REVIEW: LIGHT AND STARS

MAJOR TOPICS:

I. The Celestial Sphere: Appearance and Motions in the sky
- Constellations
- Coordinate Systems (horizon, RA & Dec, etc.)
- Daily motion
- Annual motion of the Sun & Stars (the Ecliptic & Analemma)
- Motion and phases of the moon
- Motion and positions of the Planets

II. Stars
- The nature of light and structure of matter
- The properties of the stars
- Stellar evolution

Bring your Field Guide to the exam!!!

I. THE CELESTIAL SPHERE (YOU CAN'T FORGET THIS!!)

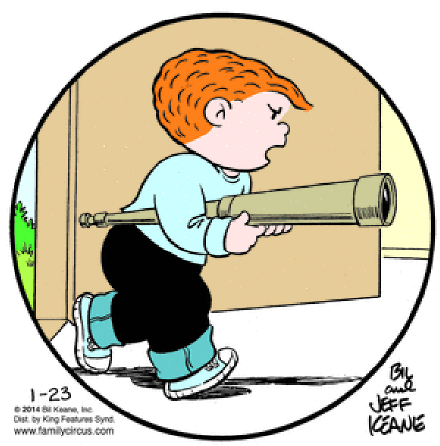
A. Constellations: ***FIELD GUIDE* (FG)** Ch. 4
- ➢ Origin and organization, asterisms
- ➢ Constellation names, abbreviations, genitives (*FG* pp. 512-513)
- ➢ Star names ("other" and Bayer designation)
  Know how to find them!

B. Coordinate systems: ***FIELD GUIDE*** Ch. 15
- ➢ horizon – horizon, zenith, nadir, meridian, etc.
- ➢ celestial – RA, Dec, NCP, SCP, Celestial Equator

C. Motions in the sky
- ➢ daily motion ***CYCLES*** pp. 1-10,
  stars, sun, moon, planets, comets, etc.
  Time zones & Celestial Navigation
- ➢ annual motion ***CYCLES*** pp. 20-32
  equinoxes and solstices)
  sun's motion along the ecliptic, the Zodiac
  sidereal and solar day and the Analemma
  named latitudes
- ➢ planetary longitude, elongation & planetary configurations
- ➢ precession
- ➢ motion and phases of the moon ***CYCLES*** pp. 11-19
  phases, elongations, times of rising, transit, and setting

Sky Stuff to Know:
Constellations: UMa, UMi, Dra, Boö , CrB, Her, Lyr, Cyg, Aql, Sgr, Cap
Solstices & Equinoxes
Know their definitions!
Know their α, δ, PL, date, & constellation
Know how to find the Atlas Chart of Each

Be able to fill in the table on "The Ecliptic" worksheet!



"I sure wish God had never invented clouds."

II. STARS

A. The Sun Field Guide Ch. 14
Fraknoi et al. Ch. 14 - 16
- ➢ Nuclear Fusion
- ➢ Sunspots

B. Spectroscopy
- ➢ Light is a wave: $c = \lambda f$, $E = hf = hc/\lambda$
- ➢ Inverse square law: luminosity and flux
  absolute & apparent magnitude

Review the Powerpoints & Labs!

KNOW HOW TO DO WHAT YOU DID ON THE LABS

$$\text{Flux} = \frac{\text{Luminosity}}{4\pi r^2} \sim \frac{1}{(\text{distance})^2}$$

γ-rays		HIGH ENERGY
X-rays		HIGH FREQUENCY / SHORT WAVELENGTH
Ultraviolet (UV)		
Visible	blue	
	green	
	yellow	
	orange	
	red	
Infrared (IR)		LOW FREQUENCY / LONG WAVELENGTH
Radio		LOW ENERGY

- electromagnetic spectrum Fraknoi et al. Ch 17
  - types of spectra and their sources (continuum, emission line, absorption line)
- atomic structure, source of emission and absorption lines
- Hydrogen Balmer spectrum
- Spectral Classes: **O B A F G K M** (… extra credit for a good mnemonic)

  order (A – N): Willamina Fleming
  order (O – M) and subclasses & classification: Annie Jump Cannon
  temperature association: Cecillia Payne Gaposchkin
  Cepheid variables: Henrietta Swan Leavitt

C. Star Properties (how do we measure or calculate … any needed equations will be given)

- temperature
- distance
- size
- flux and luminosity

Know the **Images of objects** … be able to **explain** what's happening & what stage of star formation they show!

D. HR diagram Field Guide Appendix 3, Raymo March 15 –22, Fraknoi et al. Ch 18.4

- axes (what's plotted against what? What are the scales)
- regions (Main Sequence, Giants (red & blue) Dwarfs (red & white), Luminosity Classes)

E. Stellar evolution Field Guide Ch. 5 (p. 144-167), Fraknoi et al. Ch 15 – 24, Video Notes

- Star Birth (*e.g.* Great Nebula in Orion, Eagle Nebula: Pillars of Creation)
- Main Sequence Stars Fraknoi et al. Ch 15, 16, 21
  What process defines a STAR?
  What luminosity class designates "main sequence"?
  What is a star's source of energy?
  Review Power from Fusion Worksheet!
  Sunspots

$E=mc^2$

Know name, position & constellation of examples of each stage

- Red Giant Stage Fraknoi et al. Ch 22
  what starts and ends this stage in low-mass stars (Sol)
- Star Death Fraknoi et al. Ch 23, 24
  Planetary Nebula and White Dwarf
  Supernova and Neutron Stars
  Supernova and Black Hole

Study
Stellar Evolution
https://pages.uoregon.edu/jimbrau/astr122/Notes/Chapter20.html

Along with budget cuts came a marked reduction in new discoveries.

17. Star Magnitude, Flux and Luminosity

Calculated the distances to four stars in meters, then calculated their luminosities from their absolute magnitudes and used that to calculate their fluxes on Earth.

For M_{Sol} = absolute magnitude of the sun and $M_\star$ = absolute magnitude of a star,

$$L_{\star,sl} = 10^{\left(\frac{M_{Sol}-M_\star}{2.5}\right)} \text{ solar luminosities} \qquad L_{\star,watts} = 10^{\left(\frac{M_{Sol}-M_\star}{2.5}\right)}\left(3.827\times10^{26}\right) \text{ Watts}$$

For a star at $r_{\star,\,ly}$ with 1 light year = 9.48×10^{15} m, the flux at Earth is

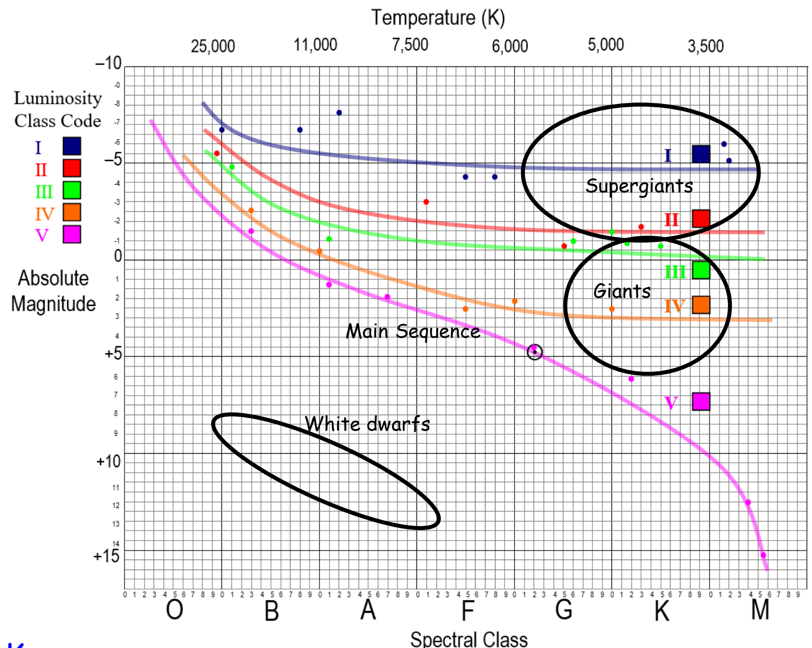
$$F_\oplus = \frac{L_{\star,\,watts}}{4\pi\left(r^2_{\star,meters}\right)} \ \frac{\text{watts}}{\text{m}^2}$$

18. Hydrogen Spectrum

Using gas tubes and spectroscopes, we measured the wavelengths of the β and γ Balmer Hydrogen lines from that of the α line. We also calculated the energies of the transitions in hydrogen that give rise to them.

19. HR Diagram

Plotted stars on the HR Diagram with colors corresponding to their luminosity class and used the plot to draw smooth lines representing the five luminosity classes.



20. Star Temperature and Size

Calculated the temperatures, luminosities and sizes of stars from the data in Appendix 2.

The temperature is found using the star's spectral class that spans temperatures T_{min} to T_{max}.

$$T_\star = T_{max} - \left\{\left(\text{subclass}\right)\times\frac{T_{max}-T_{min}}{10}\right\} \text{ K}$$

Then the star's radius is found using the Stefan-Boltzmann constant, $\sigma = 5.67 \times 10^{-8}$ W/m^{2}K^4

$$R_\star = \sqrt{\frac{L_\star}{4\pi\sigma T^4}} \text{ m}$$

21. Power from Fusion

Using data from fusion and the Sun, we calculated the amount of hydrogen that would suppy the annual electric power for NY residences through fusion. We then calculated the mass of hydrogen fused each second by the Sun and how much mass is converted completely to energy.

$$E = mc^2 \begin{cases} E = \text{energy released by H fusing to He} \\ m = \text{mass lost in fusion}\left(m_{He} - 4m_H\right)\text{that turns into energy} \\ c = \text{speed of light} = 2.998\times10^8 \text{ m/s} \end{cases}$$

22. Stellar Evolution in the Sky

Labeled an image of the sky with star names with colors corresponding to their luminosity