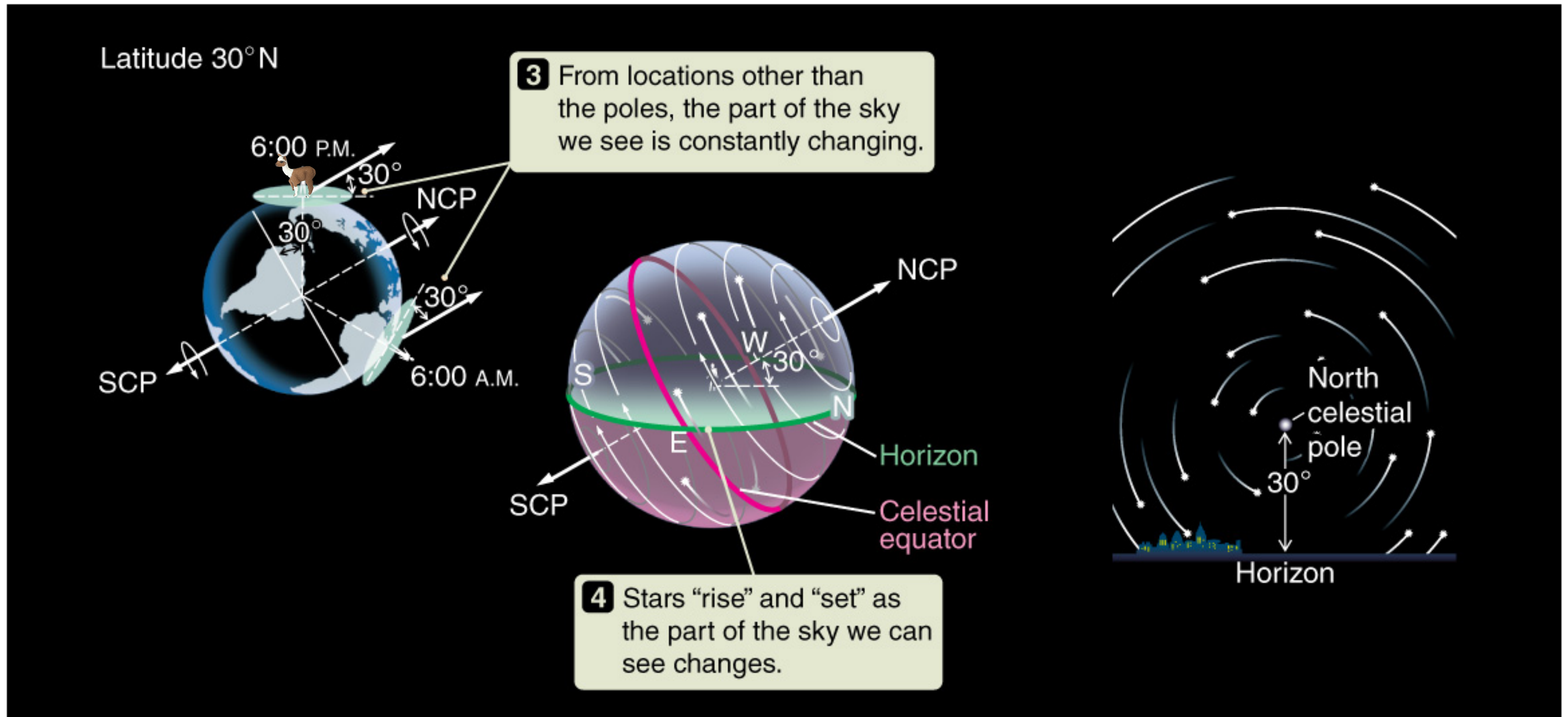


From the North Pole looking directly overhead, the **north celestial pole (NCP)** is at the zenith.

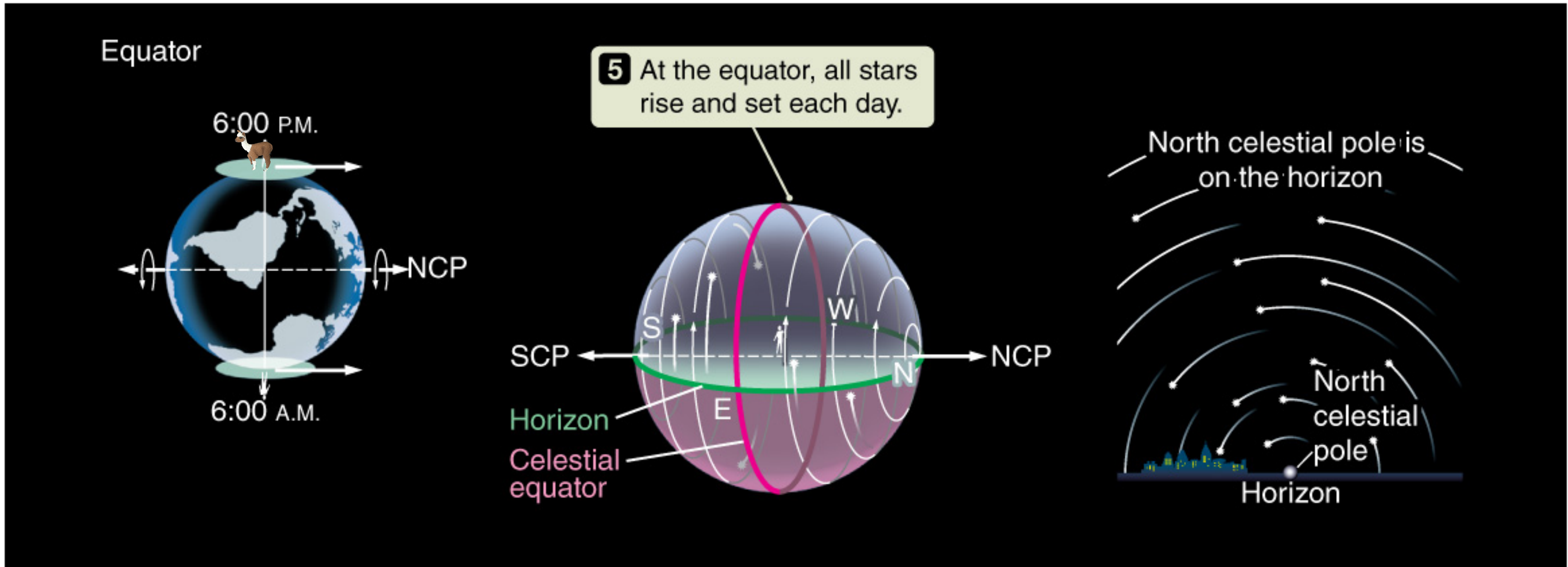
As Earth rotates, the stars appear to move in a counterclockwise direction around the **NCP**.

From the North Pole, you always see the same half of the sky.

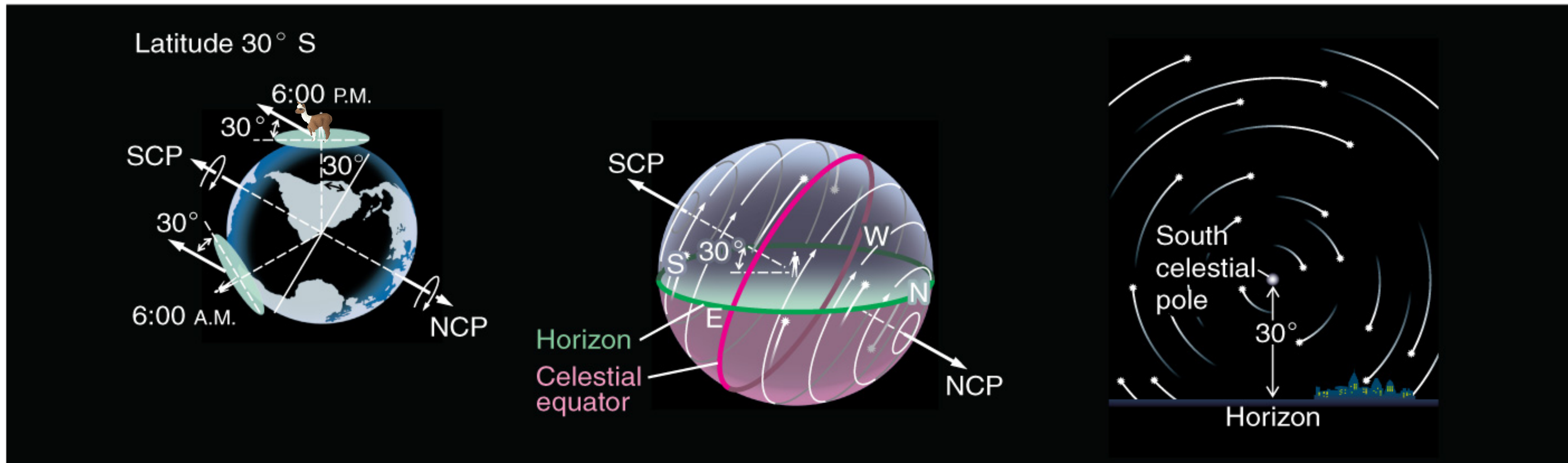
If you're 30 degrees north of the equator:



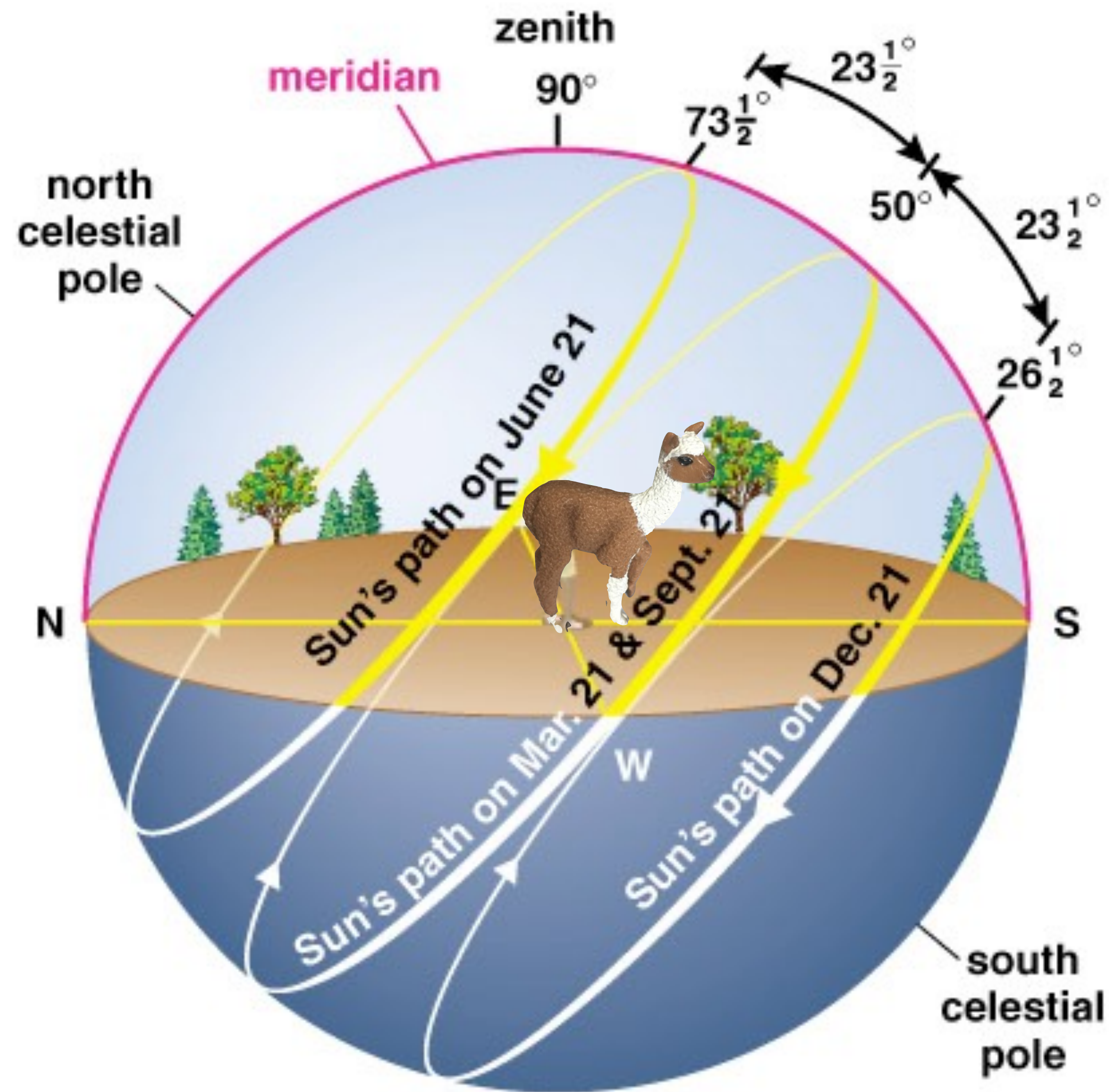
At the Equator, where you can see the entire sky:



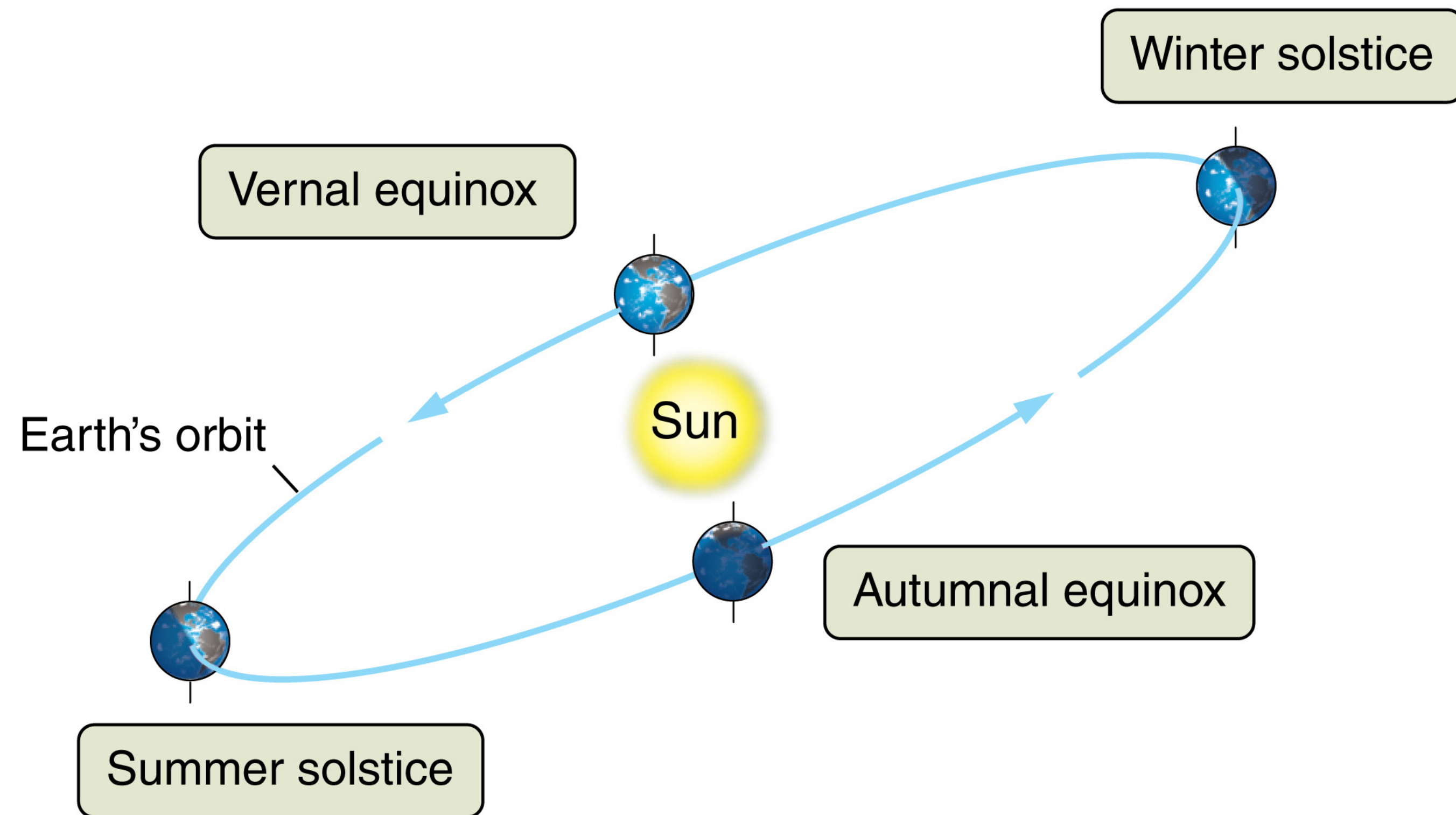
Southern Hemisphere, same as in the north but relative to the South Celestial Pole



Max altitude of the Sun determined by where we are on Earth and where the Earth is in its orbit



Motion of Earth around the Sun

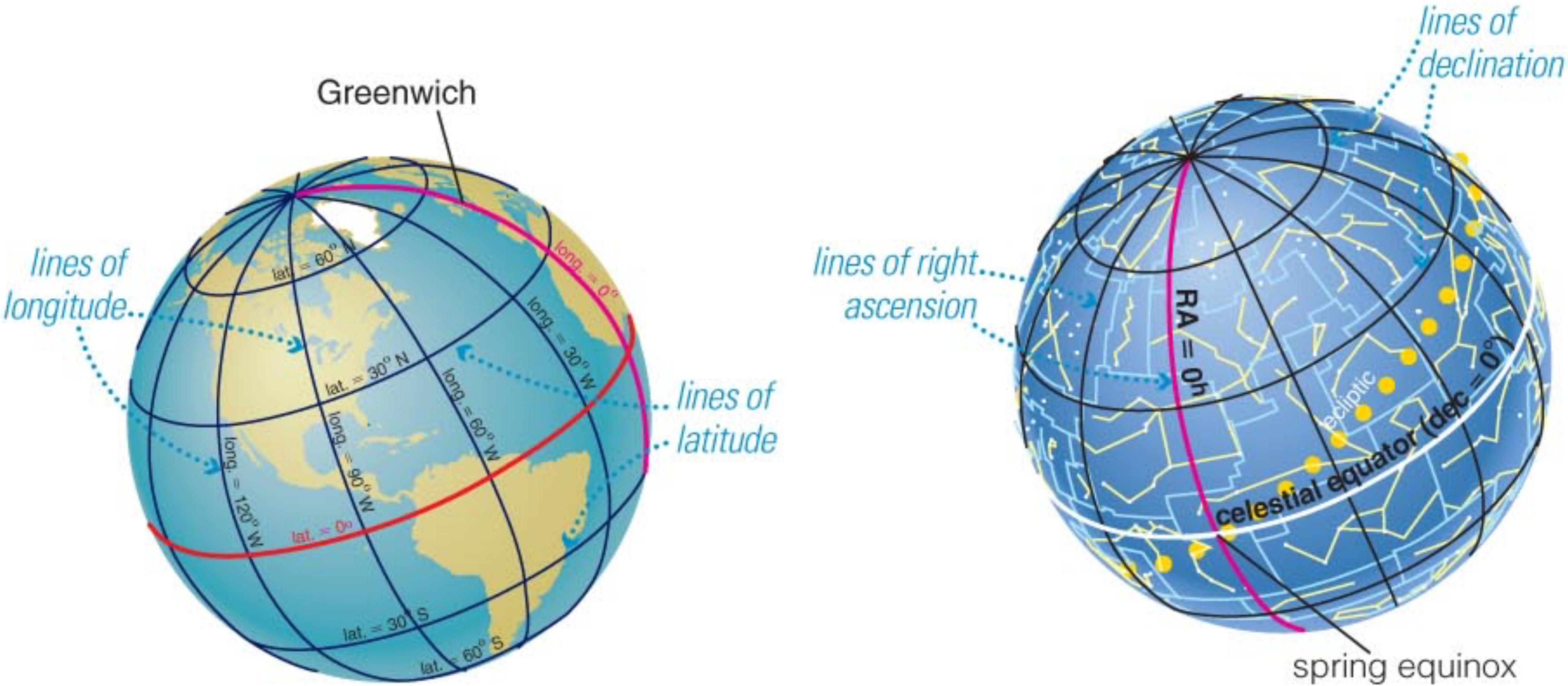


Where and when are we?

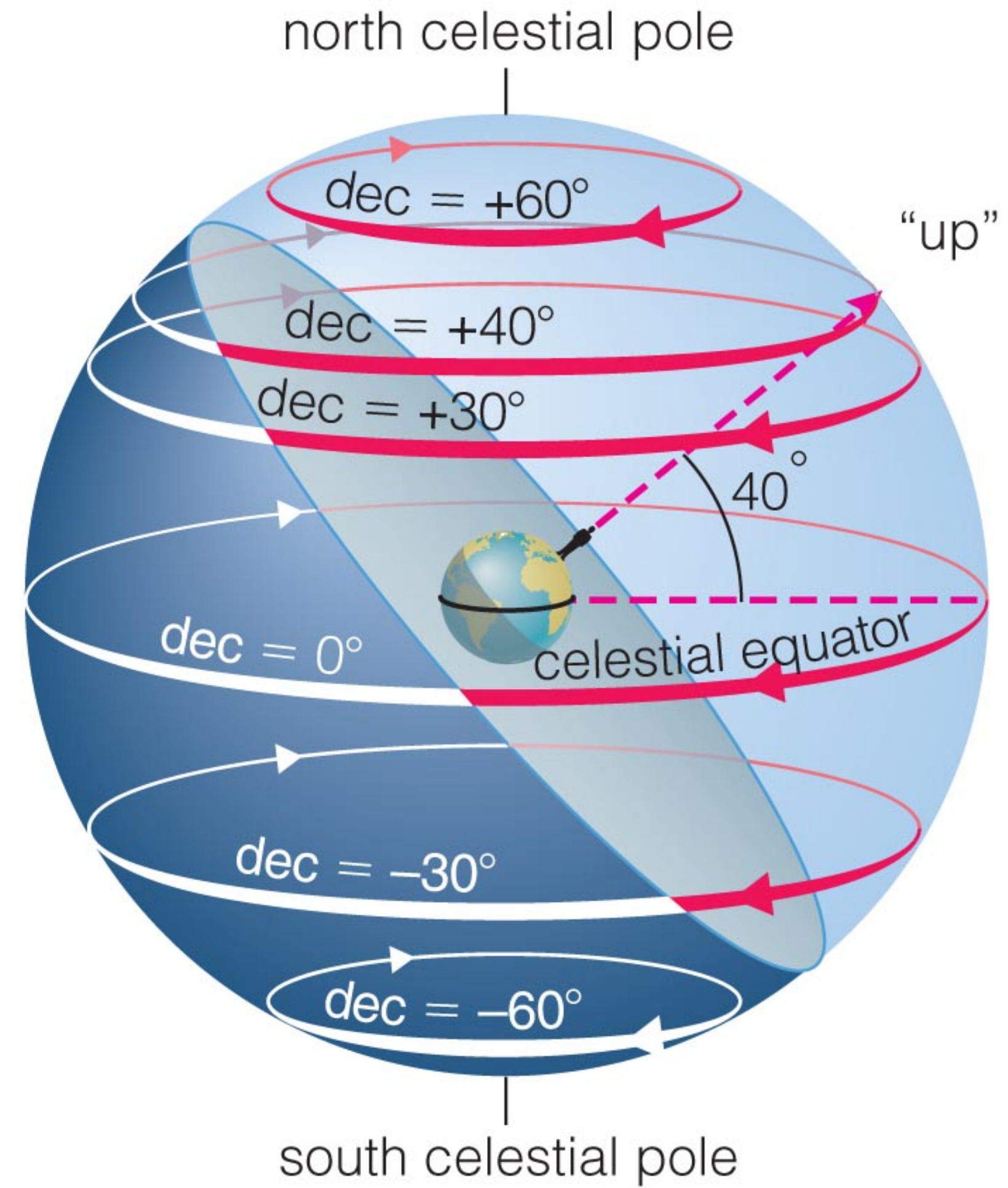
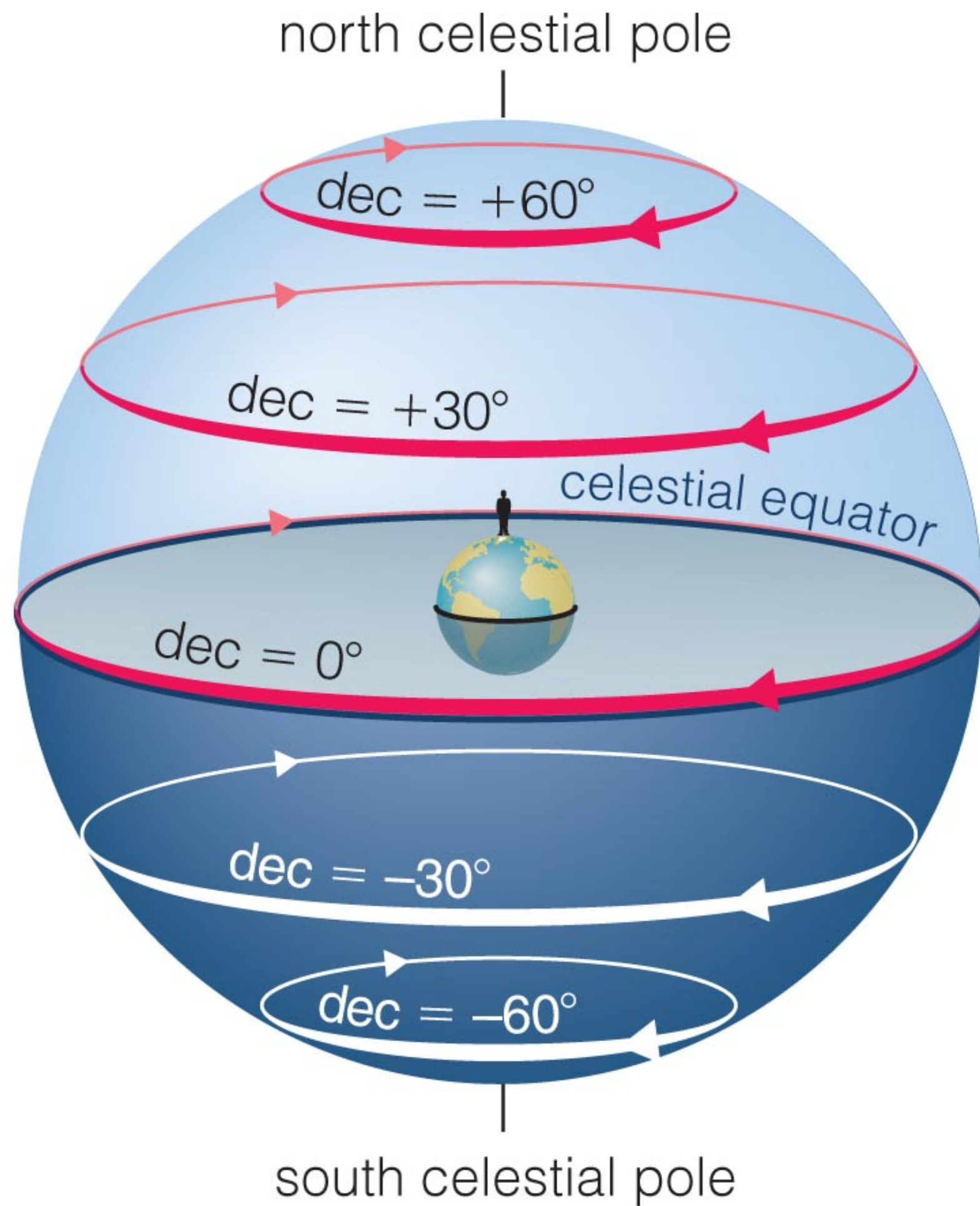


http://www.youtube.com/watch?v=Xm_Cn8-DCNc

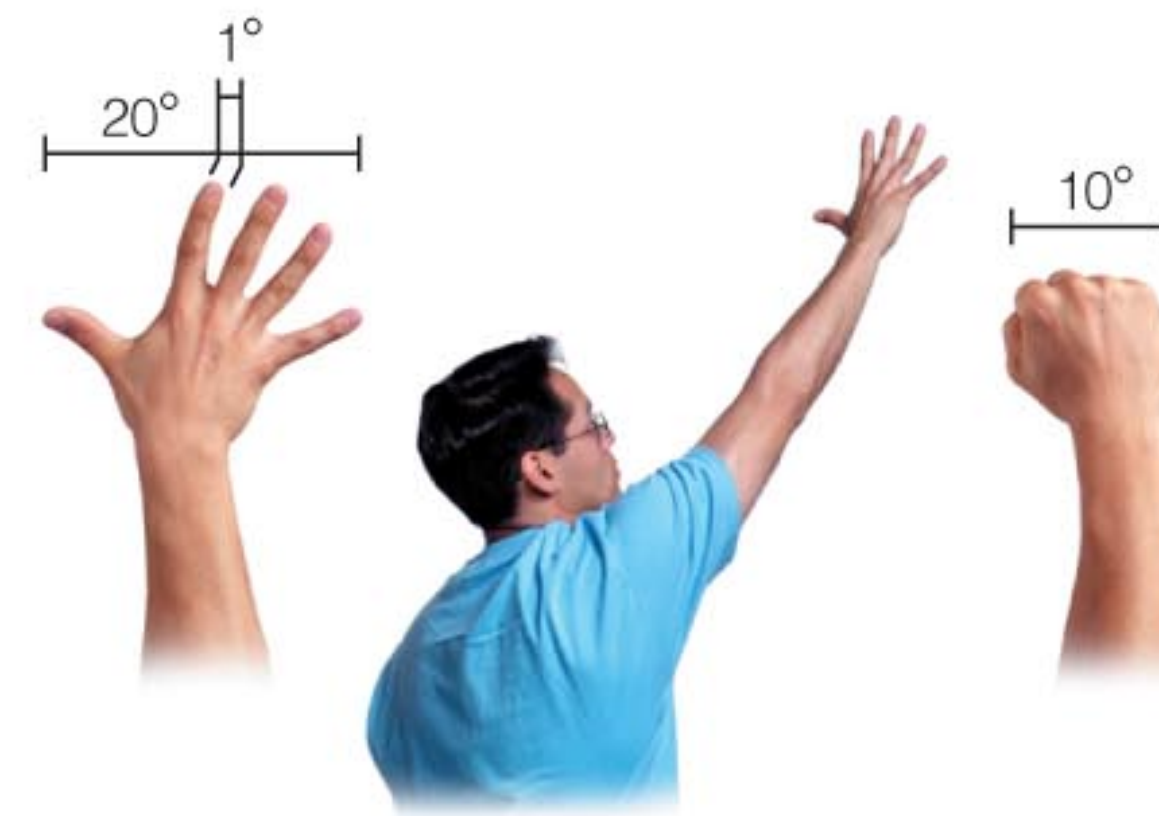
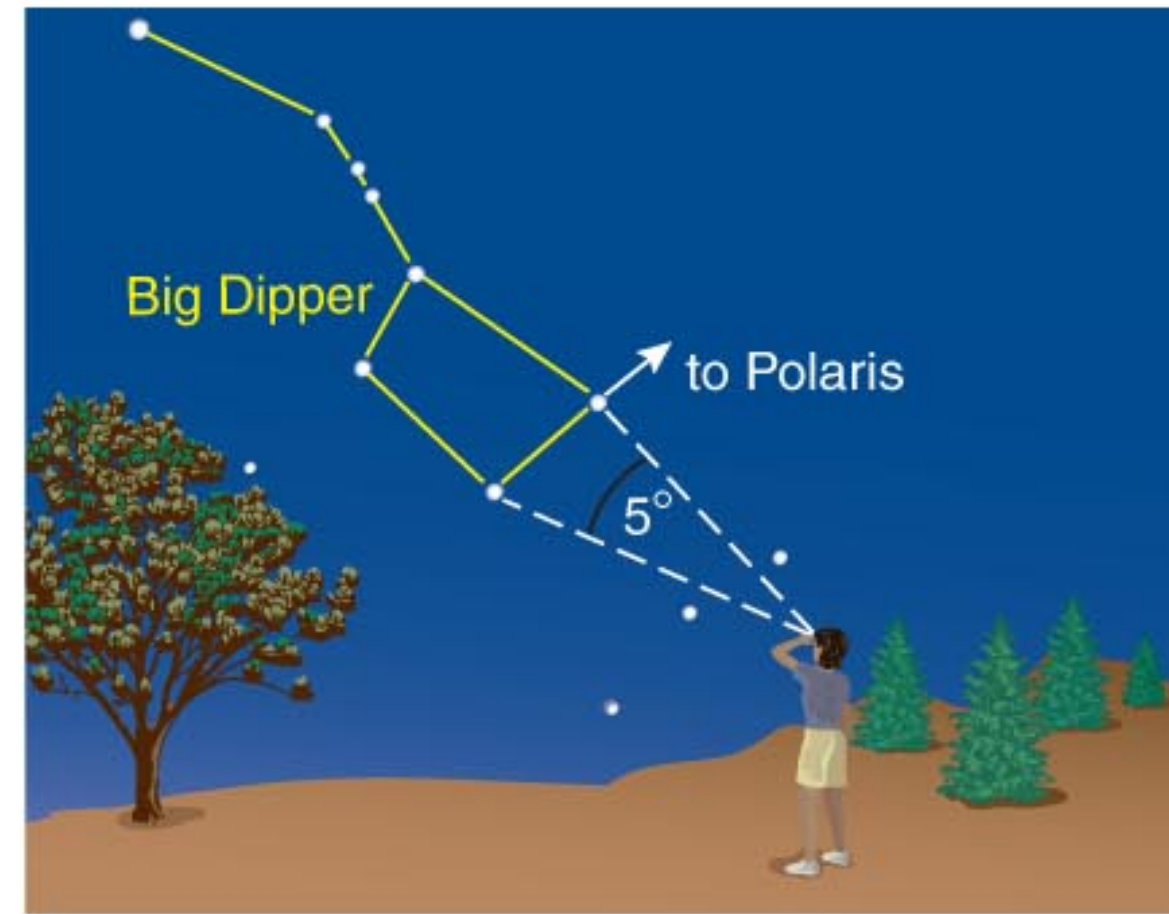
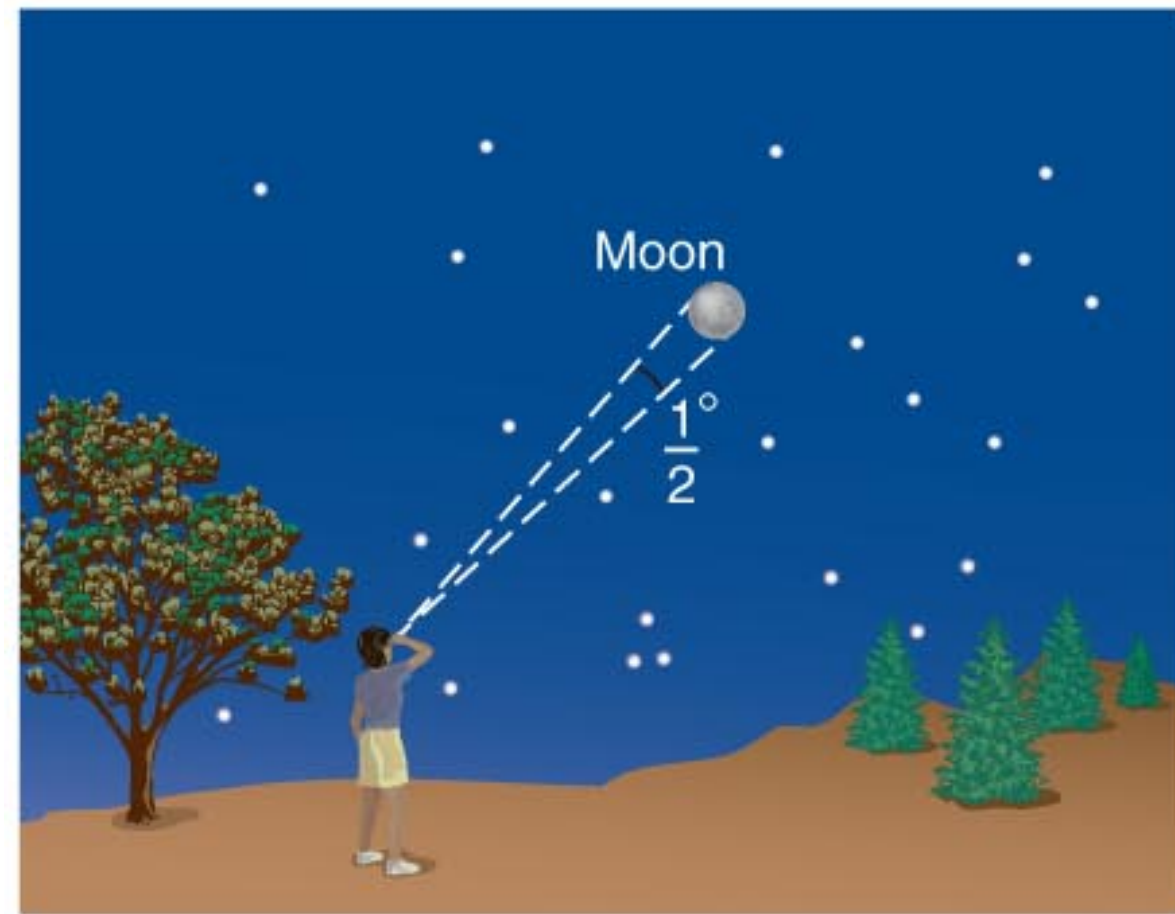
Coordinates on the Sky



Right Ascension & Declination



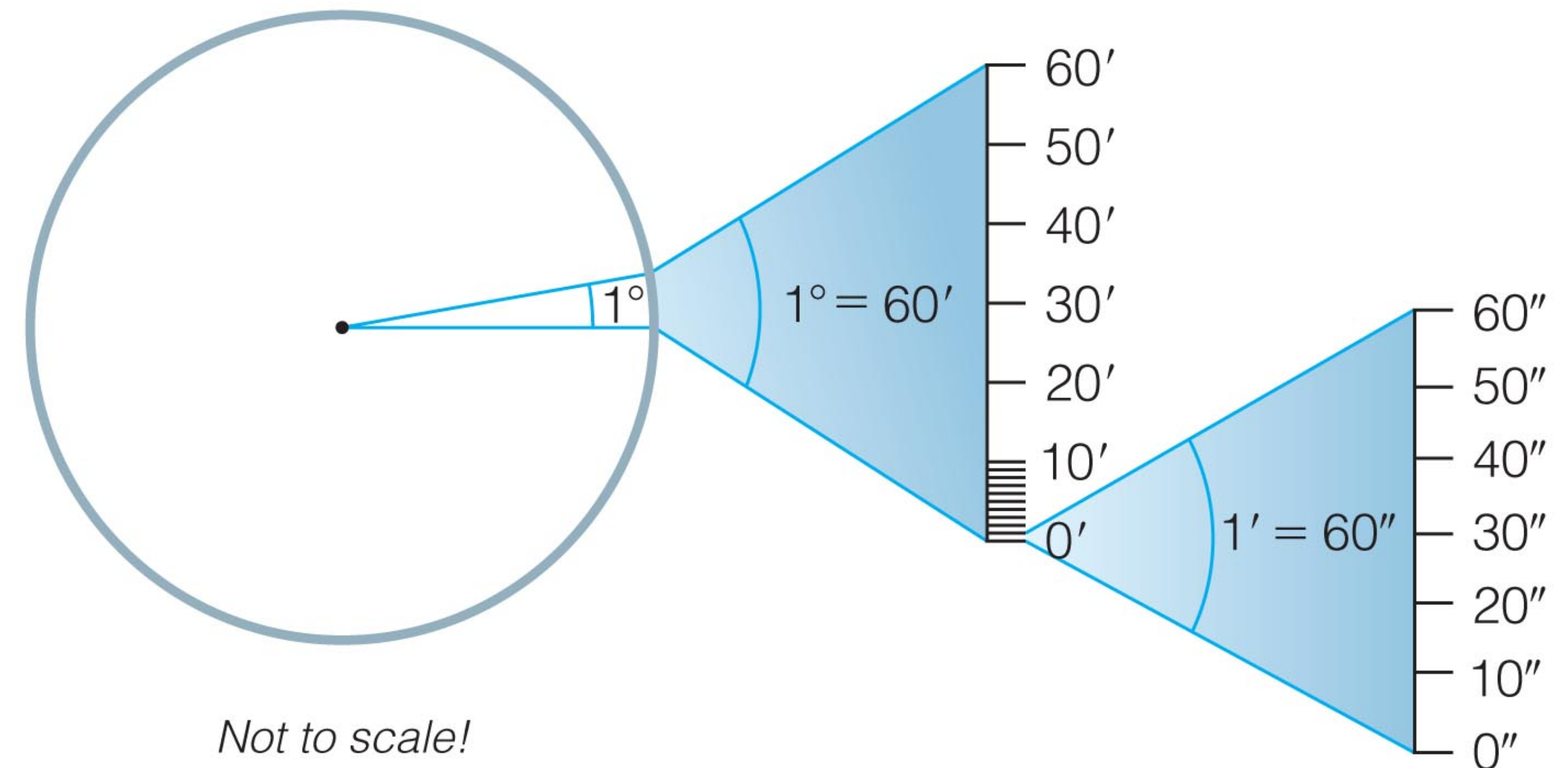
Angular Sizes / Distances on the Celestial Sphere



Stretch out your arm as shown here.

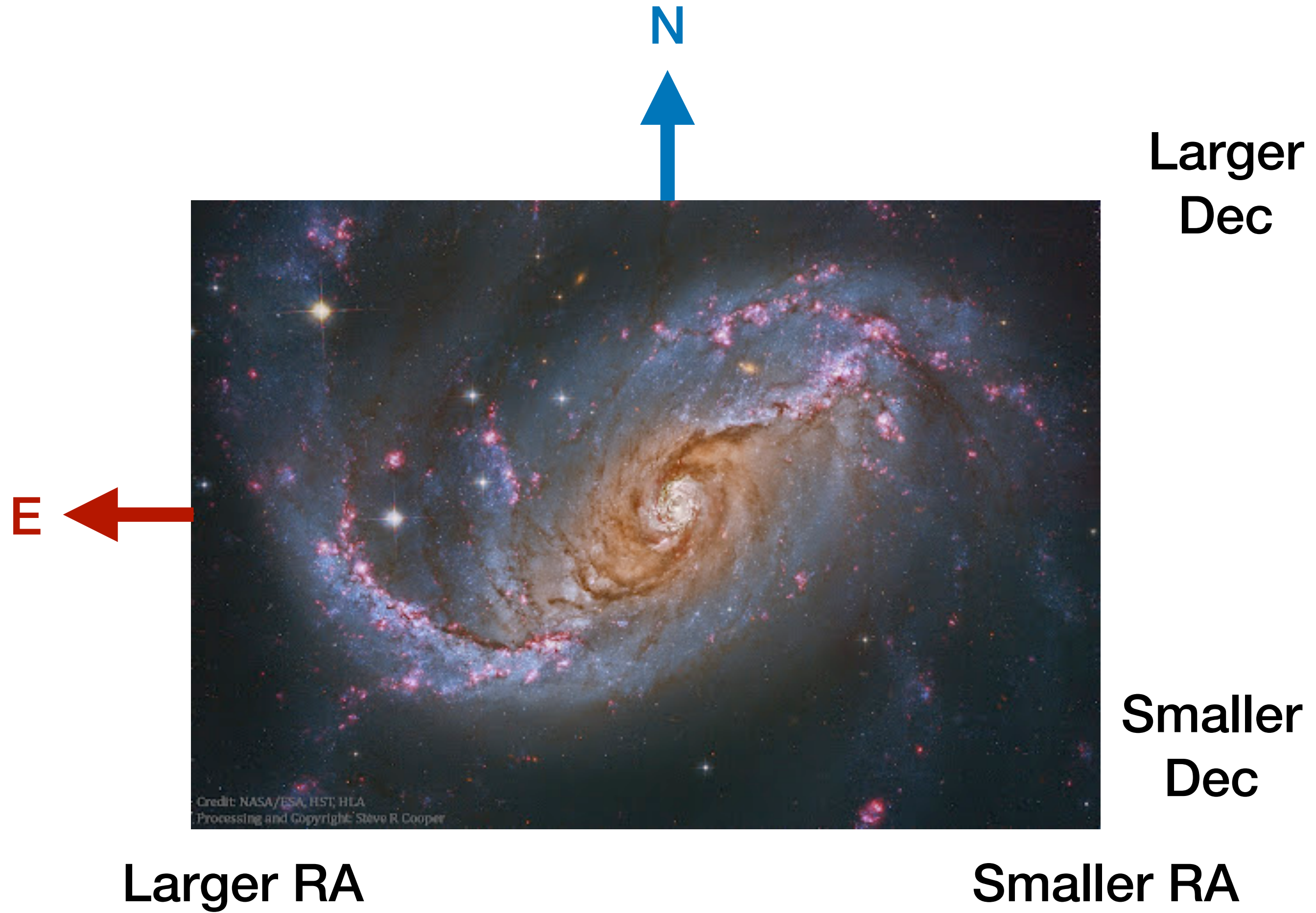
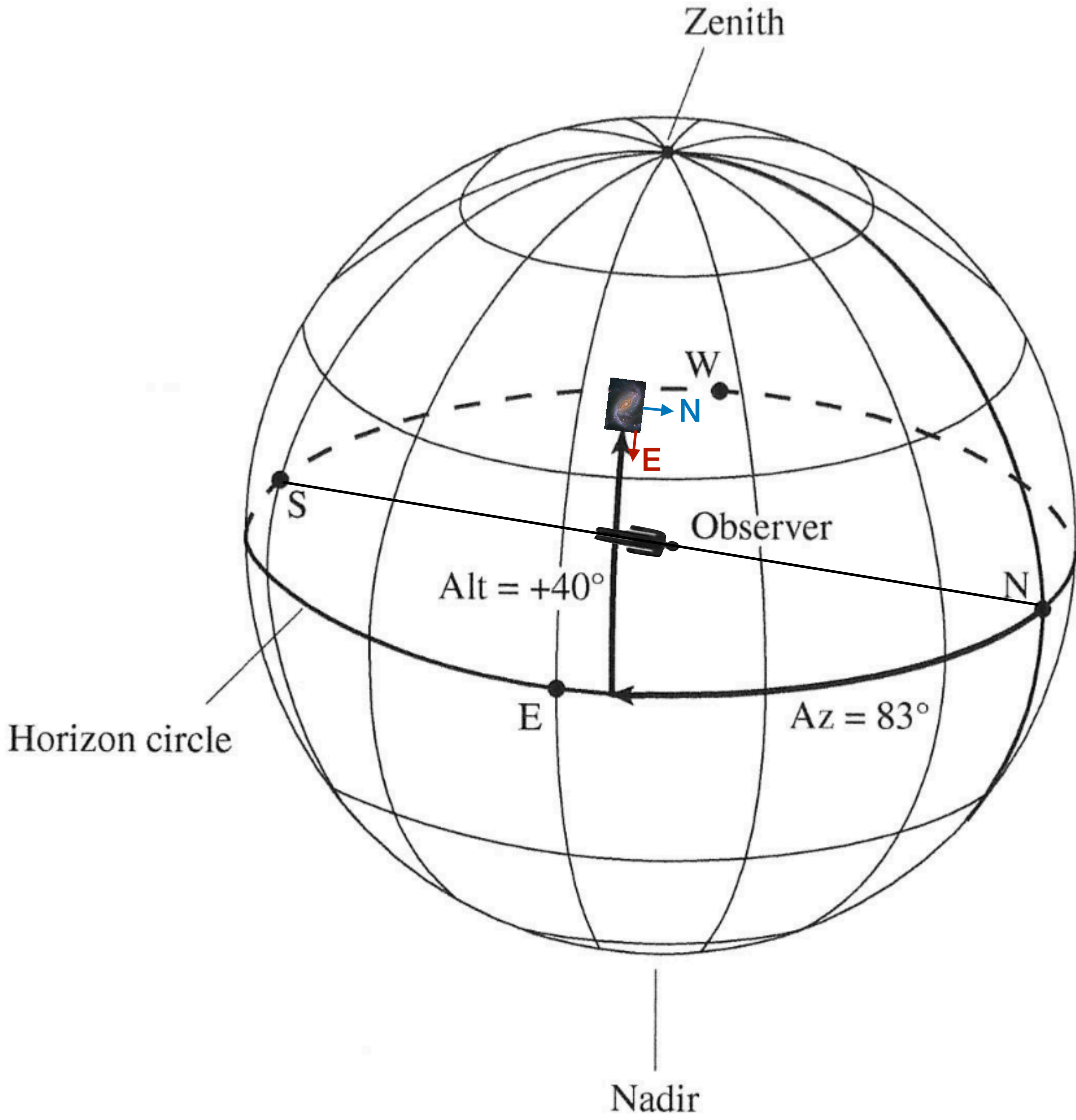
Right Ascension

- tells time, marking when stars cross an Hour Angle of 0^h
- can be quoted either in degrees or hours/minutes/seconds where 24^h = 360°
- differences of RA DO NOT correspond to angular differences except when Dec = 0°



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Celestial Sphere view from the inside



Group Discussion

Imagine you find yourself adrift in the ocean.

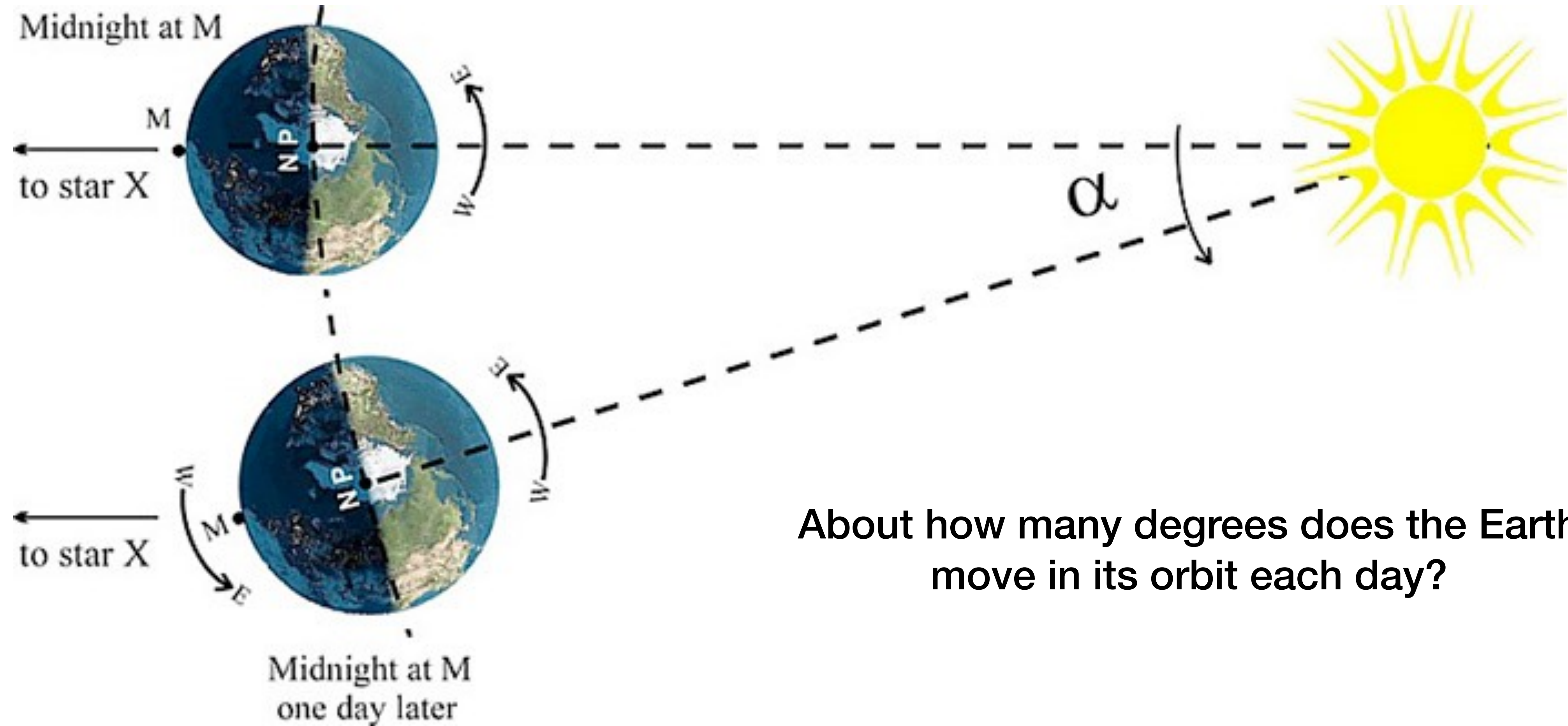
You estimate the North Star to have an altitude of approximately 60 degrees.

1. What is the angle between the North Star and your Zenith?
2. What is your latitude on the Earth?
3. Incredibly, a supernova bright enough to be visible during the day exploded and just skims your horizon at its lowest point in the sky. What is its declination?
4. What do you need to know/have with you to figure out your longitude on the Earth?

Draw a picture!

Changes in the Sky

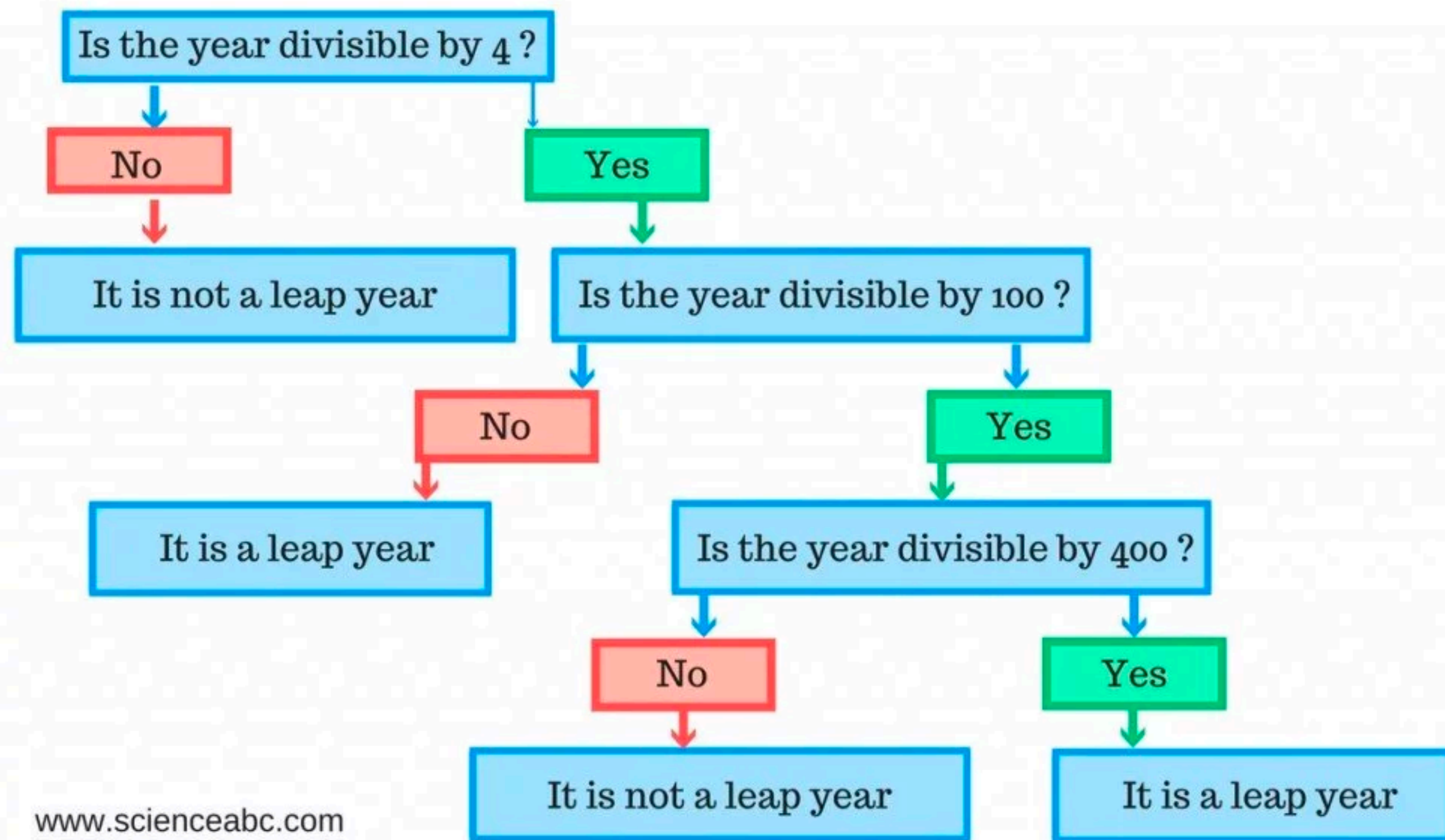
Why star rise/set times change



About how many degrees does the Earth move in its orbit each day?

Calendars aren't trivial, because an orbit around the Sun takes 365.2422 days

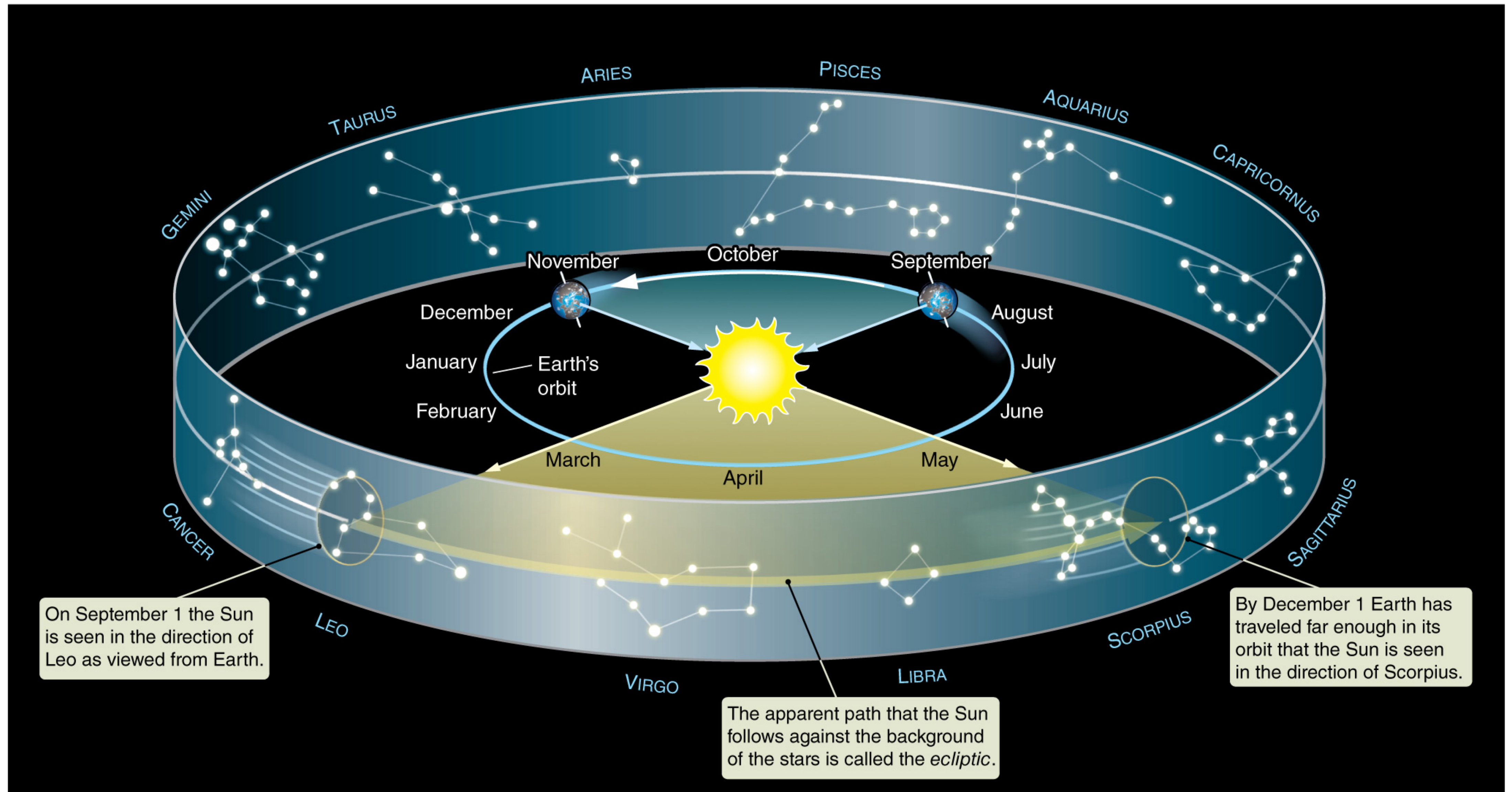
How to identify a leap year



Julian calendar was used for over 1000 years (leap day every 4 years). Every 400 years, the calendar is offset from the seasons by 3 more days.

Gregorian Calendar
(what we use today)

The Ecliptic: Sun's path on the Celestial Sphere



The Ecliptic

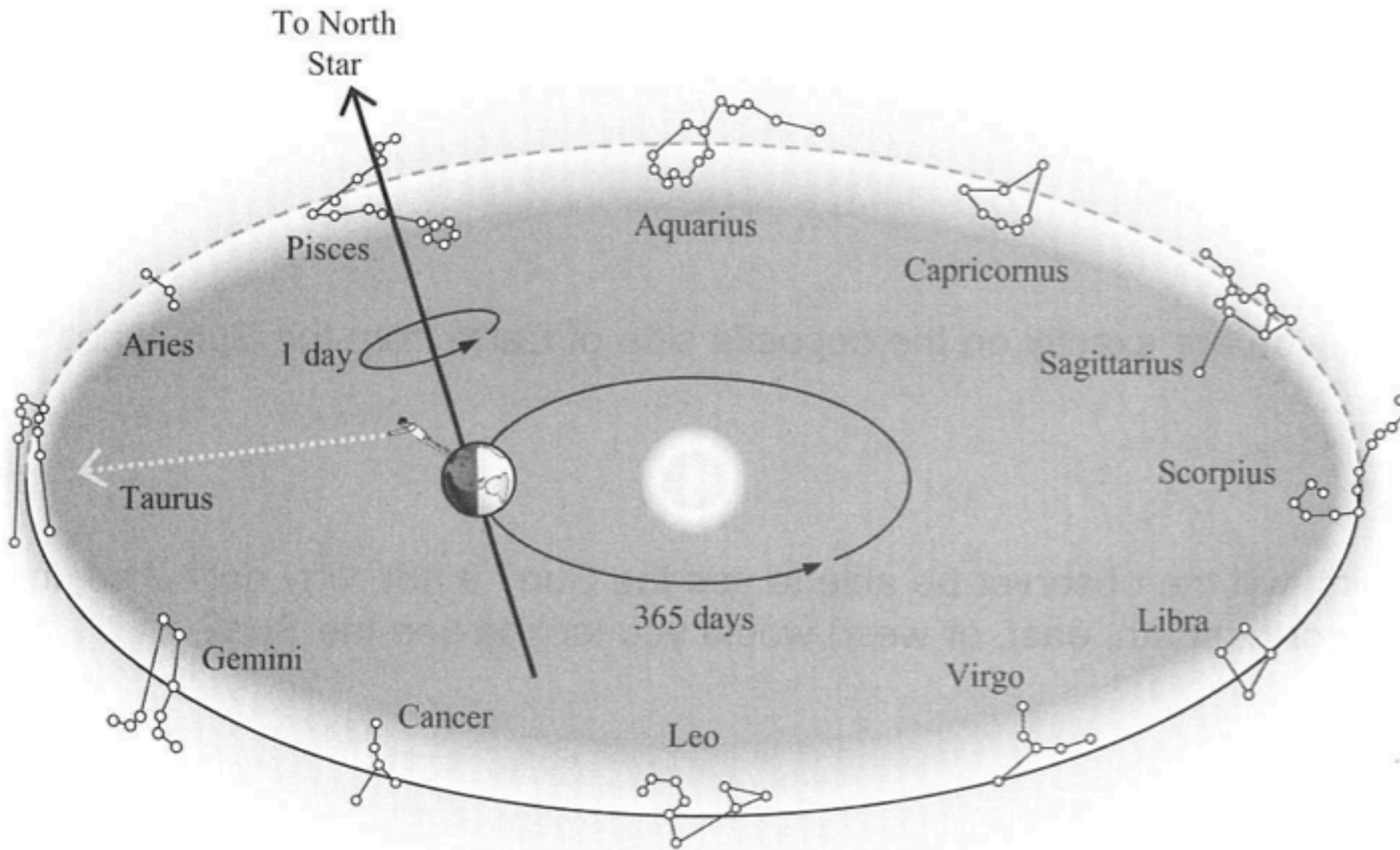


Figure 1

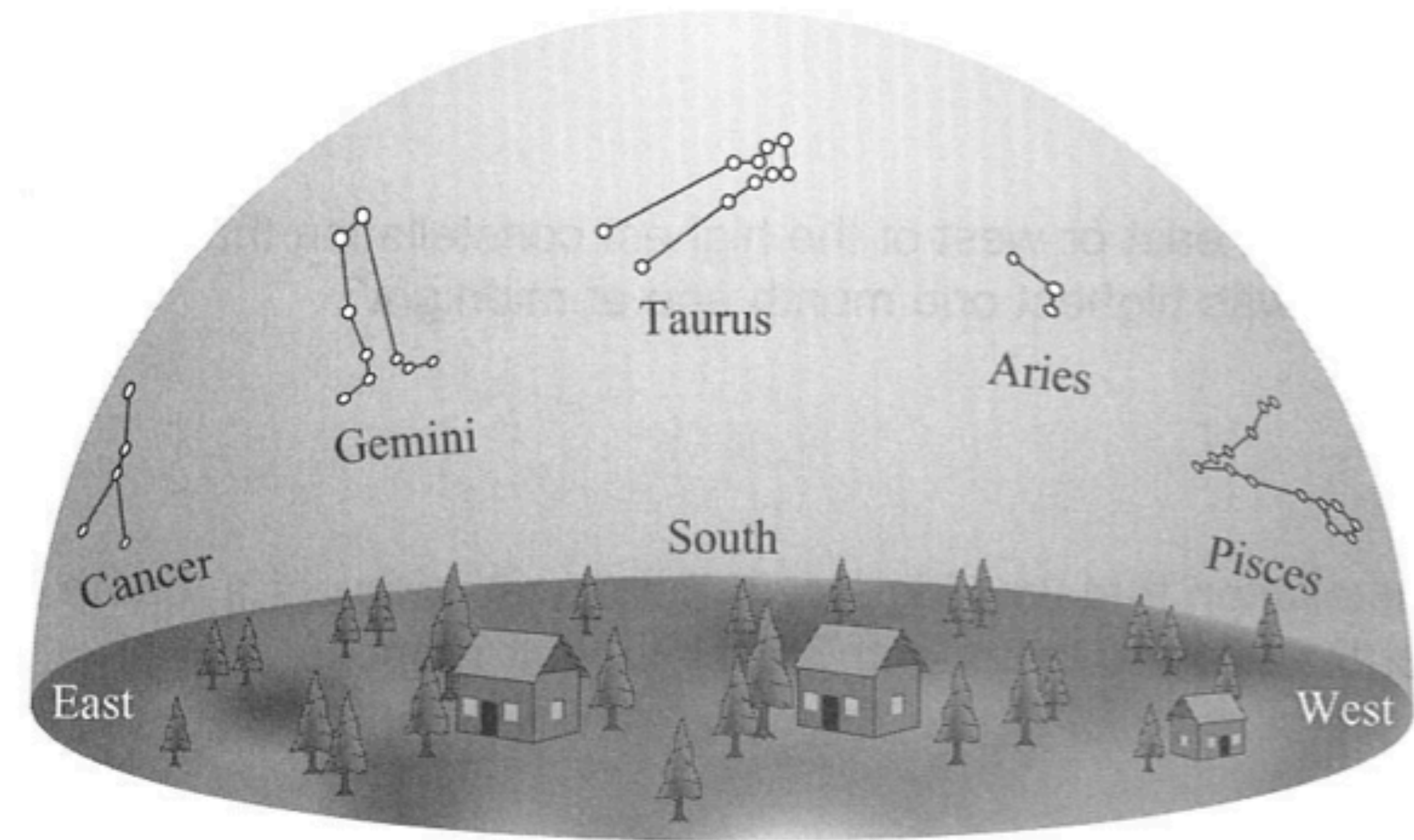
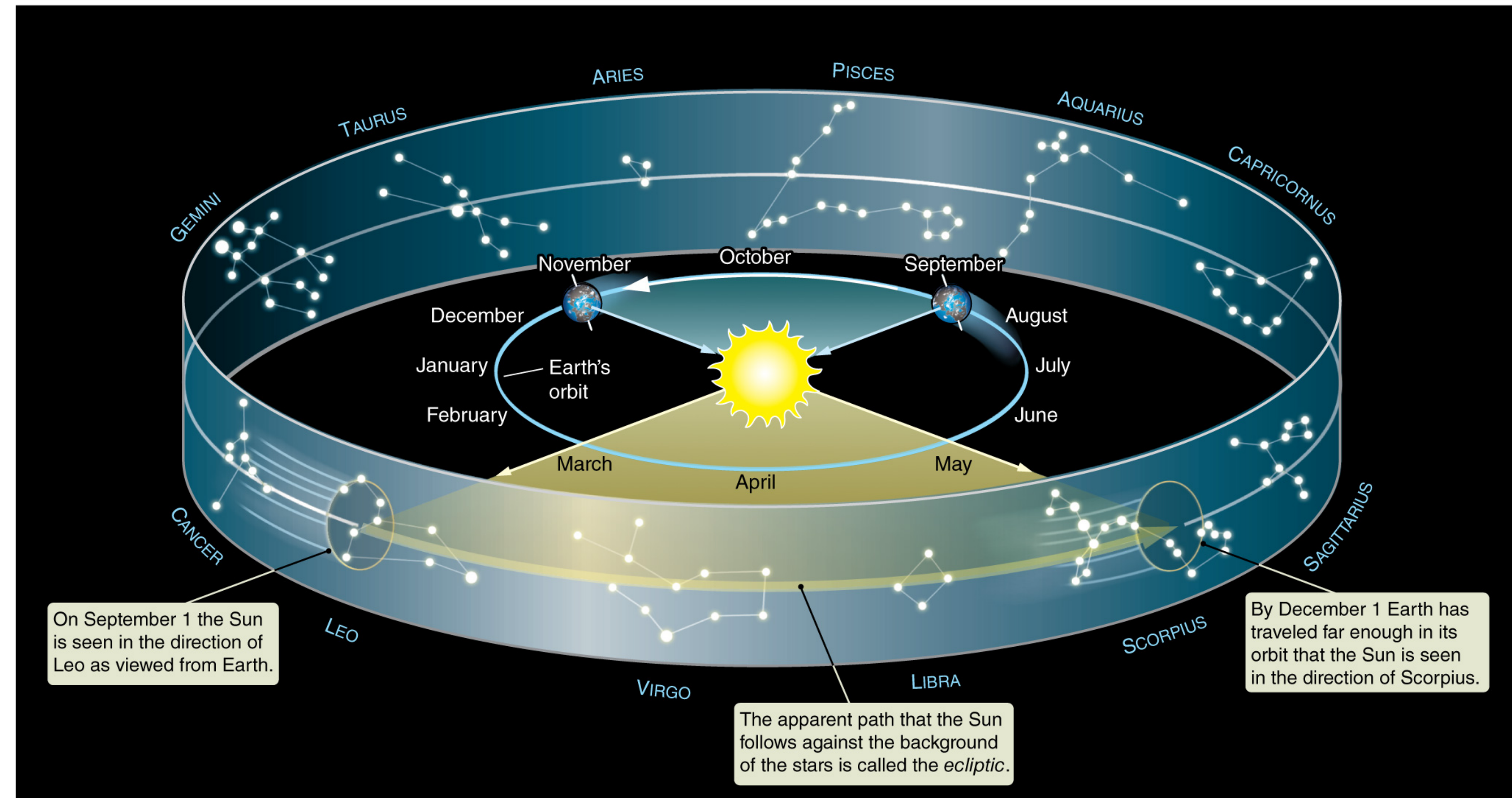


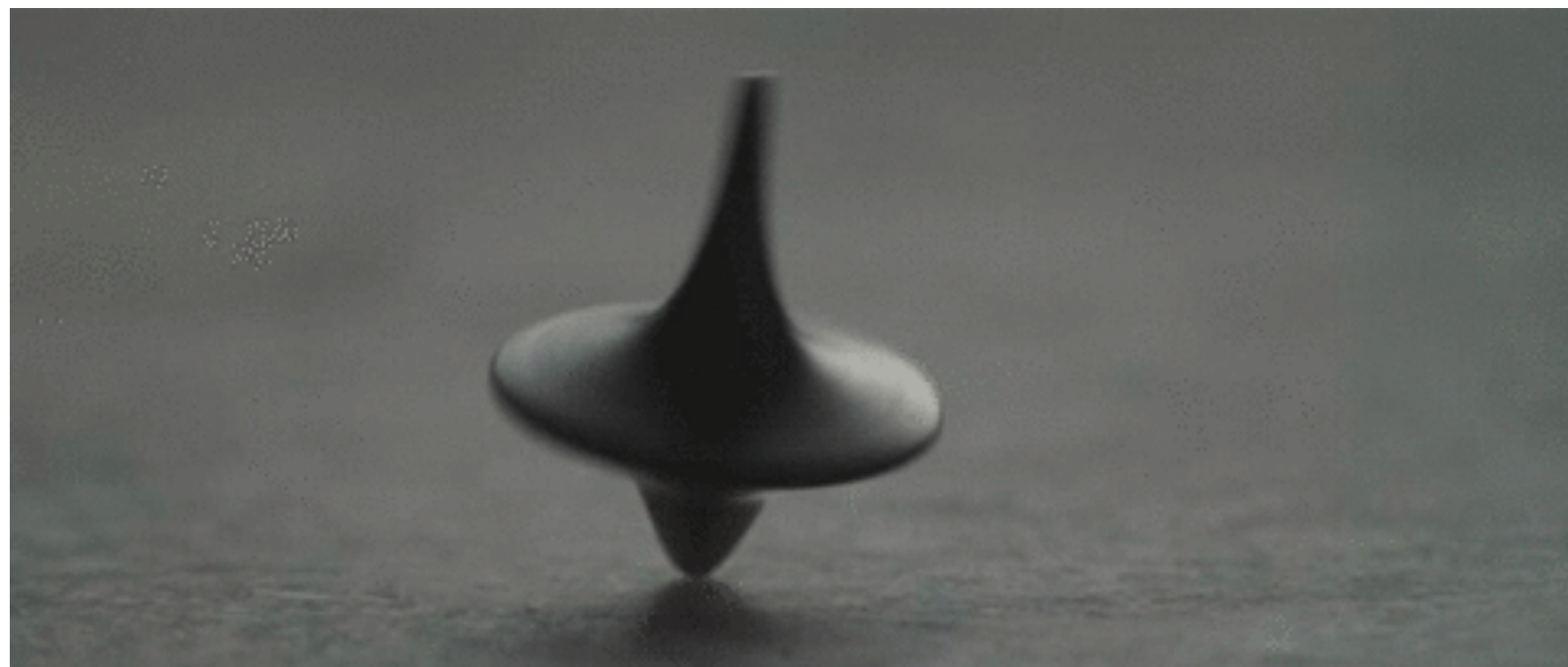
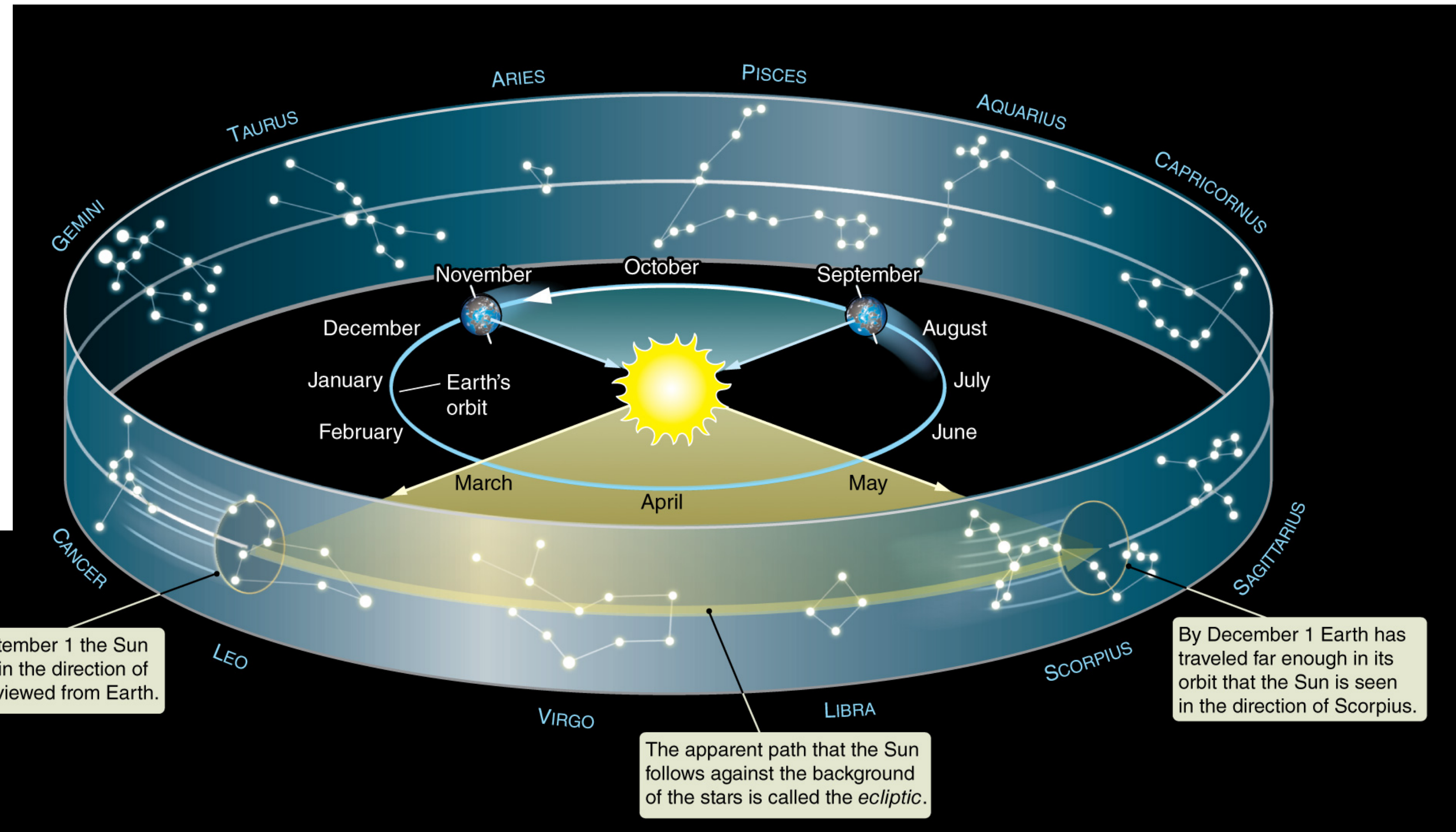
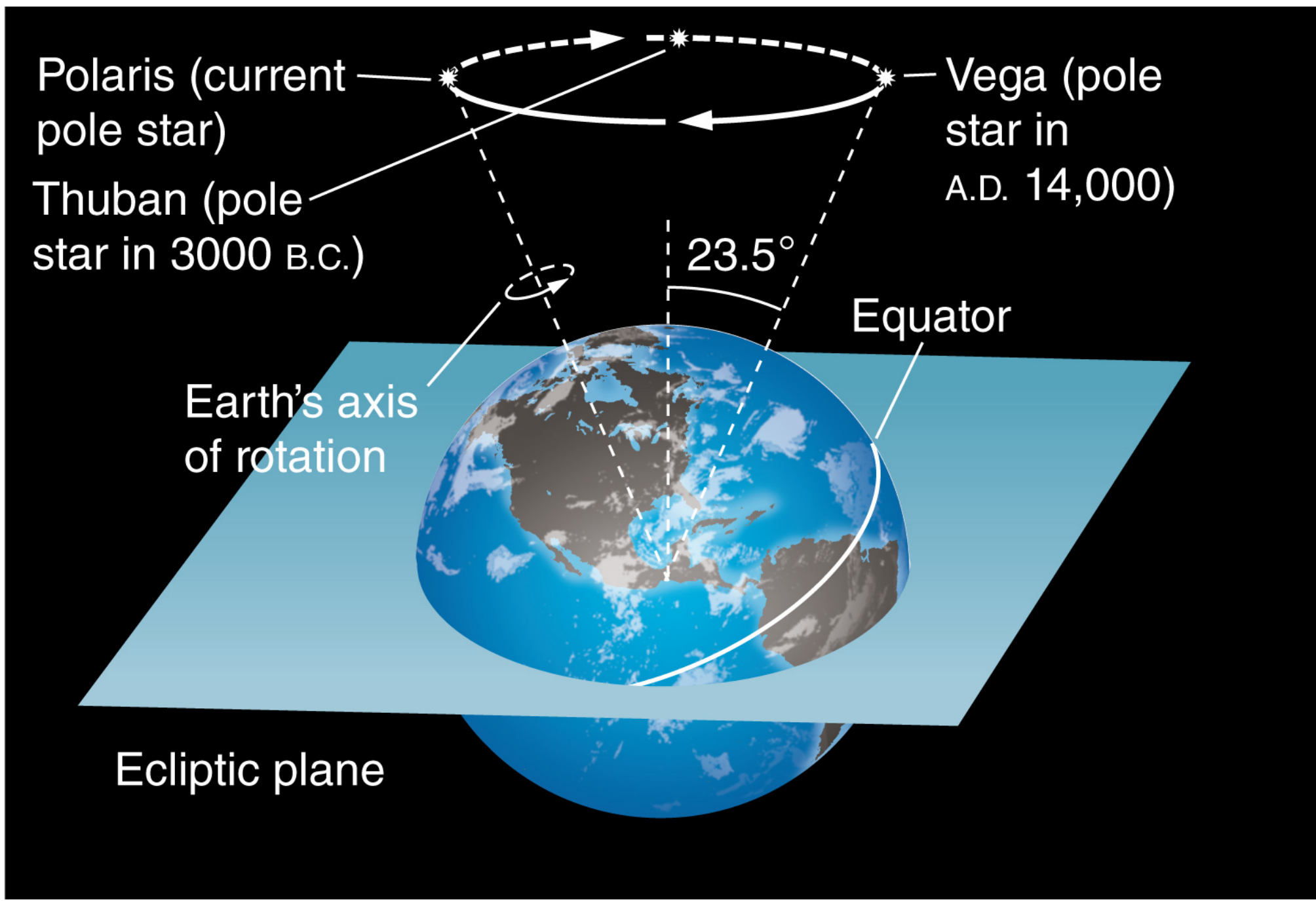
Figure 2

Hey you, what's your sign?

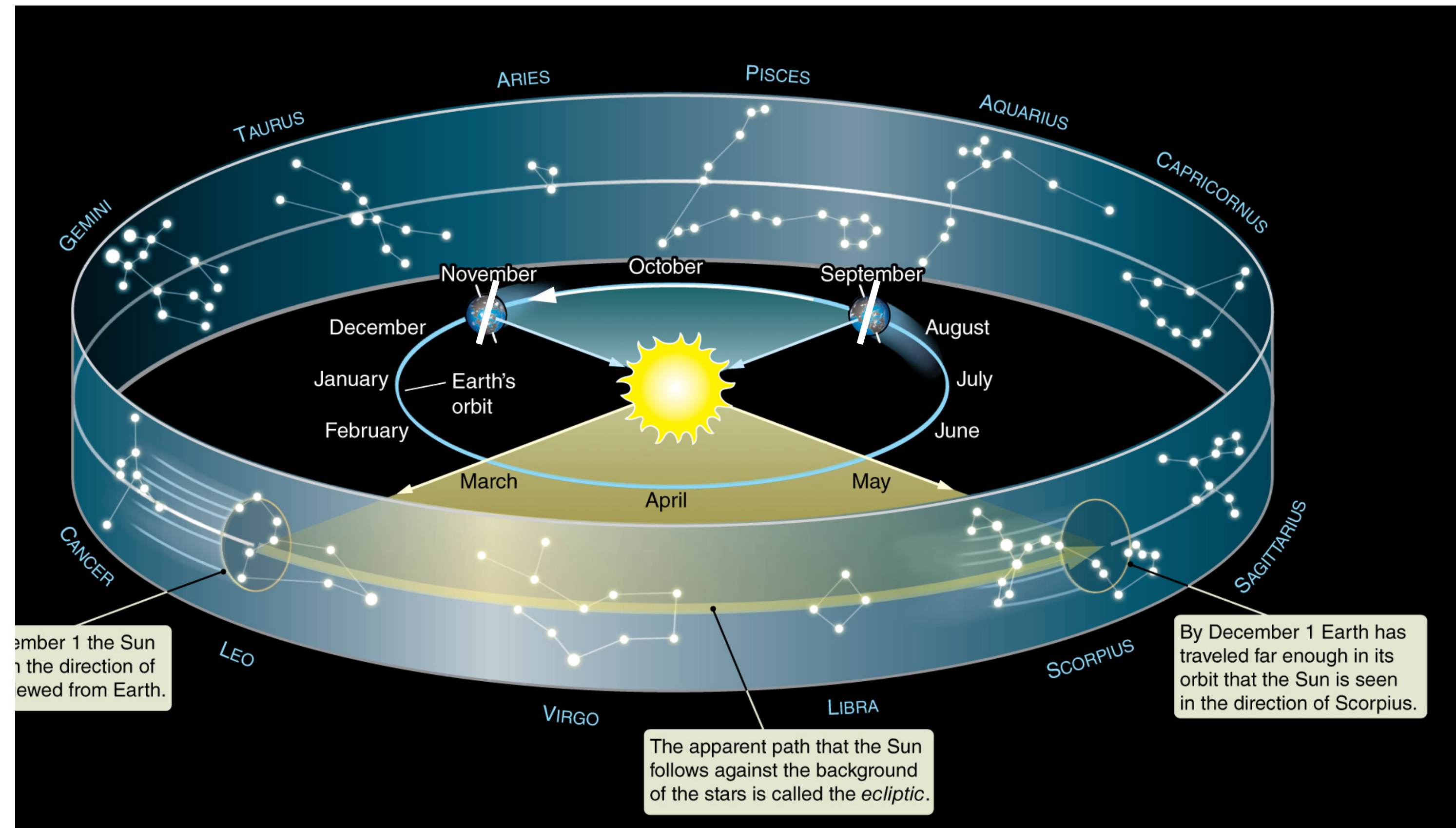
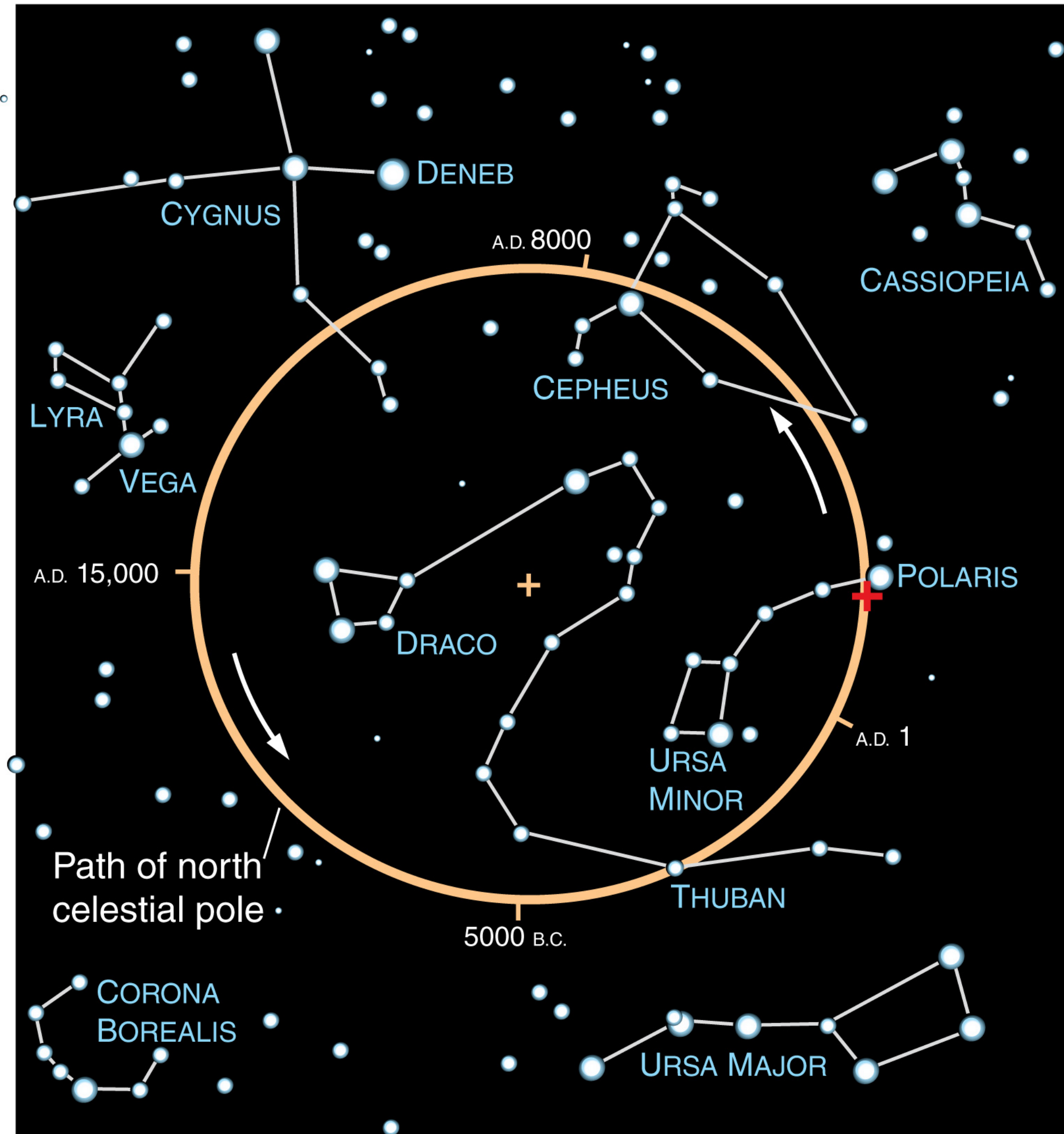
Astrology
is
bunk!



Earth's axis wobbles like a top: called Precession



Earth's axis wobbles like a top: called Precession



Because of precession, the RA & Dec of a star are always changing!

To keep sane, astronomers use coordinates from a particular time, referred to as the Epoch; at present, we use Epoch J2000, the RA/Dec objects had at midnight on January 1st, 2000.

To actually locate a star or object when observing, the coordinates must be “precessed”.

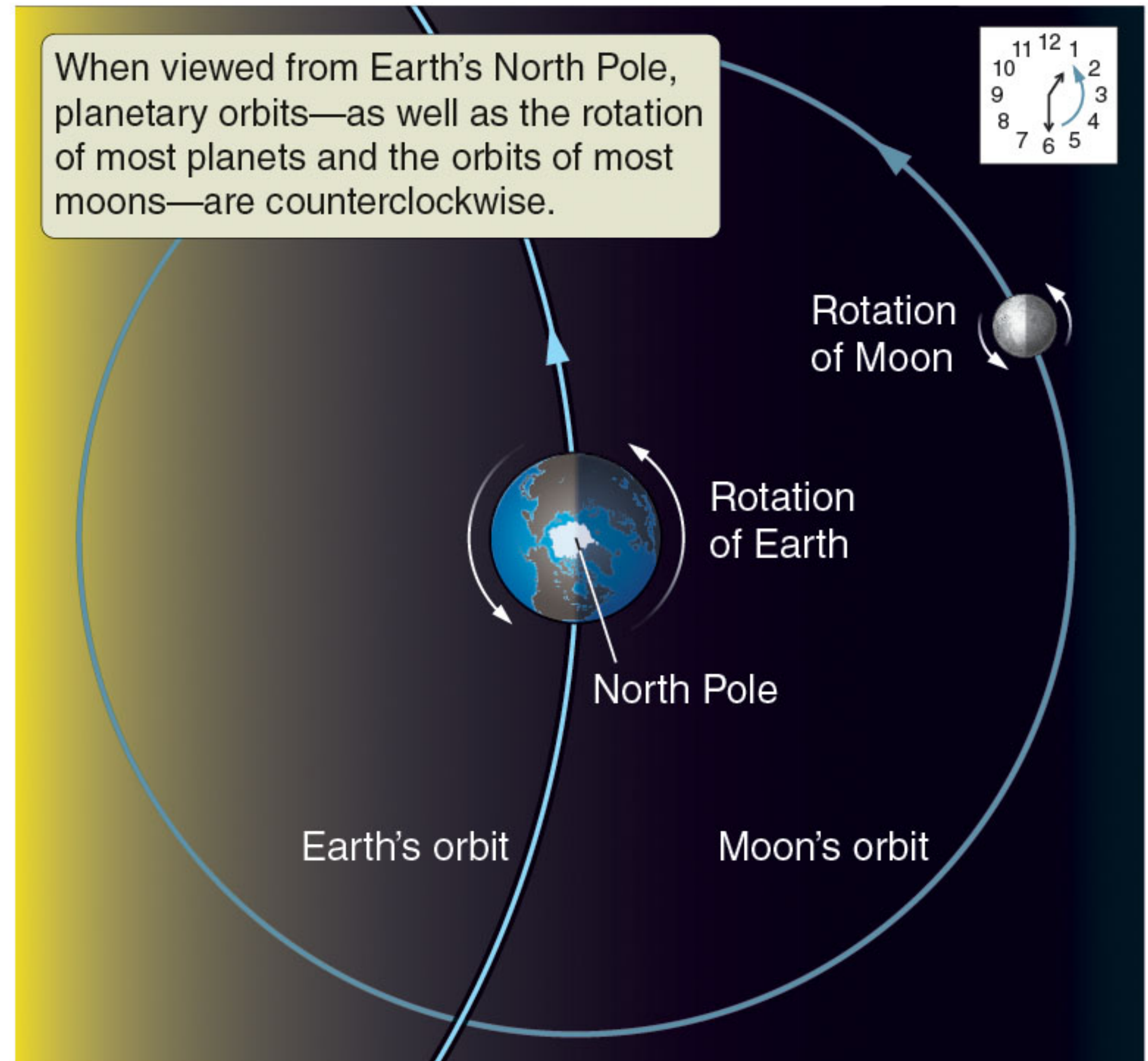
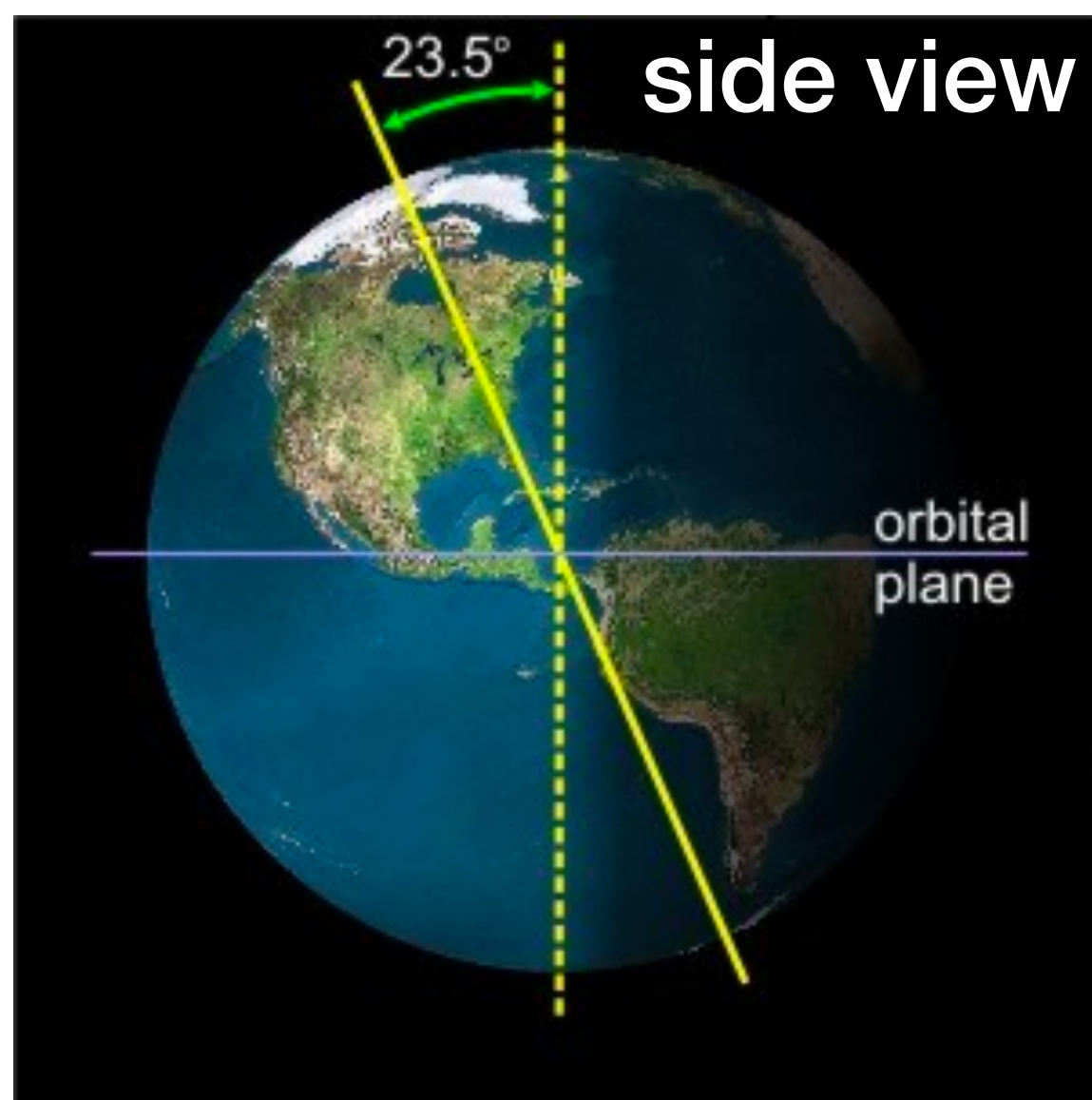
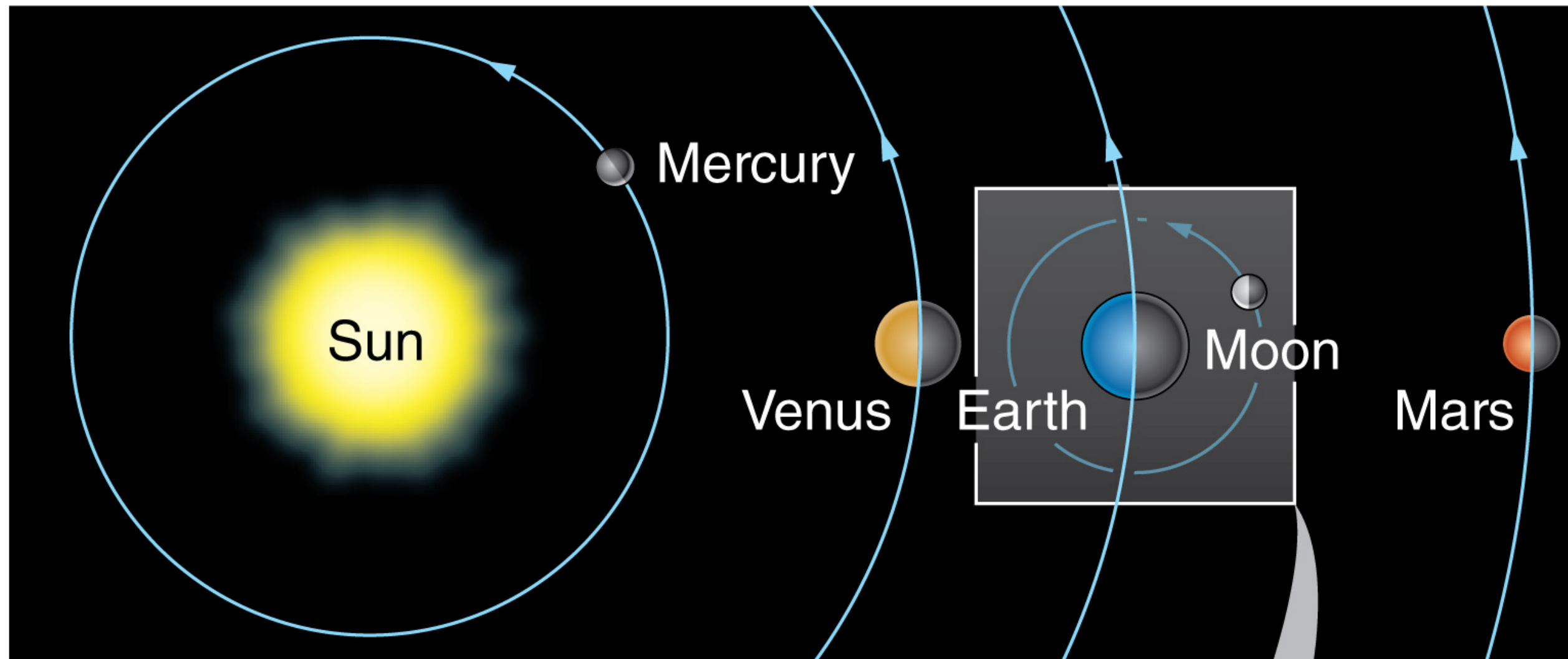
This “precession of the equinoxes” has a rate of $\sim 50''$ per year (modest optical telescopes tend to have angular resolutions of $\sim 1''$ and fields of view of a few arcminutes across, so this rate is quite significant!

What causes precession (i.e., how is Earth's angular momentum able to change)?

What causes seasons?

What effects result from this cause that leads to colder/hotter temperatures?

Everything moves and is a tad cockeyed



MOON PHASES!!!!



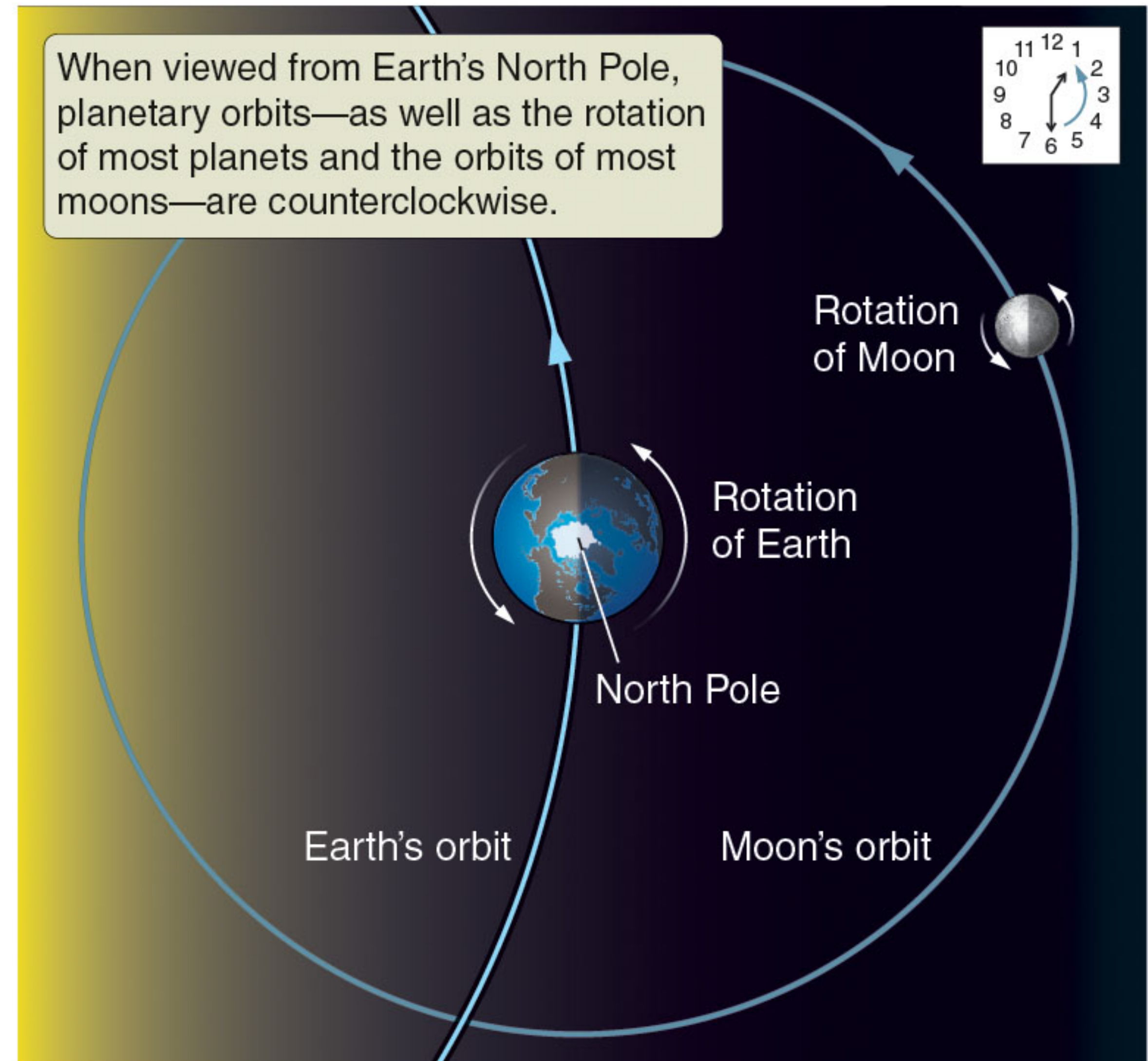
You wake up outside, no idea how long you were unconscious for.

You look to the horizon and see this Moon.

Is it waxing or waning? What time is it (roughly)?

What direction are you looking? What time will the

Moon rise a week from now?



When viewed from Earth's North Pole, planetary orbits—as well as the rotation of most planets and the orbits of most moons—are counterclockwise.

Rotation of Moon

Rotation of Earth

North Pole

Earth's orbit

Moon's orbit