

The Sky

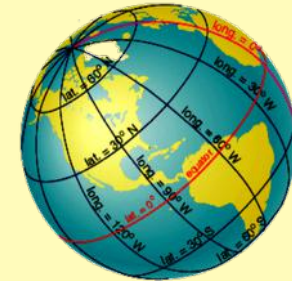


Coordinates

- we *use coordinates* to find *locations* on Earth

(eg) latitude & longitude of Nanaimo: 49° N, 123° W

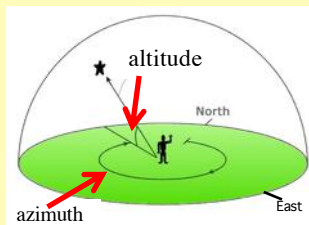
- *need* coordinates for objects in the *sky*, too!



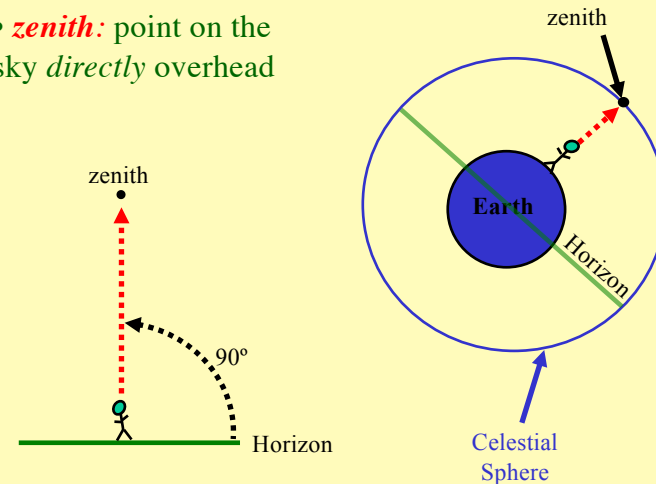
Altitude & Azimuth

- **altitude (alt)**: height (angle) above horizon ($0-90^\circ$)
- **azimuth (az)**: angle east of north ($0-360^\circ$)
- *useful* for *local* sky, but *alt & az of an object changes with time & location on Earth*

(eg) At 10pm in Nanaimo on May 25 the star Vega is at alt 30° & az 135° . By 11pm, however, Vega will have *moved* in your *local* sky - it is *no longer* at 30° & 135°



- **zenith**: point on the sky *directly* overhead

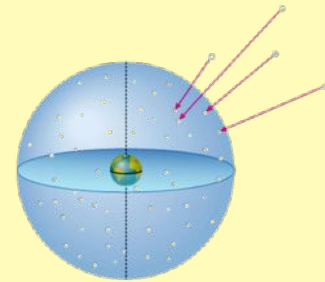


Alt-az telescope mount



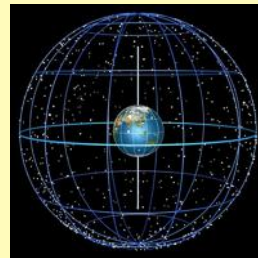
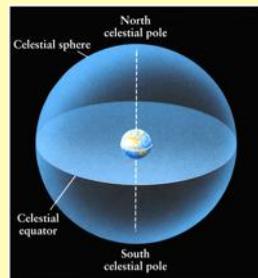
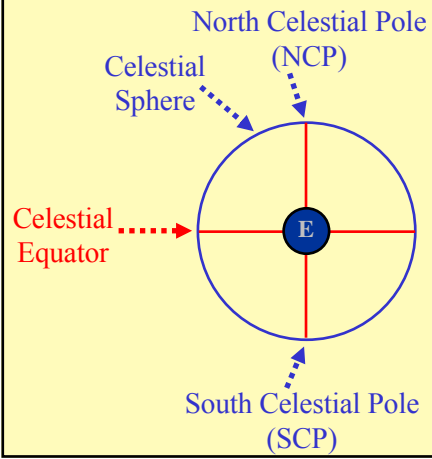
Celestial Sphere

- *imagine* stars are *fixed* in place *as if* they were all *glued* onto a *glass sphere* centered about Earth: *CS*



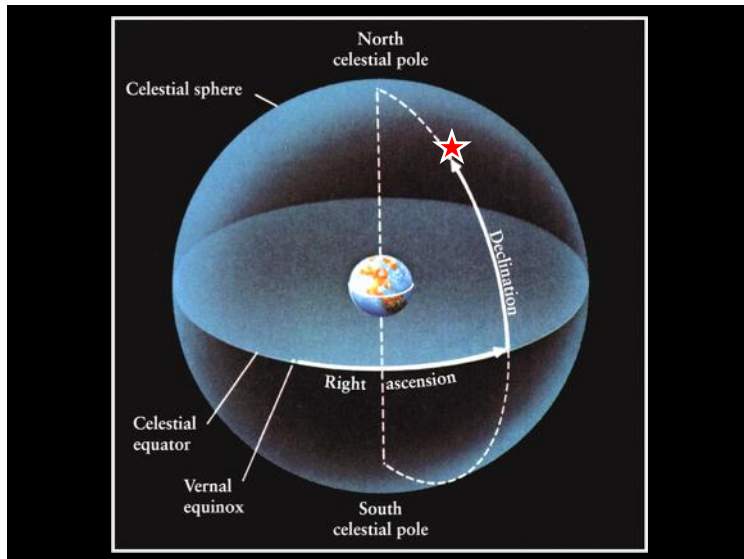
- “convenient fiction” - *not true!!!*

- *CS* has an *equator* & *poles*
- define *new coordinate system*



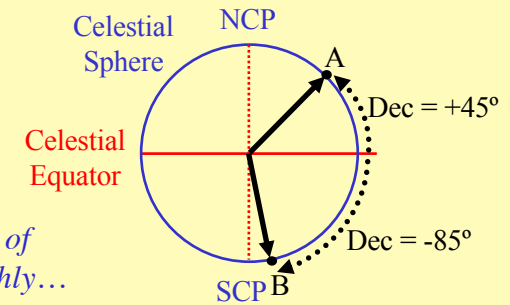
RA & Declination

- *declination (dec)*: angle ($\pm 90^\circ$) to an object from the *celestial equator* (0°)
- *right ascension (RA)*: how many *hours* ($0-24\text{ h}$) *east* an object is from the *vernal equinox* (0 h)
- *dec* & *RA* give objects a *fixed position in the sky* (*eg*) *dec, RA do not change***
- (*eg*) *The star Vega is at RA 18h 36m, dec $+38^\circ 47'$*



CLICKER: *the declination of point A is roughly...*

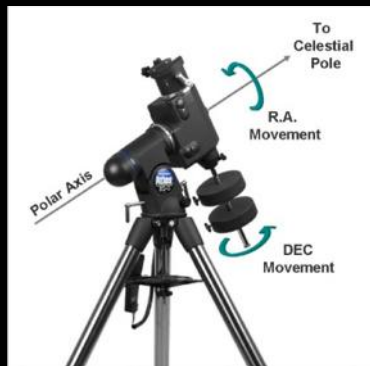
- (a) 0°
- (b) $+45^\circ$
- (c) -45°
- (d) $+75^\circ$



CLICKER: *the declination of point B is roughly...*

- (a) 0°
- (b) $+90^\circ$
- (c) -45°
- (d) -85°

Equatorial telescope mount



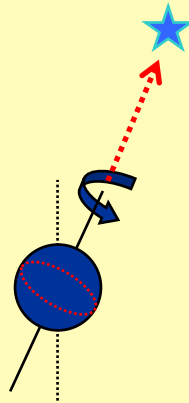
CLICKER: *the Sun's position on the CS...*

- (a) *is always on the Celestial Equator*
- (b) *is always at the zenith*
- (c) *has constant alt & az*
- (d) *has values of RA & dec that change constantly*

Star Motions

- all stars in the Northern Hemisphere *appear* to rotate about the **North Star (Polaris)**
- **Polaris** is *not* even among the “Top 40” brightest stars in the sky

DEMO: do some rotation...



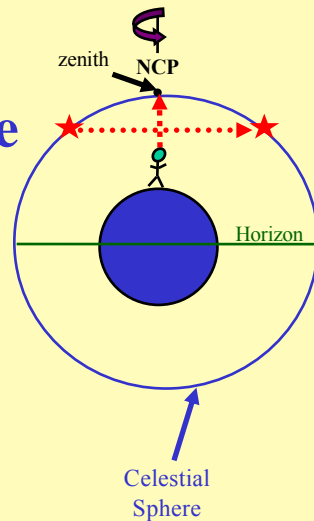
Star motions & Polaris



Star Motions at The (North) Pole

*Q: Where is Polaris?
How do stars move as viewed from (north) pole?*

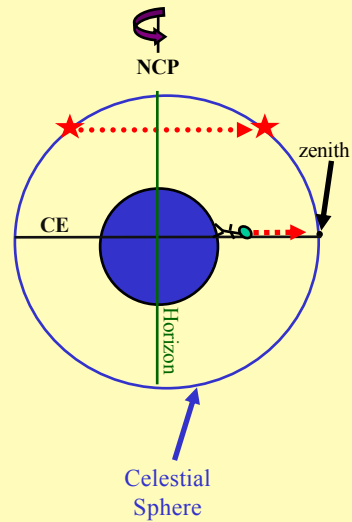
- at (north) pole, **Polaris** is at the **zenith**; stars move **parallel to the horizon** & **do not rise or set**



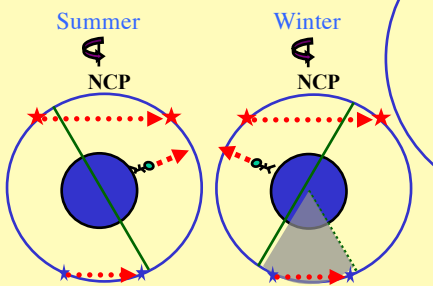
Star Motions at the Equator

*Q: Where is Polaris?
How do stars move as viewed from equator?*

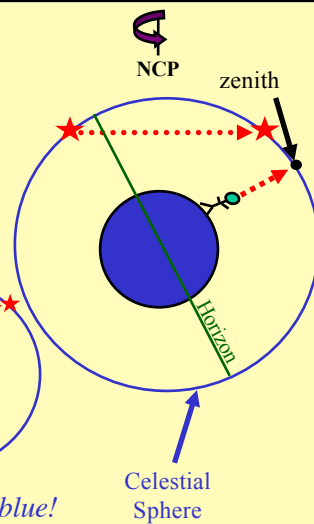
- at equator, the **CE** passes through the **zenith** & **all** stars **rise** and **set**; over a year the **entire** sky is visible!



- in **Nanaimo**, we see both **NCP** & **CE**, but **not** the sky near **SCP**



(eg) see red star, but never see blue!





CLICKER: Which location below would be **closest** to the location of the time-lapse sky image above?

- (a) Nanaimo
- (b) South Pole
- (c) Equator
- (d) Vernal Equinox

The Zodiac

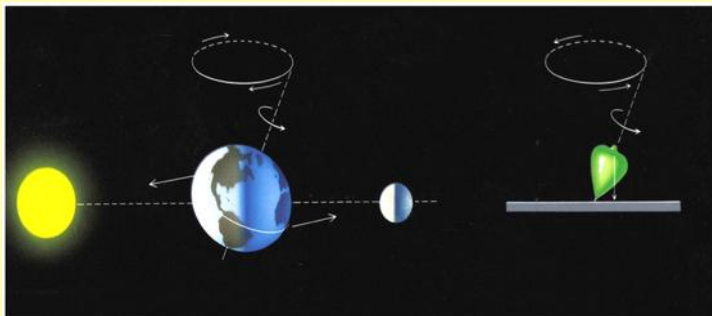
• **The Zodiac** are the *constellations* through which the *Sun, Moon & planets appear to move*



- **originally 12, now 13** (boundaries have changed)
- **every culture** considered **Zodiac** important as they **contain (apparent) paths of Sun, Moon & planets**

Precession

- Earth's **rotational axis wobbles like a top**
- takes **26,000 years** to **precess** (wobble) once



• result: **rotational axis** points to **different places in sky** over time, **changing positions of Sun & stars**

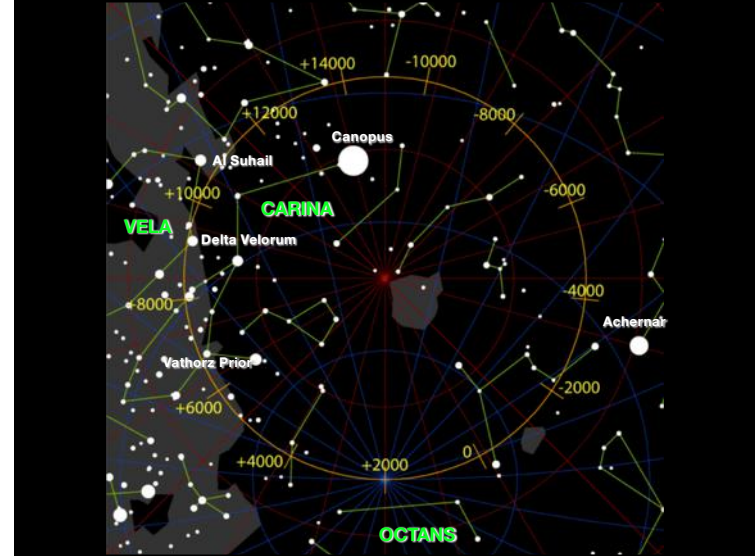
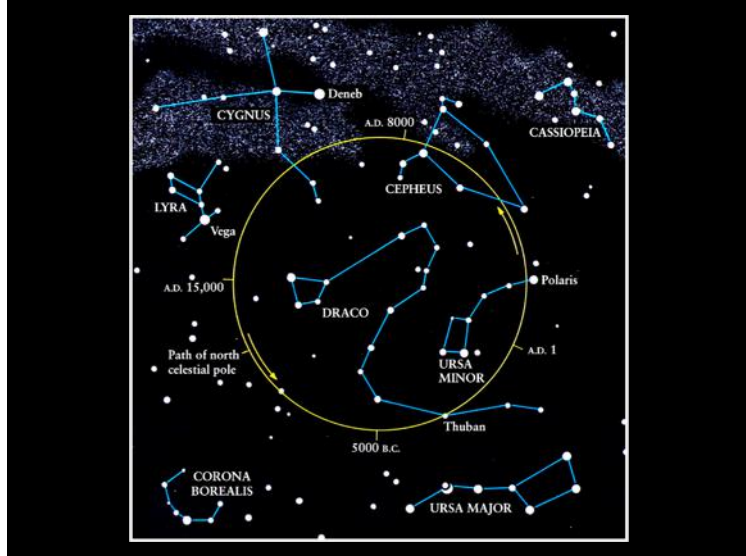
• **currently: Polaris** is the “North Star”

• **~2000 BCE: Thuban** (in **Draco**) (pyramids)

• **~12,000 years from now: Vega** (in **Lyra**)

• **astrological Zodiac** set up **~2000 years ago** (when **NCP** was between **Thuban** and **Polaris**)

• timing of **Sun's location in Zodiac** has **changed** from what it was **originally because of precession**



Star Signs, Traditional and actual			
Constellation	Traditional	Actual (2011)	Days
Capricornus	Dec. 22 – Jan. 21	Jan. 20 – Feb. 16	28
Aquarius	Jan. 22 – Feb. 21	Feb. 17 – Mar. 12	24
Pisces	Feb. 22 – Mar. 21	Mar. 13 – Apr. 19	38
Aries	Mar. 22 – Apr. 21	Apr. 20 – May 14	25
Taurus	Apr. 22 – May 21	May 15 – June 21	38
Gemini	May 22 – June 21	June 22 – July 21	30
Cancer	June 22 – July 21	July 22 – Aug. 11	21
Leo	July 22 – Aug. 21	Aug. 12 – Sep. 17	37
Virgo	Aug. 22 – Sep. 21	Sep. 18 – Oct. 31	44
Libra	Sep. 22 – Oct. 21	Nov. 1 – Nov. 22	22
Scorpius	Oct. 22 – Nov. 21	Nov. 23 – Nov. 30	8
<i>Ophiuchus</i>		Dec. 1 – Dec. 18	18
Sagittarius	Nov. 22 – Dec. 21	Dec. 19 – Jan. 20	33