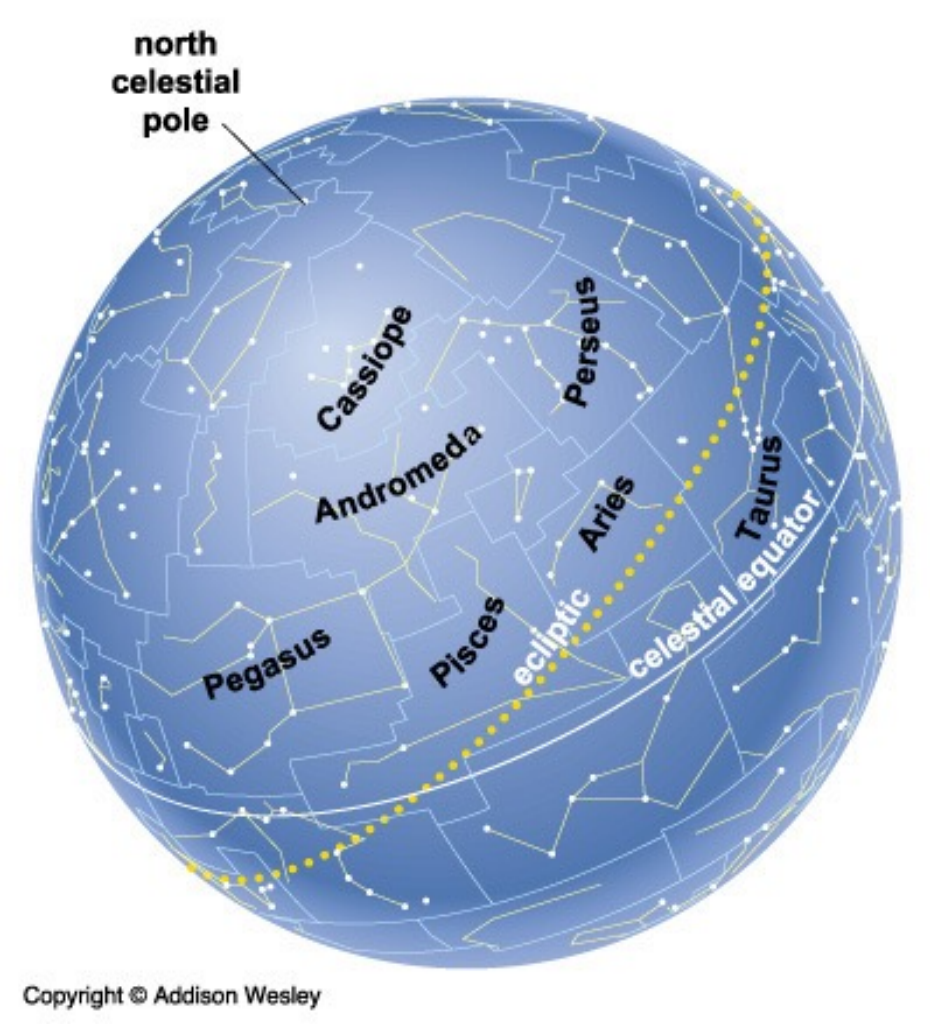
Measuring the Sky

The Celestial Sphere



- The sky above looks like a dome…a hemisphere..
- If we imagine the sky around the entire Earth, we have the **celestial sphere**.
- This a 2-dimensional representation of the sky

← Because it represents our view from Earth, we place the Earth in the center of this sphere.

The Celestial Sphere

North & South celestial poles

the points in the sky directly above the Earth's North and South poles

celestial equator

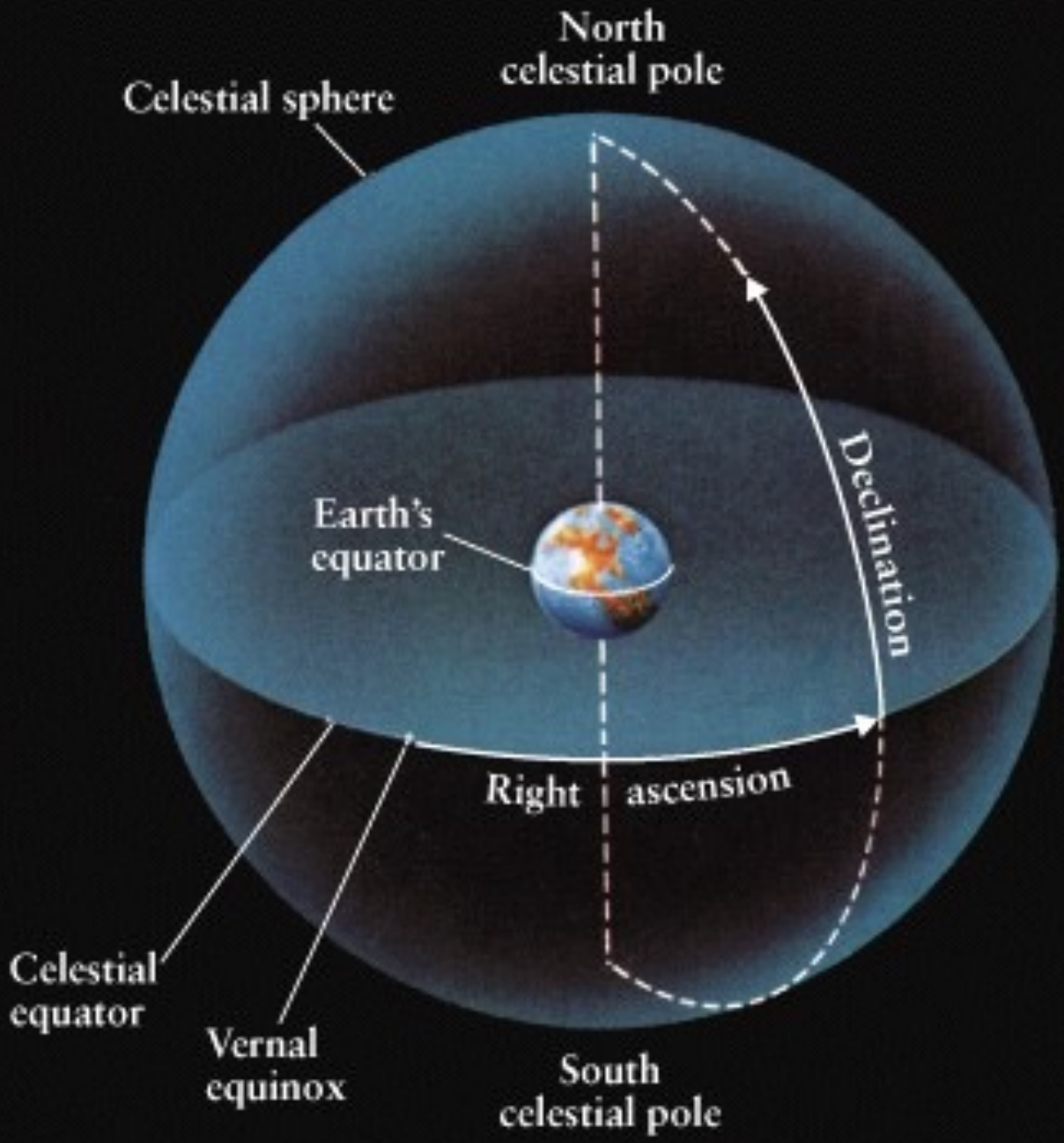
the extension of the Earth's equator onto the celestial sphere

ecliptic

the annual path of the Sun through the celestial sphere, which is a projection of ecliptic plane


N
N50°
W50°
W30°
E30°
E10°
W1°Prime Meridian
N30°
Tropic of Cancer
N10°
Equator
Image NASA
Google

A spinning imaginary ***Celestial Sphere*** surrounding Earth aids in navigating the sky



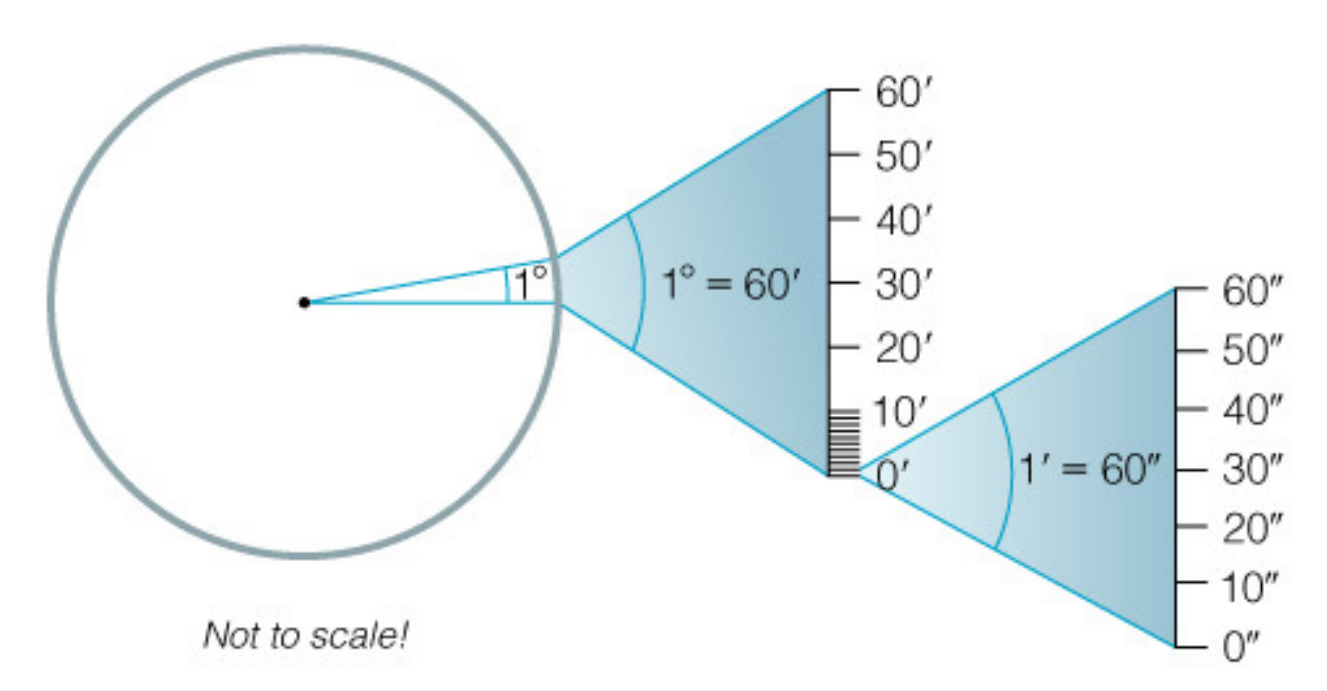
Measuring the Sky

We measure the sky in *angles*, not distances.

- Full circle = 360º
- 1º = 60 arcmin
- 1 arcmin = 60 arcsec

Angular Measurements and Notation:

- Full circle = 360º
- 1º = 60′ (arcminutes)
- 1′ = 60″ (arcseconds)



What is 55.435 degrees in degrees-minutes-seconds notation?

$$55\,\text{deg}$$
$$+0.435(60) = 26.1 arcmin \Rightarrow 26\ arcmin$$
$$+0.1(60) = 6 arcsec$$
$$so,\ 55^{o}26'06''$$

What is $73^{o}45'33.''56$ in decimal degrees?

$$73\,\text{deg}$$
$$+45/60 = .75$$
$$+33.56/3600 = 0.009322$$
$$= 73.759322\ \text{deg}$$

Homework #2

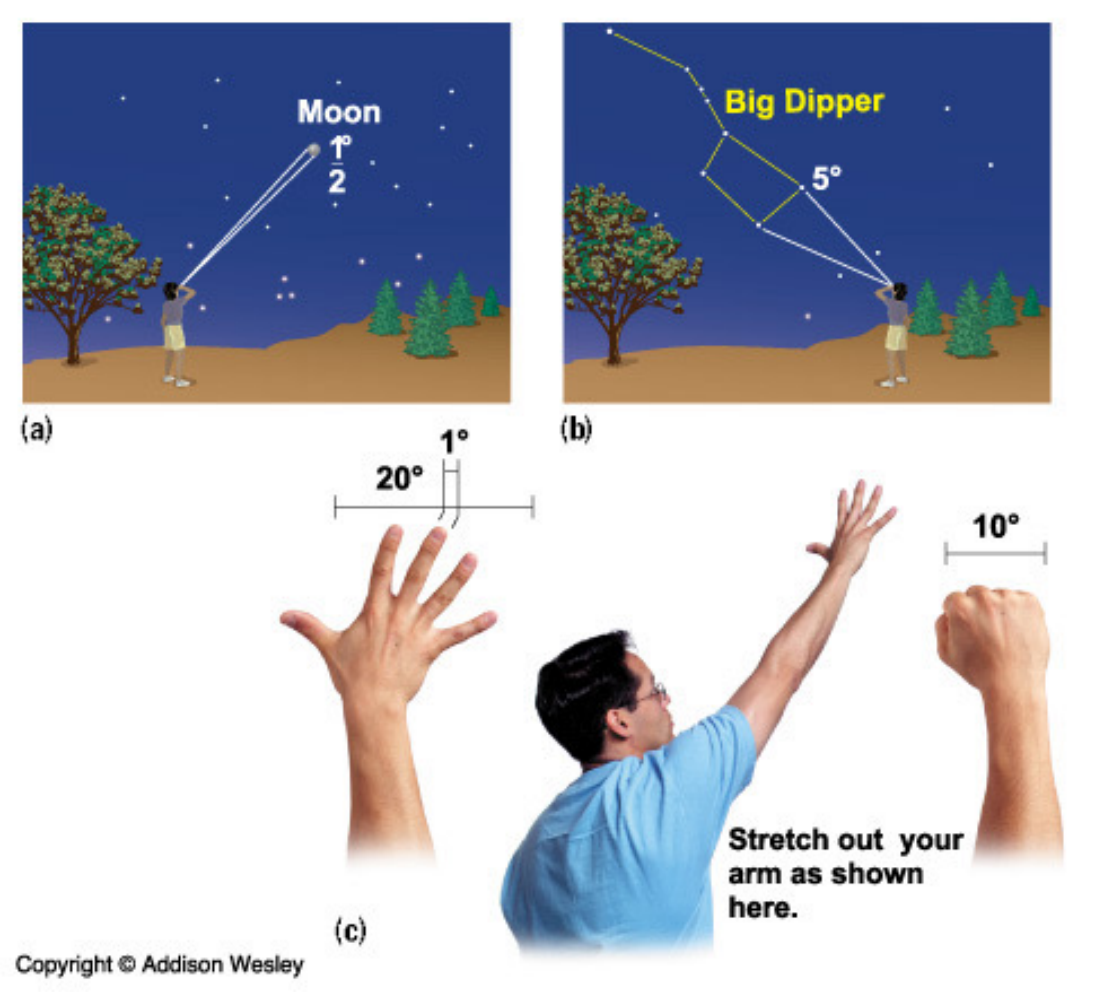
- 45.635 degrees is how many degrees, arcminutes, and arcseconds?

- How many degrees, arcminutes, and arcseconds does the moon move across the sky in one hour? (the lunar day is 24 hours and 48 minutes long)

- The moons diameter is about 30 arcminutes, so find out how long it takes for the moon to travel its diameter.

Current reading – Chapters 1 & 2

Measuring Angles in the Sky



The Local Sky

zenith

the point directly above you

horizon

all points 90° from the zenith

altitude

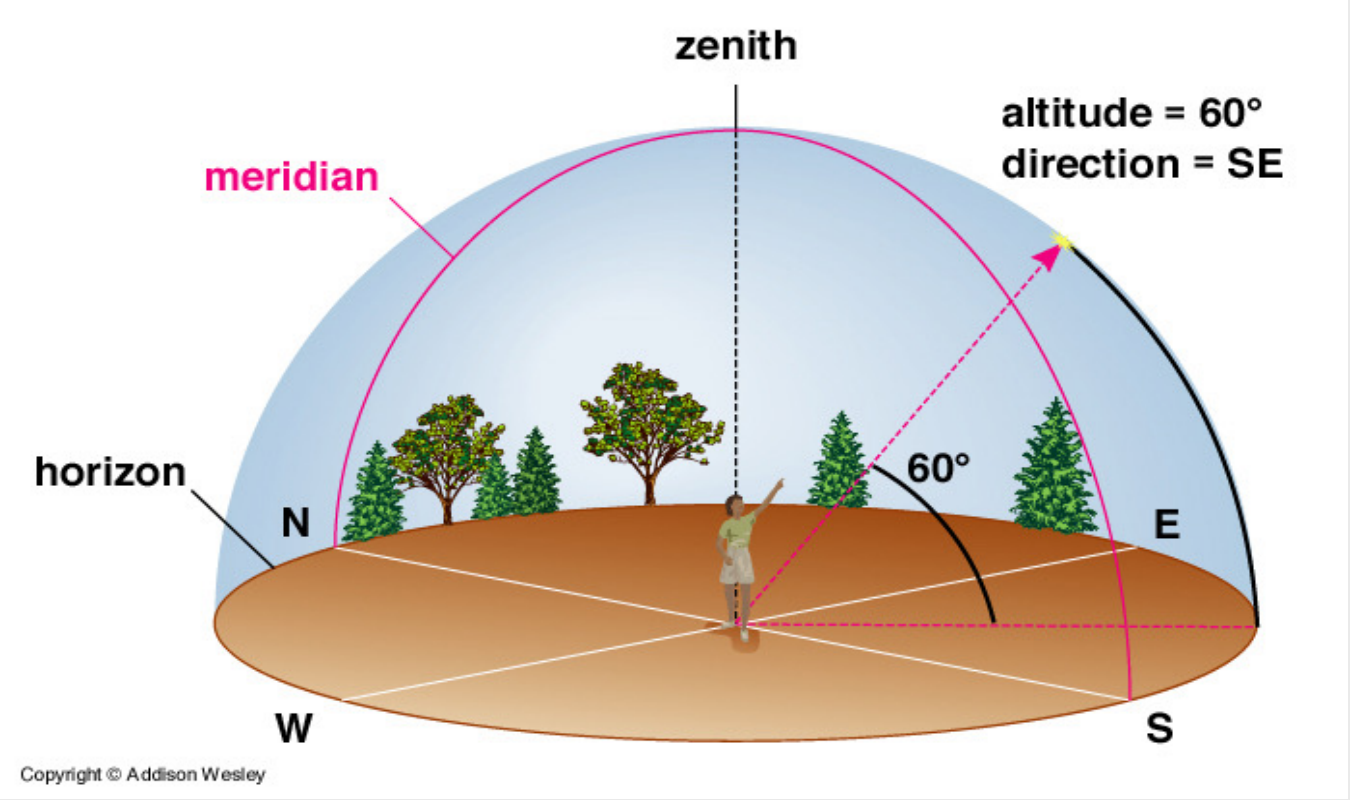
the angle above the horizon

meridian

due north horizon ⇒zenith ⇒due south horizon

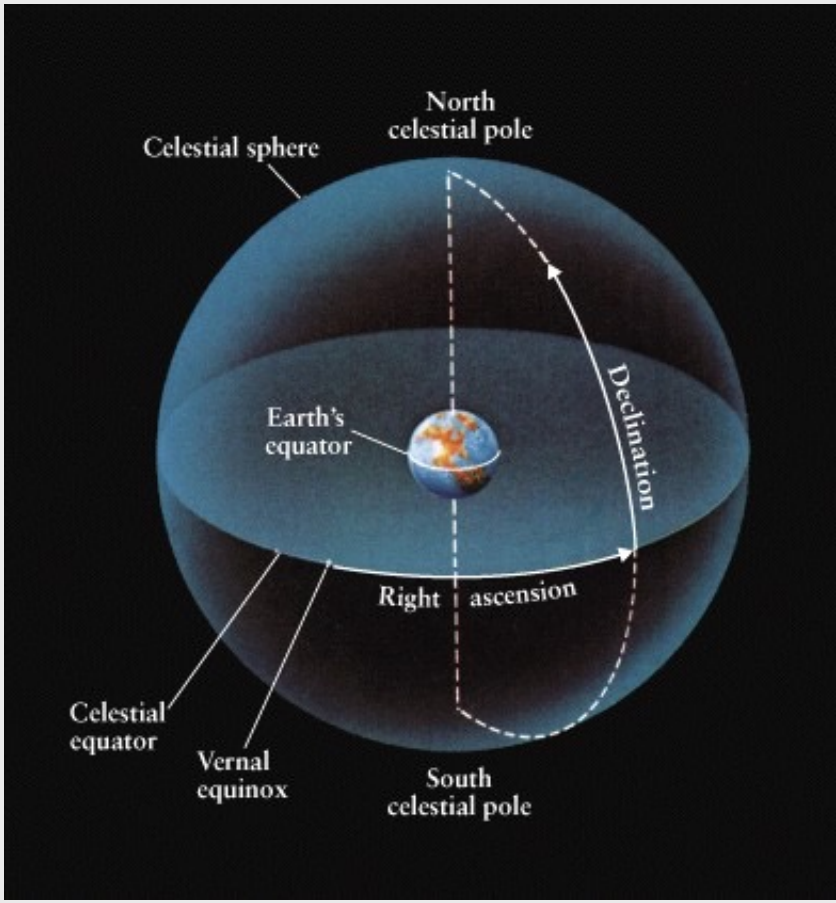
To pinpoint a spot in the local sky:

Specify altitude and
direction along the horizon

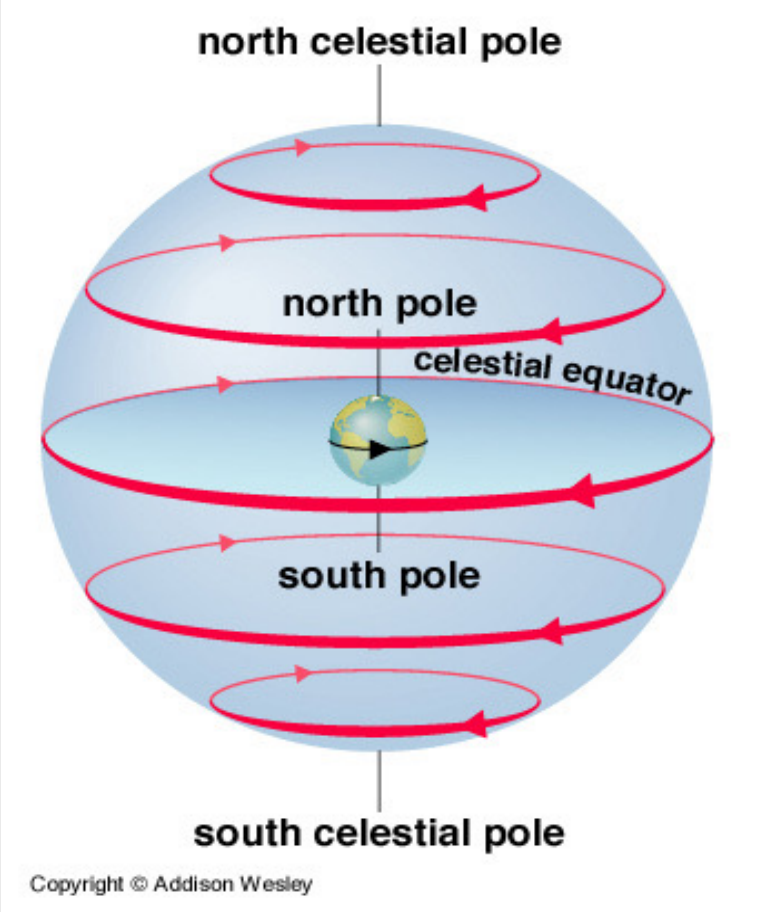


Elements of the equatorial coordinate system on the celestial sphere

- *Vernal Equinox*: The position of the Sun on the first day of spring (Sets the prime meridian)
- *Right Ascension*: How far east of the Vernal Equinox an object is located – measured as time! (longitude)
- *Celestial Equator*: The line separating the celestial sphere into northern and southern halves.
- *Declination*: How far above or below the celestial equator an object is located.(latitude)



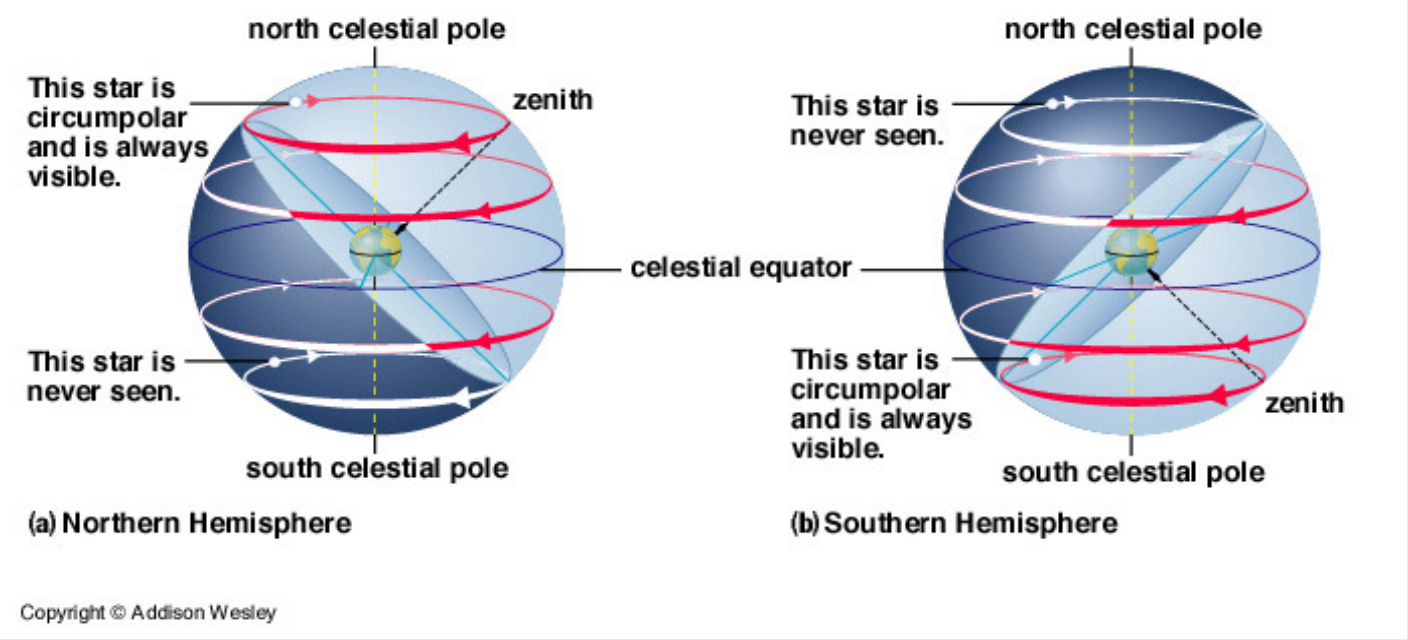
The Daily Motion



- As the Earth rotates, the sky appears to us to rotate in the opposite direction.
- The sky appears to rotate around the N (or S) celestial poles.
- If you are standing at the poles, nothing rises or sets.
- If you are standing at the equator, everything rises & sets 90° to the horizon.

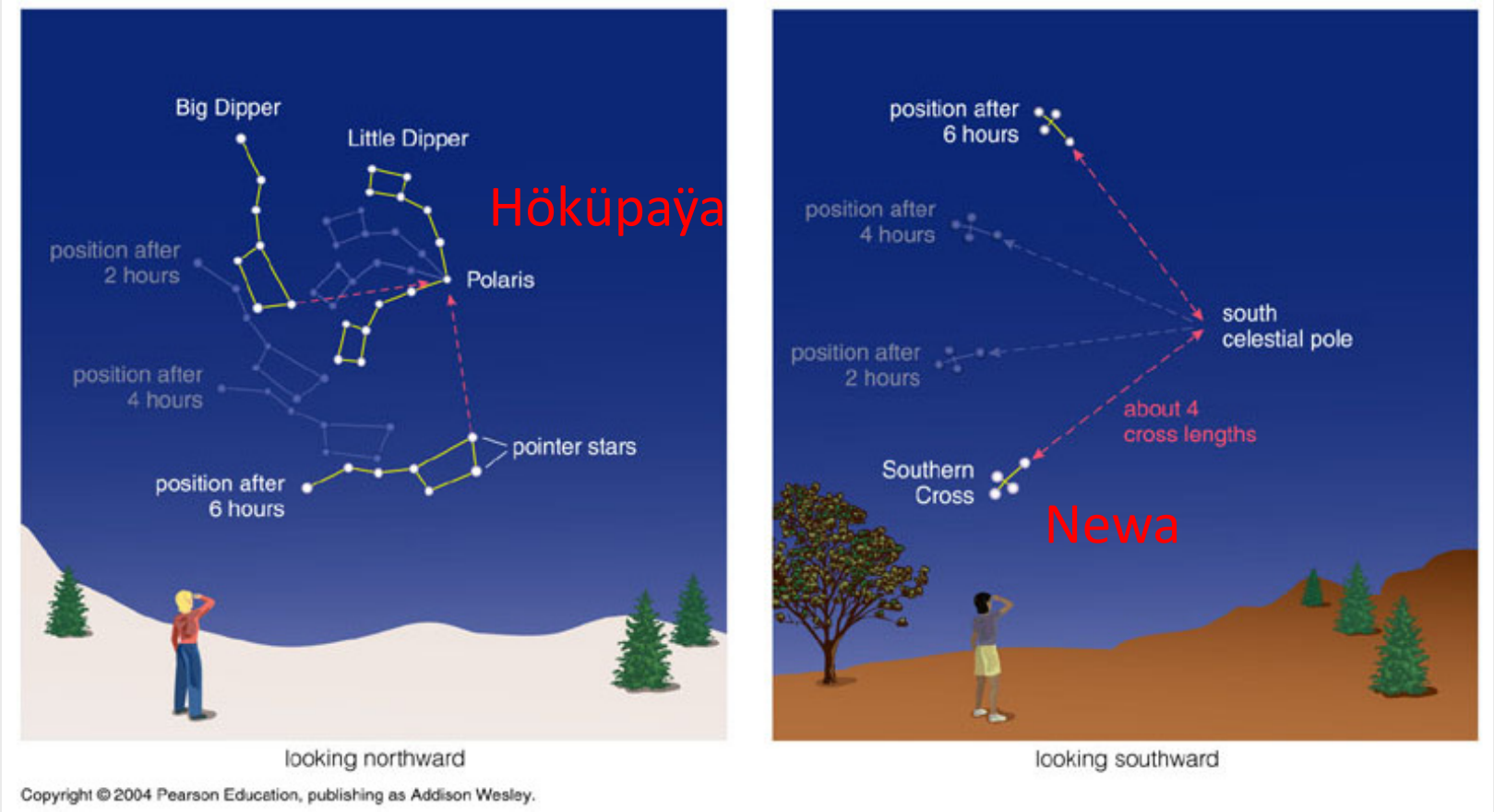
The Daily Motion

- The altitude of the celestial pole = [your latitude].
- All stars at an angle < [your latitude] away from:
  - your celestial pole never set. (**circumpolar**)
  - the other celestial pole are never seen by you.
- Other stars, (& Sun, Moon, planets) rise in East and set in West at an angle = [90° – your latitude].



The Daily Motion

daily circles --- CCW looking north, CW looking south

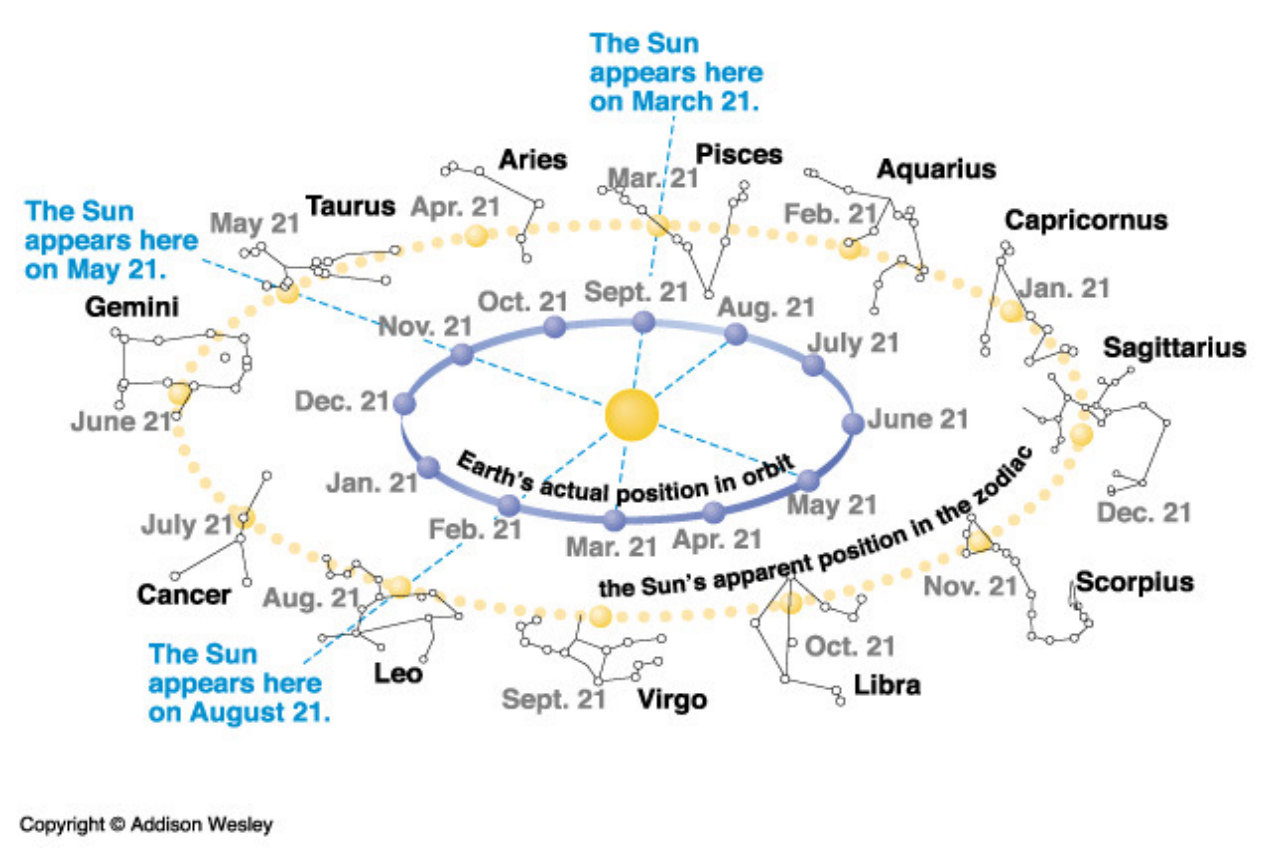


Time Exposure Photograph:

- Estimate the exposure time
- Which direction did stars move?

Annual Motion

- As the Earth orbits the Sun, the Sun appears to move eastward with respect to the stars.
- The Sun circles the celestial sphere once every year.



Annual Motion

ecliptic

the apparent path of the Sun through the sky

equinox

where the ecliptic intersects the celestial equator

solstice

where the ecliptic is farthest from the celestial equator

zodiac

the constellations which lie along the ecliptic

Annual Motion

- The Earth's axis is tilted 23.5° from being perpendicular to the ecliptic plane.
- Therefore, the celestial equator is tilted 23.5° to the ecliptic.
- As seen from Earth, the Sun spends 6 months north of the celestial equator and 6 months south of the celestial equator.