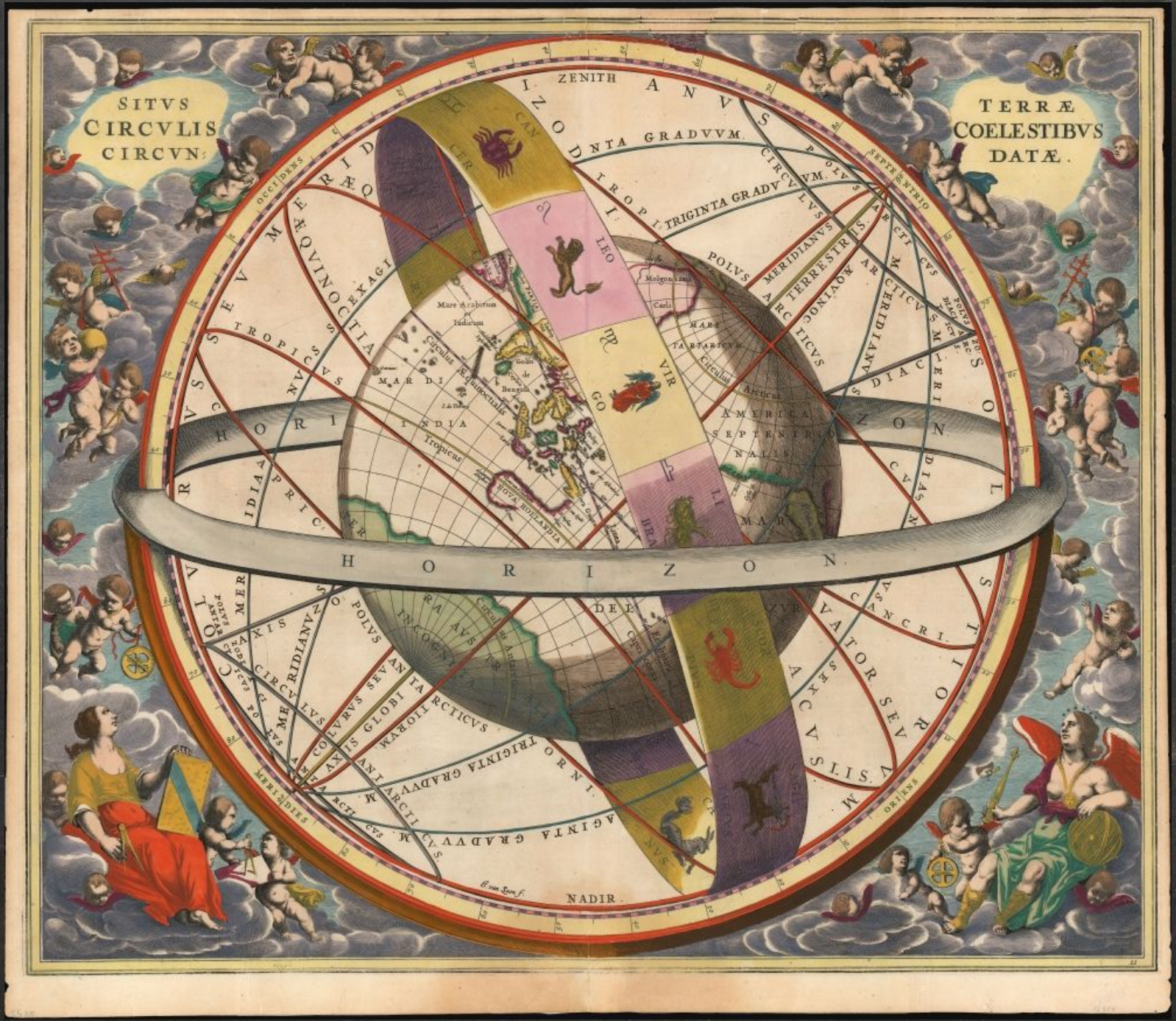
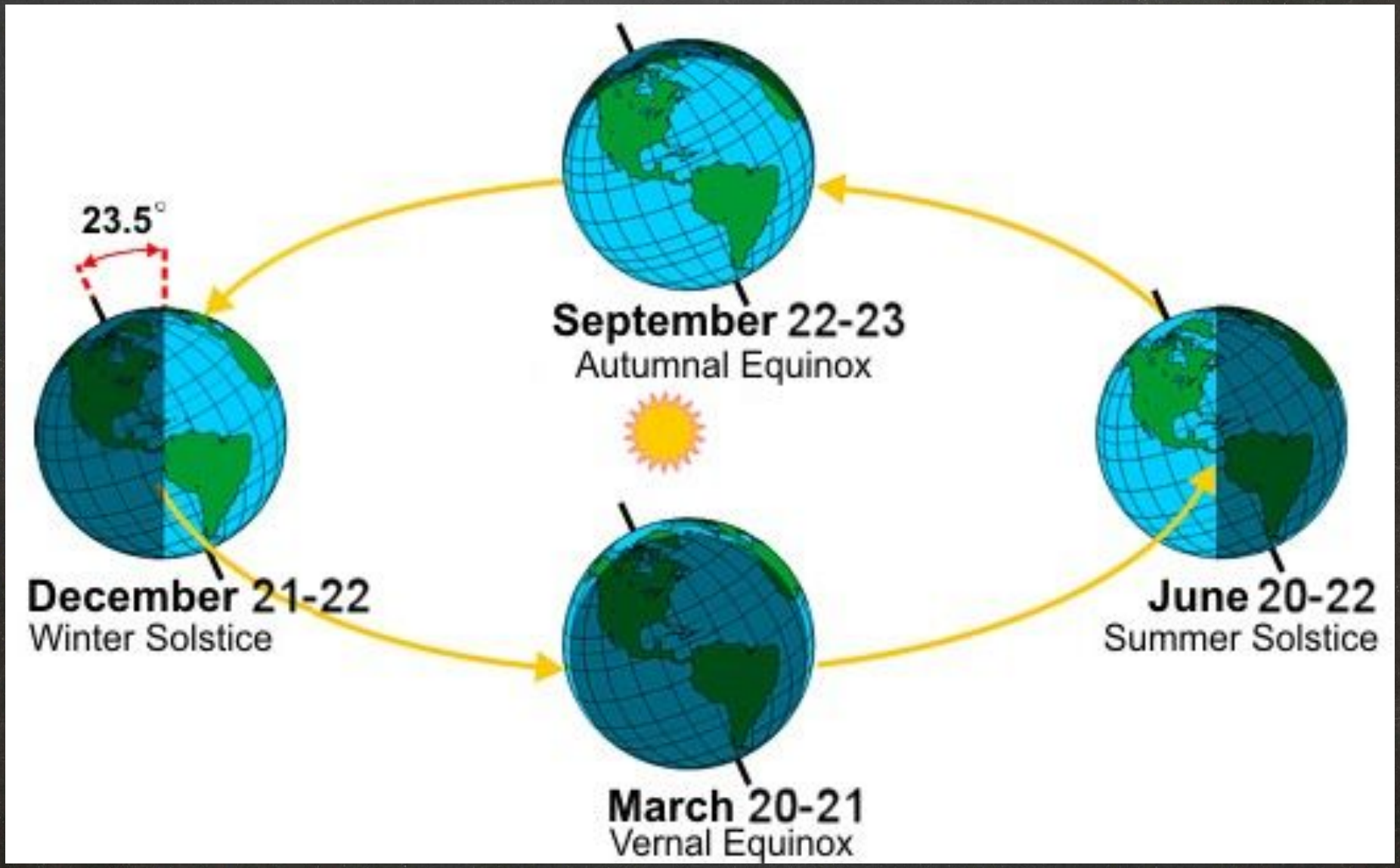
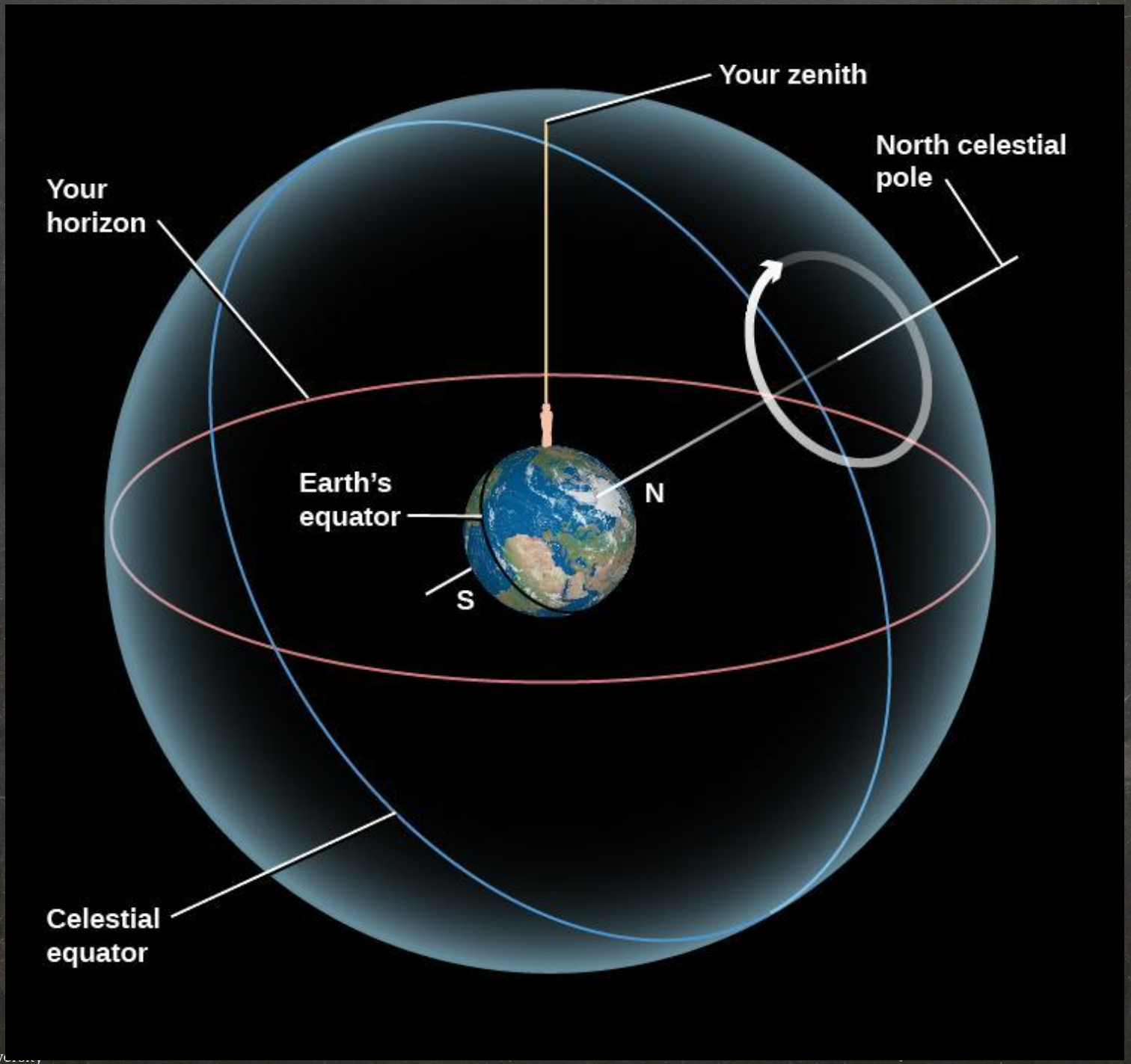




Andres, Boston University

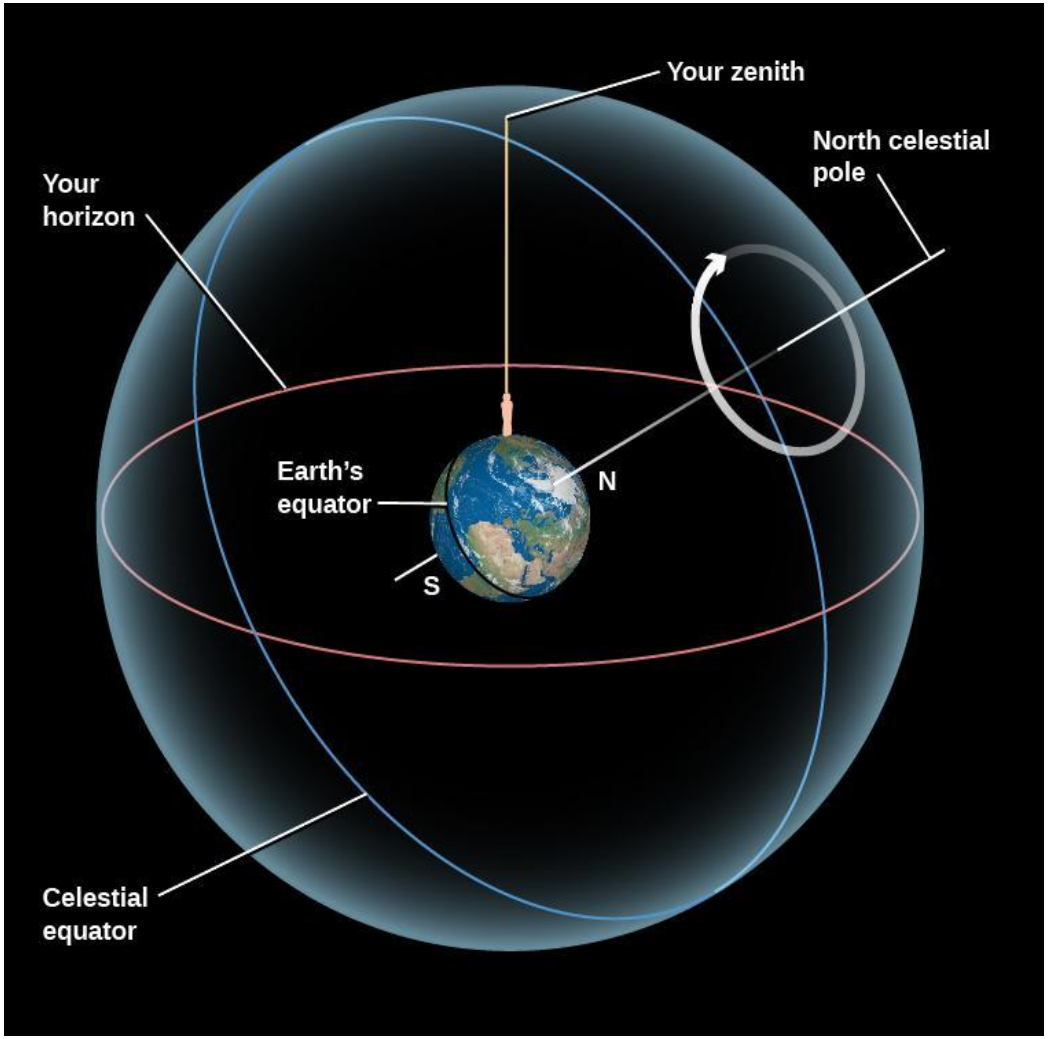

Your zenith
North celestial pole
Your horizon
Earth's equator
N
S
Celestial equator

2.1 The Sky Above

Learning Objectives

By the end of this section, you will be able to:

- Understand the modern meaning of the term *constellation*
- Define the main features of the celestial sphere
- Explain the system astronomers use to describe the sky
- Describe how motions of the stars appear to us on Earth
- Describe how motions of the Sun, Moon, and planets appear to us on Earth



Constellations and Asterisms

Every culture around the world developed their own stories about the shapes in the night sky. Astronomy is one of the oldest sciences!

Most of the shapes and stories that we might be most familiar with are from Ancient Greece.

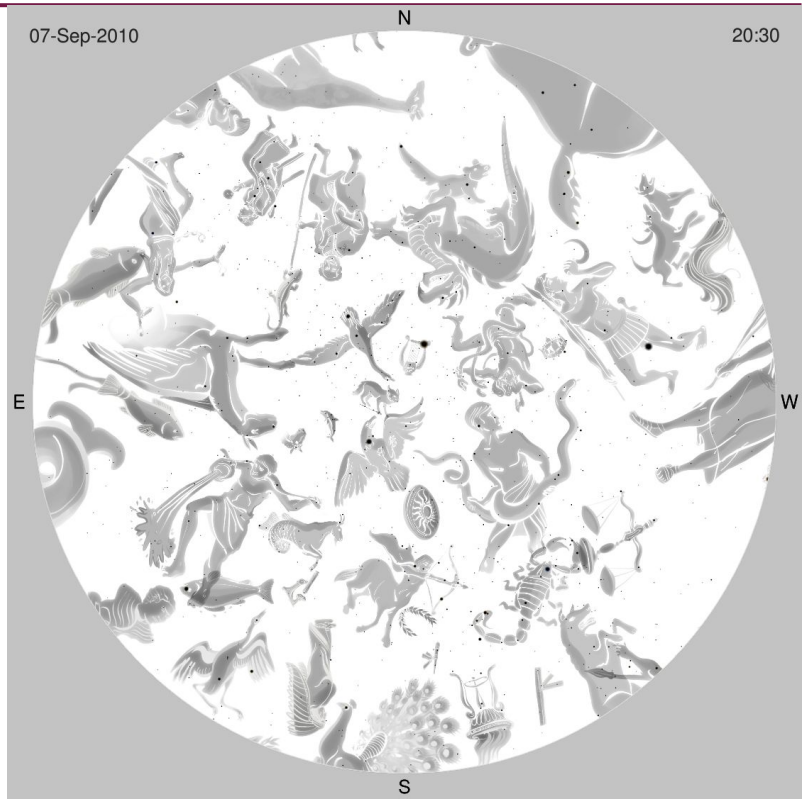


Image Credit Link: https://www.ifa.hawaii.edu/~barnes/ast110l_f10/constellations.html

Constellations and Asterisms

In the modern definition of a **constellation**, it is the patch of sky (or sector) that gets the name, rather than the set of stars themselves.

Of the 88 official constellations defined by the IAU in 1928, 48 are ancient in origin.

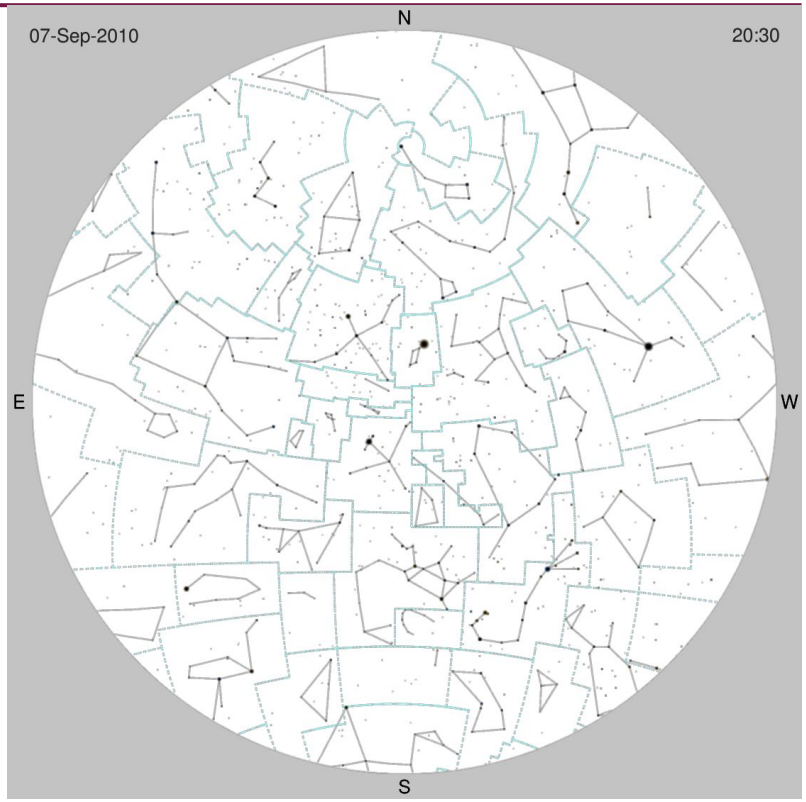
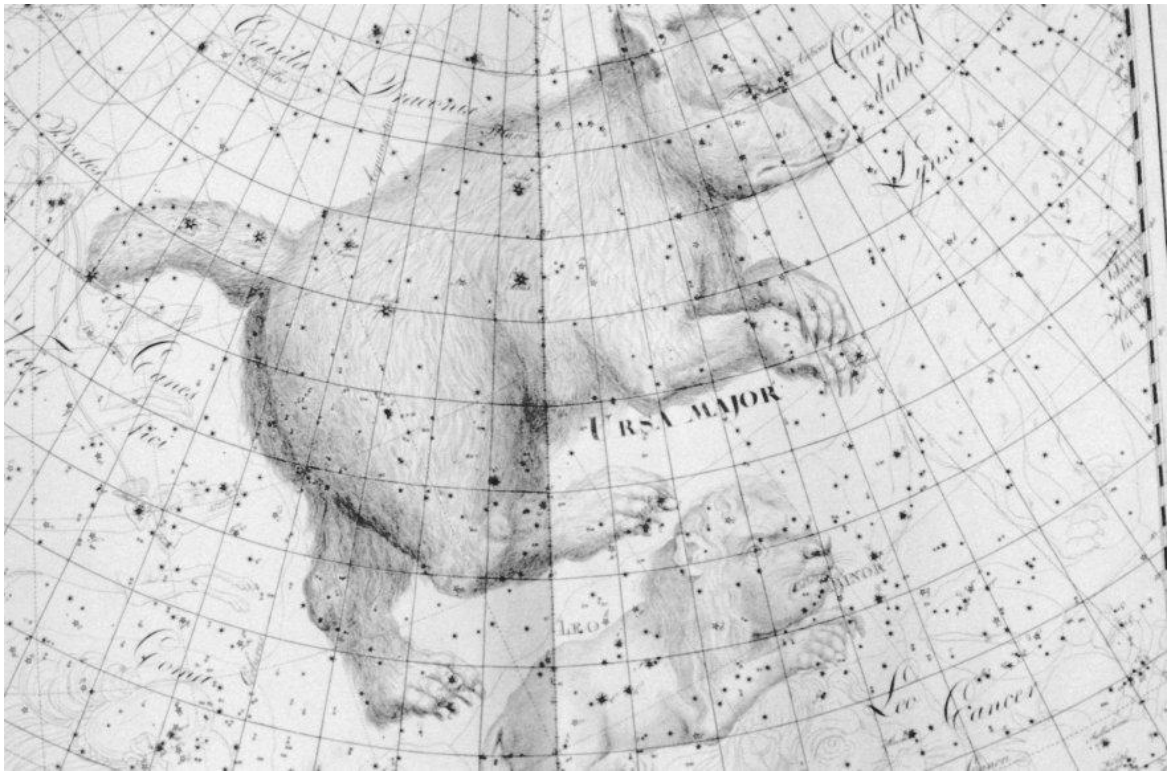


Image Credit Link: https://www.ifa.hawaii.edu/~barnes/ast110l_f10/constellations.html

Constellations and Asterisms

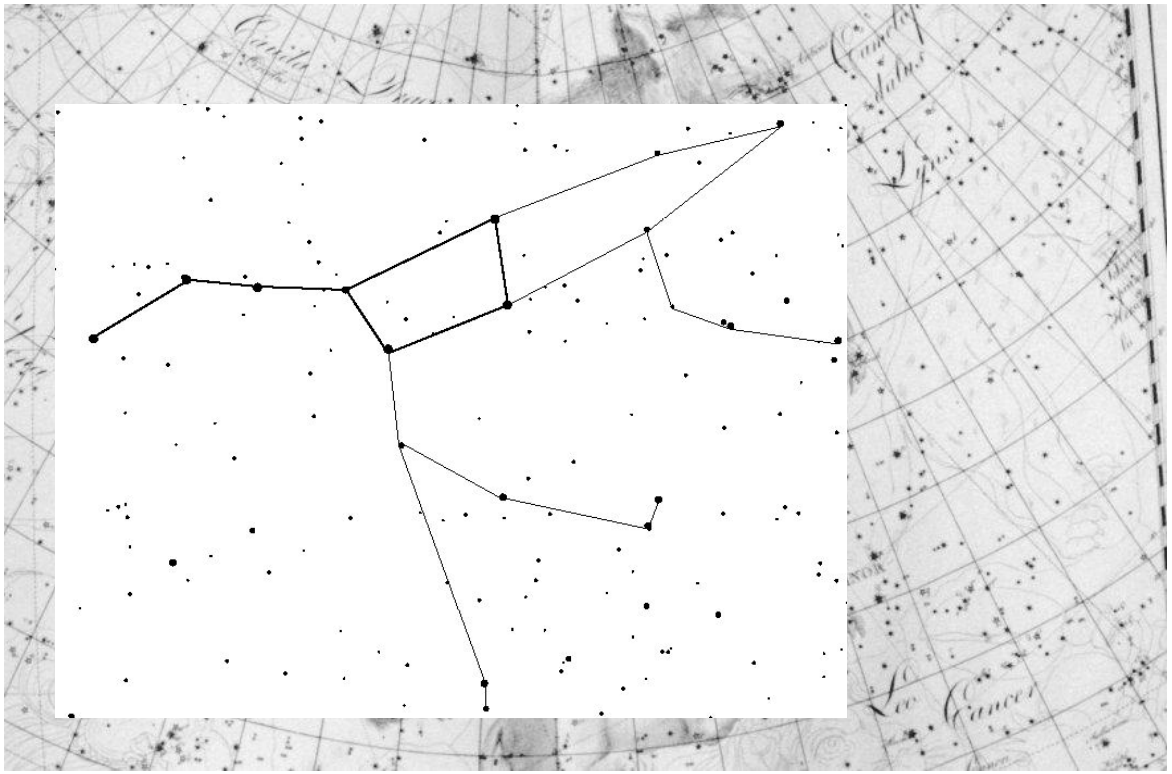


Can you identify a common set of stars in the **constellation** shown here called ***Ursa Major*** (the great bear)?

Image Credit Link: http://stars.astro.illinois.edu/sow/uma-bo.html

https://stellarium-web.org/en/

Constellations and Asterisms

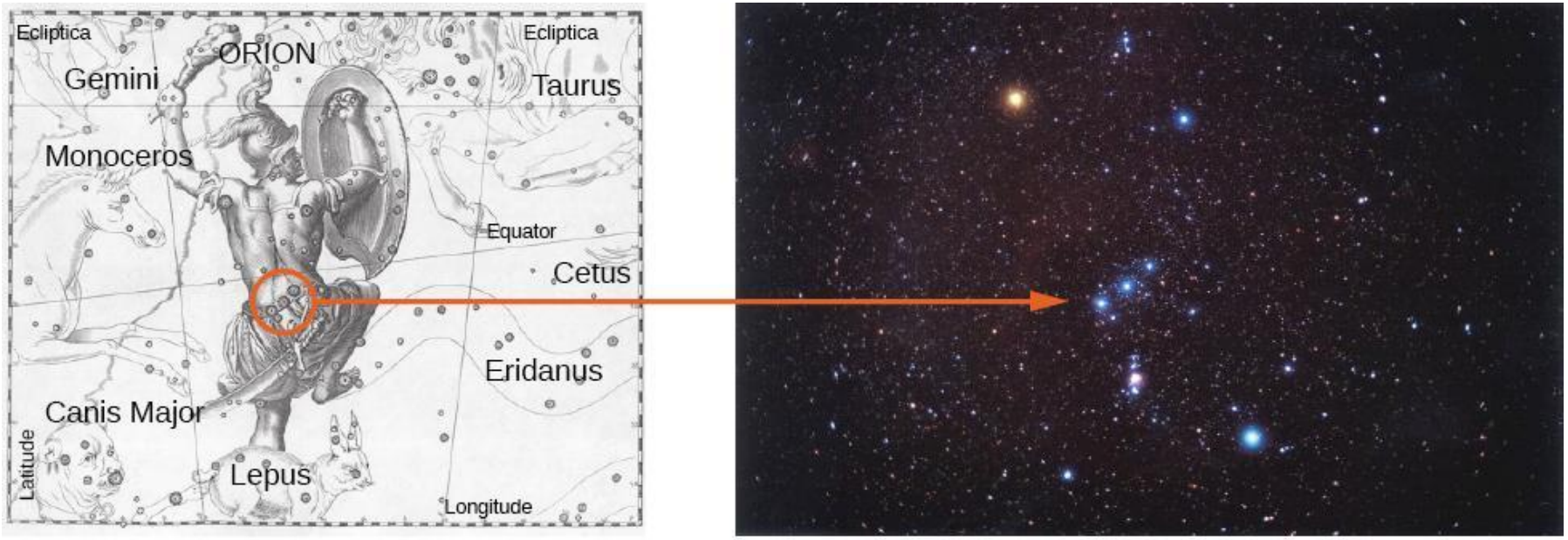


This simplified star chart might help.

An **asterism** is a *subset* of stars that form a widely recognized shape. The ***Big Dipper*** is a great example.

Image Credit Link: http://www.physics.csbsju.edu/astro/constellations/ursa_major_nl.html

Constellations and Asterisms

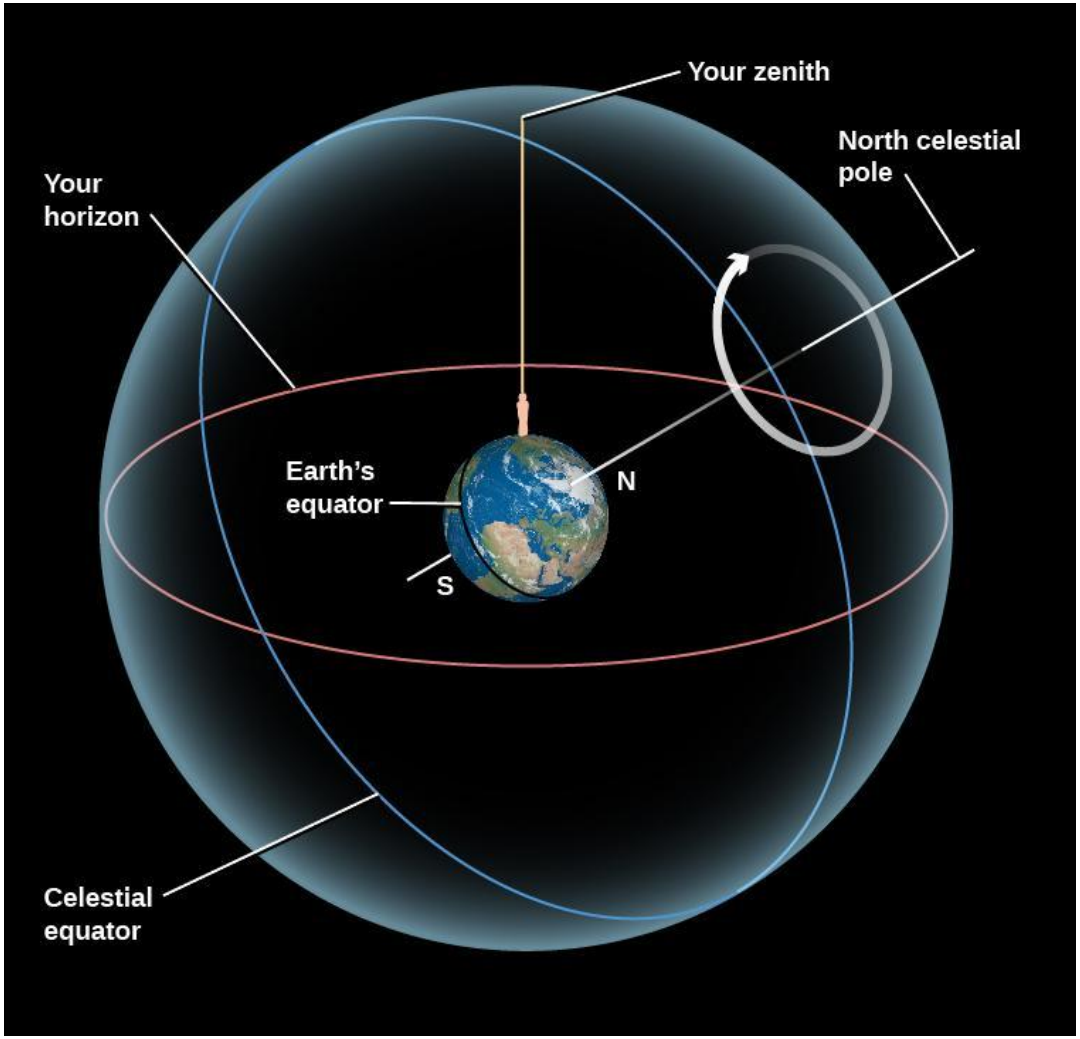


(a) (b)

Orion's Belt is an **asterism** within the **constellation** of *Orion*.

The Celestial Sphere

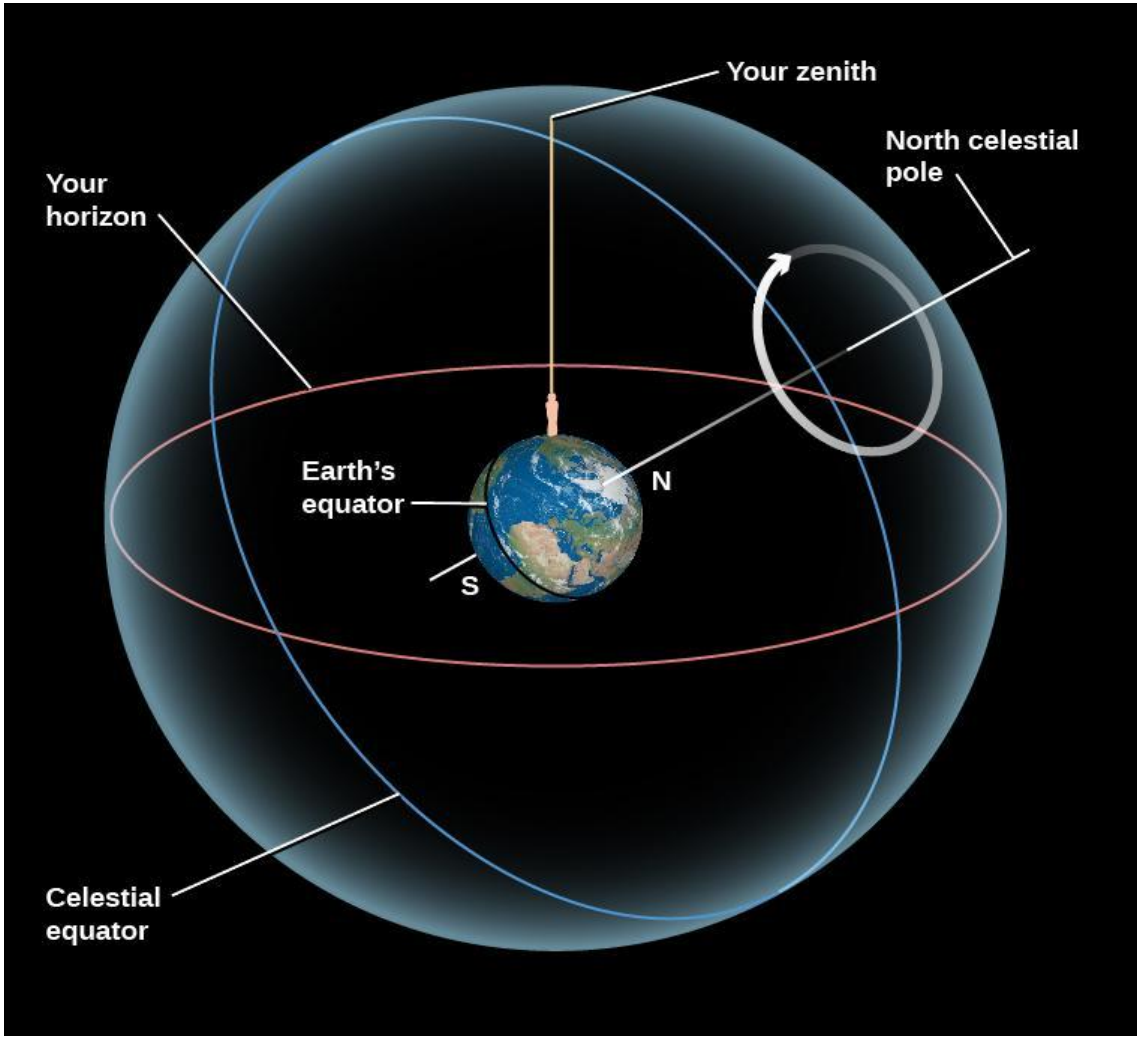
To help us understand how stars move through our skies, we make a simplified scientific model of the sky. We'll call this the **Celestial Sphere**. This assumes all stars, no matter how far they are, are projected onto a sphere around the Earth.



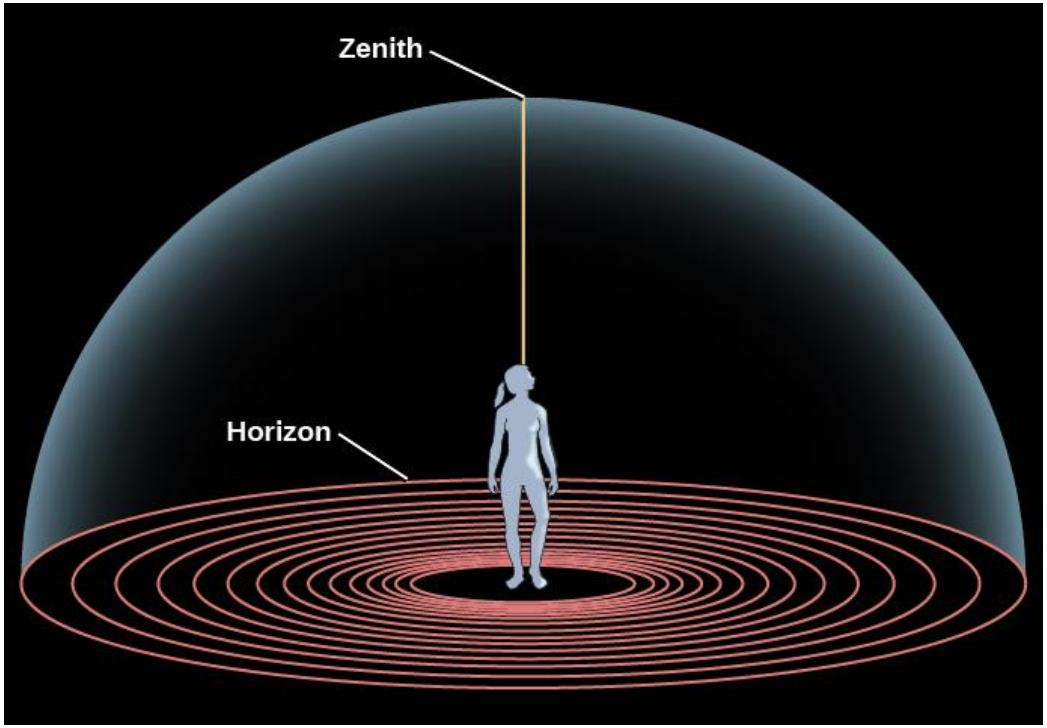
The Celestial Sphere

New terms we'll learn:

- Horizon
- Zenith
- Nadir
- Celestial Equator
- North celestial pole
- South celestial pole
- Ecliptic*



The Celestial Sphere: Observer-Centered Terms

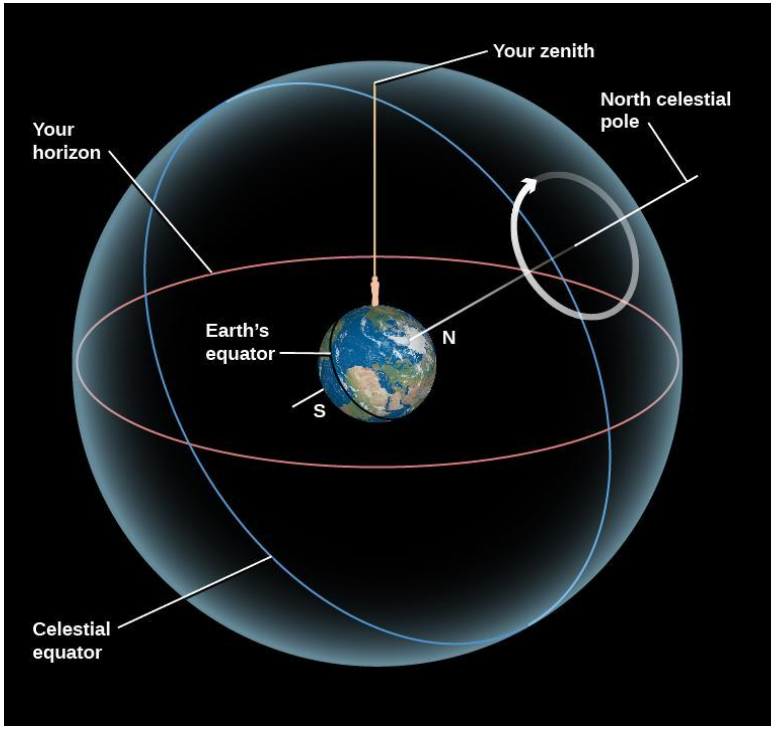


Horizon: where the dome of the sky you can see meets the ground from your point of view.

Zenith: the point directly over your head.

Nadir: the point directly below your feet.

The Celestial Sphere: Fixed Points in Space



Celestial Equator: the projection of the Earth's equator into space.

North celestial pole: the projection of the Earth's geographic north pole into space.

South celestial pole: the projection of the Earth's geographic south pole into space.

The Celestial Sphere: Star Motions

In the celestial sphere model, we pretend that the Earth is fixed and that the stars move across the sky.

If we had a camera take a long exposure picture of the night sky, we would see **star trails**, showing how stars appear to move because the **Earth is rotating on its axis**.

Check out this article for images and diagrams: **photopills.com/articles/star-trails-photography-guide**

The Celestial Sphere: Star Motions

This is an example of star trails, taken in Hawaii. Look at how the stars appear to make big circles.

What object is at the "center" of those circle motions?

Image Credit Link: http://apod.nasa.gov/apod/ap051220.html

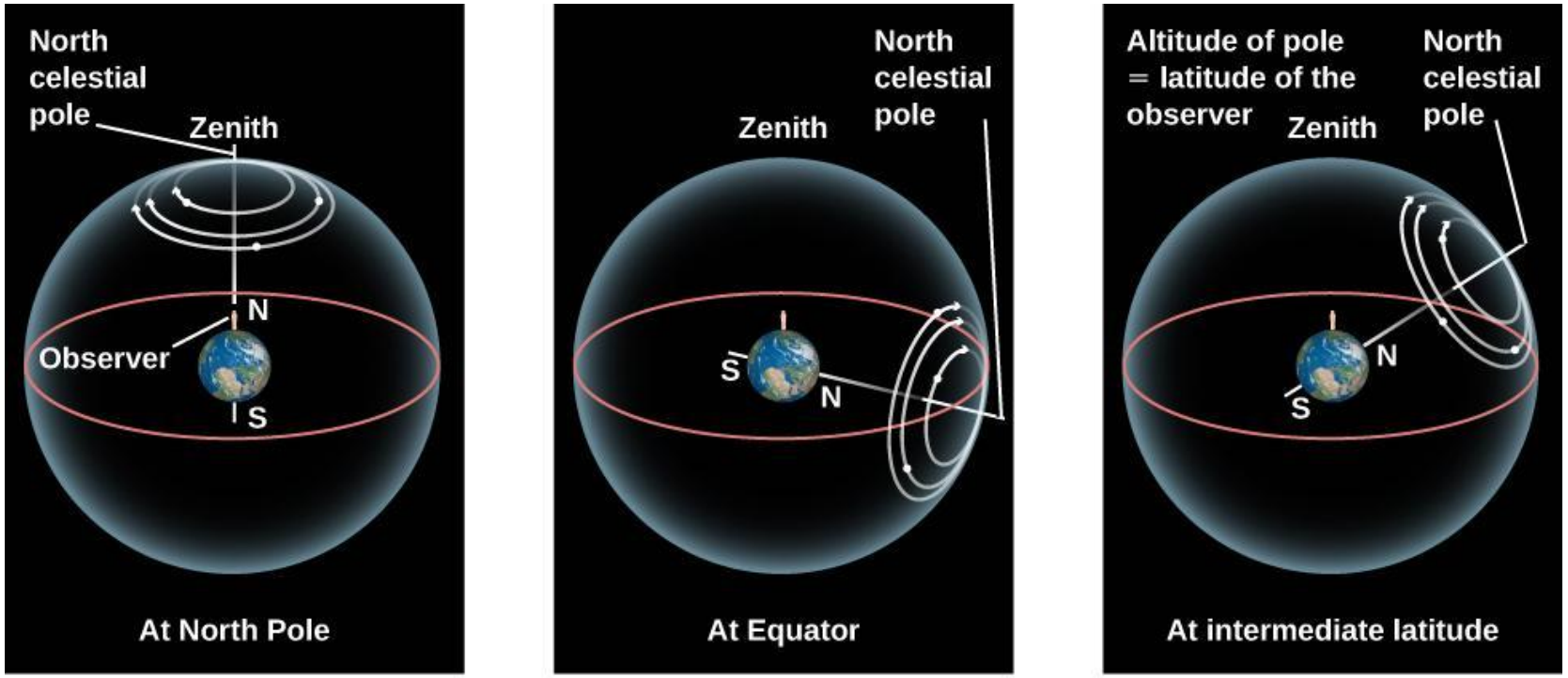
The Celestial Sphere: Star Motions

The angle height of the North Star (Polaris) above the horizon is called the **altitude**. The **altitude** of Polaris is equal to the ***latitude*** that you are at.

Grand Rapids is at 43 degrees North latitude, so Polaris is 43 degrees above the horizon in Grand Rapids.

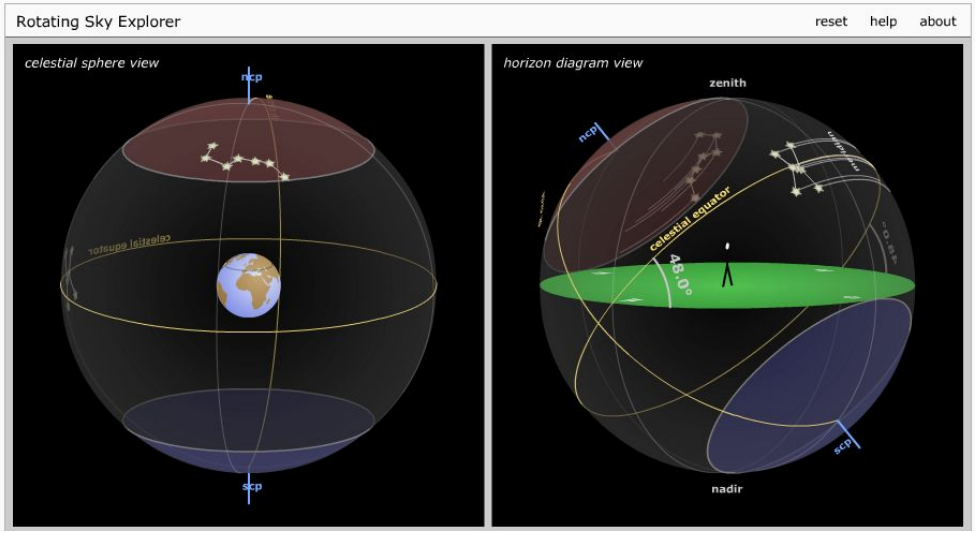
So what does the sky look like at the Earth's North Pole? What about at the equator?

The Celestial Sphere: Star Motions



The Celestial Sphere: Star Motions

If you are having difficulty picturing star trails or how the view would change at different latitudes, I strongly suggest you spend time using the **Rotating Sky Explorer**:



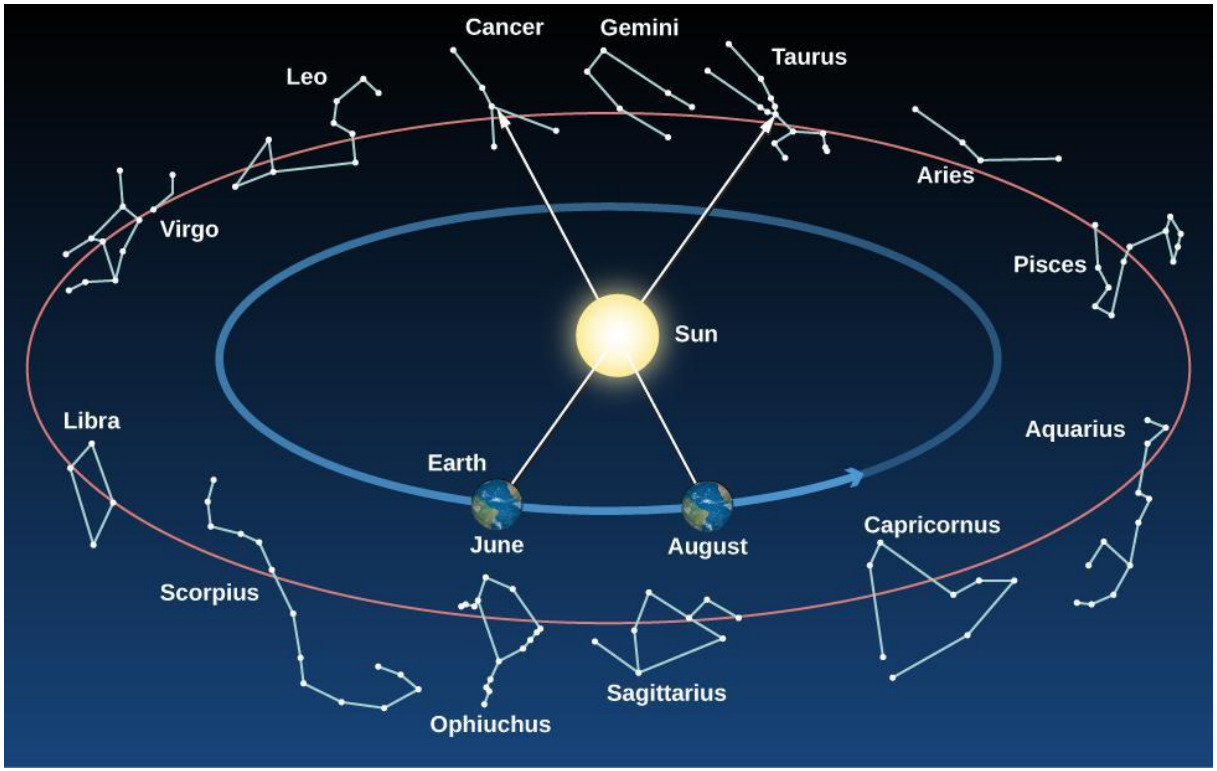
http://astro.unl.edu/naap/motion2/animations/ce_hc.html

The Ecliptic

Do you know your astrological sign? (a.k.a. sign of the zodiac)

Astrology is a ***pseudoscience*** (see Section 2.3) but it has roots in astronomical observation.

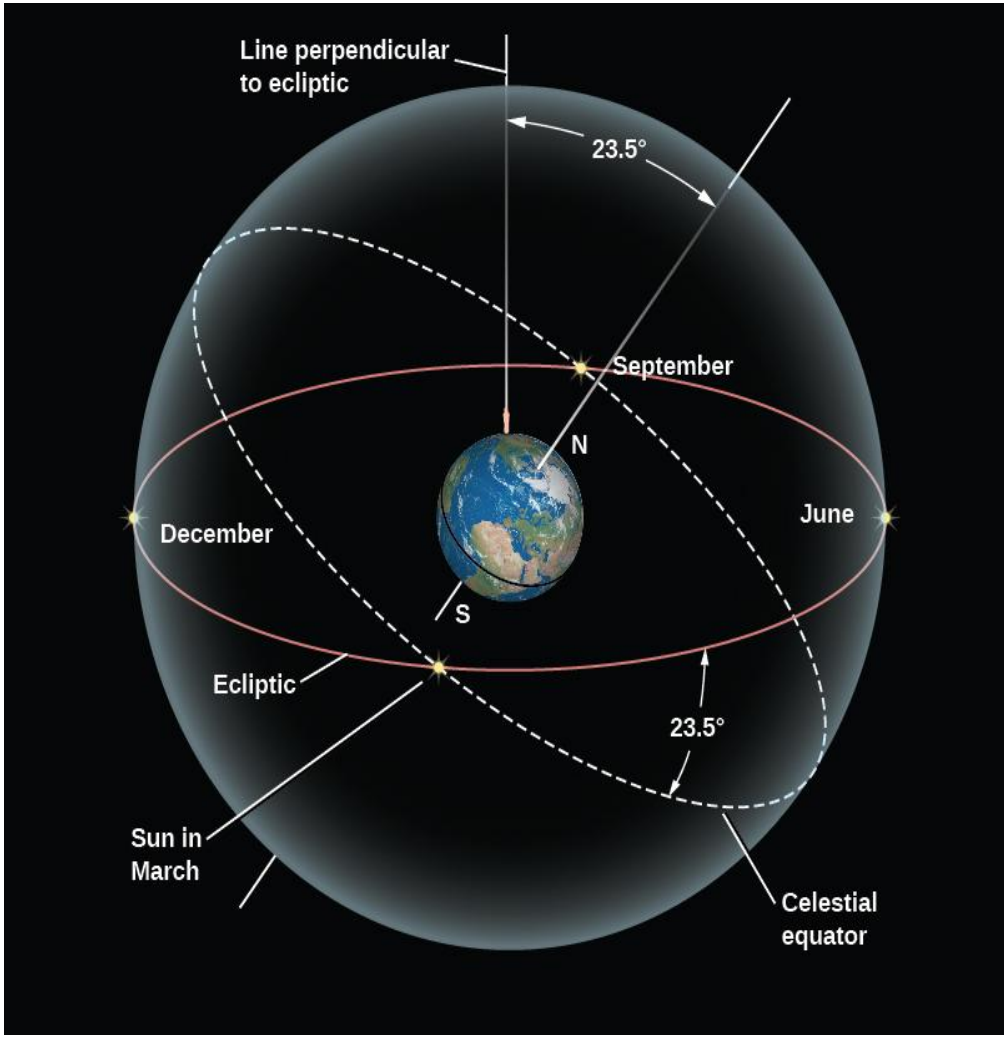
The Ecliptic



The astrological signs represent the constellations that the Sun “appears” in throughout the year.

But that also means that our night time constellations change during year.

The Ecliptic



The **ecliptic** is tilted 23.5° with respect to the **celestial equator**, because the Earth itself is tilted 23.5° relative to its path around the Sun.

They cross at two points, special dates in our calendar. More on this in Chapter 4!

https://stellarium-web.org/en/