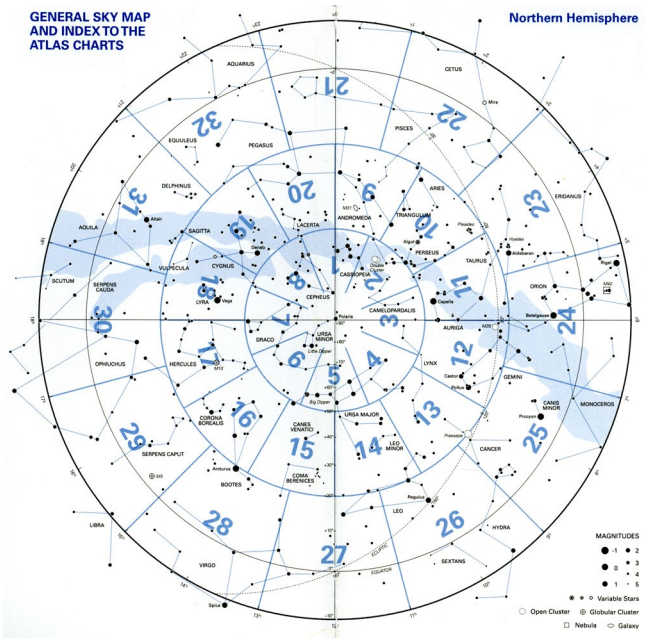
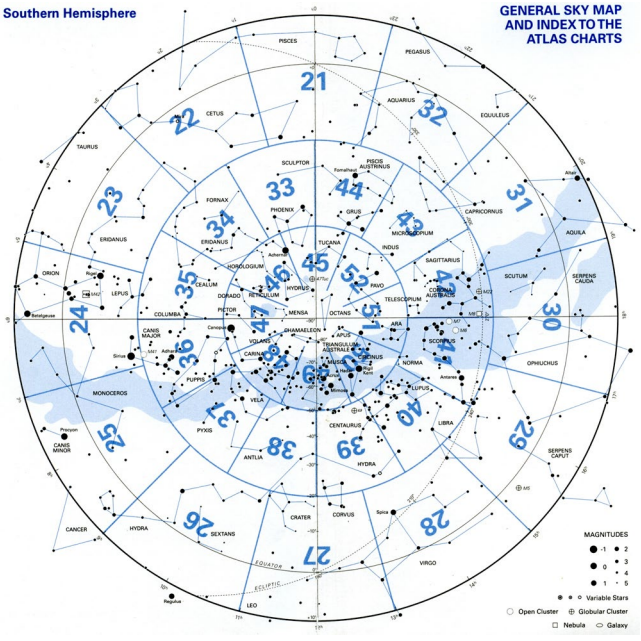
Lab Summary Fall 2026

1. Atlas Charts

Found the Atlas Charts for the Big & Little Dippers using the guide map and read them to learn about the stars in those asterisms and other objects in those areas of the sky.





2. Star Distances and Magnitudes

Used Appendix 2 to look up information about stars in the Summer Triangle and ranked them in order of distance, apparent magnitude (V) and absolute magnitude (M_V). Brighter objects have lower magnitudes … Vega V_{Vega} = 0.03 is brighter in the sky than Deneb V_{Deneb} = 1.25, but Deneb is intrinsically brighter than Vega: $M_{V,Deneb}$ = -7.5 $M_{V,Vega}$ = 0.6.

3. Celestial Coordinates

Identified stars on celestial globes using their coordinates and identified coordinates on the atlas chart sky maps.

Right Ascension (Celestial Longitude), 0^h to $23^h59^m59^s$ eastward from ♈

Declination (Celestial Latitude), 0° to ±90° northward & southward from Celestial Equator

4. Changes in Latitude

Wrote down the altitudes of the celestial pole and celestial equator for various latitudes then identified them on horizon diagrams. λ = latitude of the observer.

ALTITUDE OF CELESTIAL POLE = LATITUDE OF THE OBSERVER!

5. Star Trails

Using photographs of the trails of rising stars, we determined the (approximate) latitudes from which each photograph was taken.

Stars rise and set parallel to the C. E. at an angle of 90°- $\lambda_{observer}$ to the horizon

6. Star Transit Times

We looked up the transit times for a variety of stars using p. 13 in the *Field Guide* in both standard (EST) and daylight saving time (EDT). Vega's transit times through the summer showed that stars transit 4 minutes earlier every night.

7. Rising, Setting and Time in the Sky

Looked up star names in Appendix 2 using their right ascension. From their declinations, calculated their rising and setting azimuths, maximum altitudes and times above the horizon.

For λ = latitude of the observer and δ = declination of the star, we determined the azimuths of rising and setting, the altitude of the star at transit (the maximum), and the hours the star will be above the horizon using the following equations:

$$A_{rise} = \cos^{-1}\left(\frac{\sin\delta}{\cos\lambda}\right) \text{ degrees} \qquad A_{set} = 360 - A_{rise} \text{ degrees}$$

$$A_{max} = (90 - \lambda) + \delta \text{ degrees} \qquad \Delta t = \frac{2}{15}\cos^{-1}(-\tan\lambda\tan\delta) \text{ hours}$$

8. Time Zones

Wrote down the longitudes of the time zone centers in the western hemisphere, converted UT to EDT and EST. For cities at different longitudes, calculated the time of solar noon given the longitude of each city's time zone center.

Earth turns 15°/hour, 1° in 4 minutes, and 15 arcminutes in one minute

$\Rightarrow$ observer east of the TZ center sees events $(\text{degrees}) \times \left(\frac{4 \text{ minutes}}{1 \text{ degree}}\right)$ early.

$\Rightarrow$ observer west of the TZ center sees events $(\text{degrees}) \times \left(\frac{4 \text{ minutes}}{1 \text{ degree}}\right)$ late.

9. Celestial Navigation

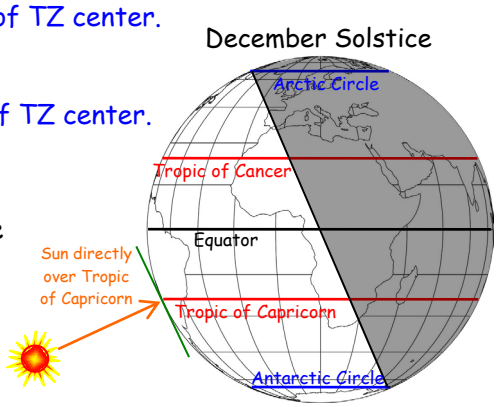
We determined an observer's latitude from the altitude of Polaris and longitude from the difference between the observed and expected transit times of Procyon on a particular day.

$\Rightarrow$ observer who sees events early is $(\text{minutes}) \times \left(\frac{1 \text{ degree}}{4 \text{ minutes}}\right)$ east of TZ center.

$\Rightarrow$ observer who sees events late is $(\text{minutes}) \times \left(\frac{1 \text{ degree}}{4 \text{ minutes}}\right)$ west of TZ center.

10. Named Latitudes

We determined wrote the geographic significance of the five named latitudes and shaded the Earth to show the Sun's position on the solstices and equinoxes.



11. The Ecliptic

We looked up the celestial position of the Sun on Sept. 10 in Leo. Used the Atlas Charts to determine information about the Solstices and Eqinoxes.

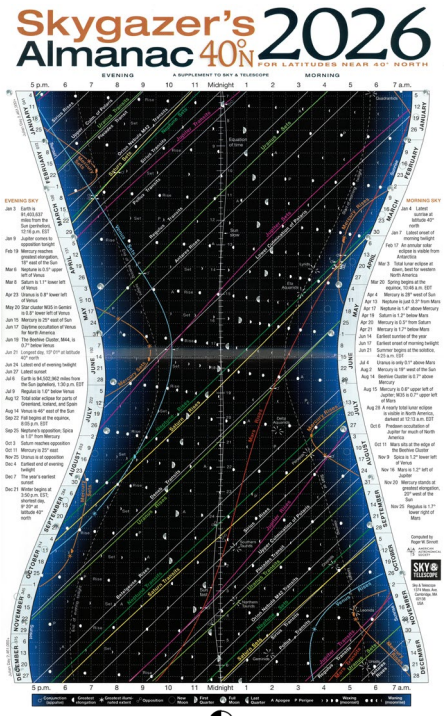
The Ecliptic is the apparent path of the Aun across the sky through the year. It is also the Earth's orbital plane.

THE TABLE YOU FILLED OUT WILL BE ON THE EXAM VERBATIM! KNOW IT!

12. The Day Through the Seasons

Using the Analemma to find solar declinations, we found the azimuths of rising and setting, the maximum altitudes and hours above the horizon for various cities. We also used the Analemma to determine the clock times of solar noon for various dates.

For observer at different latitudes (λ) and different declination of the Sun (δ), we determined the azimuths of rising and setting, the altitude of the star at transit (the maximum), and the hours of daylight using the same equations as in lab exercise 7.



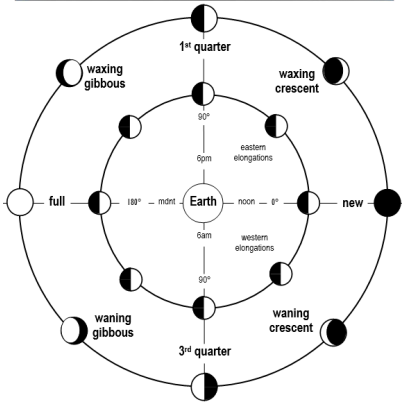
13. Planets in the Sky

Used Appendix 11 to look up planetary longitudes of the Sun and (5 naked-eye) planets on a given date. From these we determined the Atlas Charts for the positions of the Sun and planets to find what constellation each was in. We then calculated the elongations and plotted their positions for an observer at sunrise and in the solar system.

Planetary Longitude measured east from ♈ to 360° along ecliptic.
Elongation = angle from Sun to object.

14. Moon Phases

Filled out a table of phases, elongations, rising time, transit time, and setting time for the eight phases from one piece of given information on each.



15. Graphic Timetable: Events of a Single Night

After aswering questions about the the *Sky & Telescope Skygazer's Almanac*, we used it to find all the events that will occur during the night of Sep. 20-21, 2026.

16. Astronomy and Astrology

Used Starry Night to look at the sky at the moments of our births from the places of our births. Compared the astronomical constellations the sun, moon and planets were in to the astrological "houses" they were in according to natal charts. Most were different showing that astrology is not a scientific representation of the sky.

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 x 10^{15} m, the flux at Earth is

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

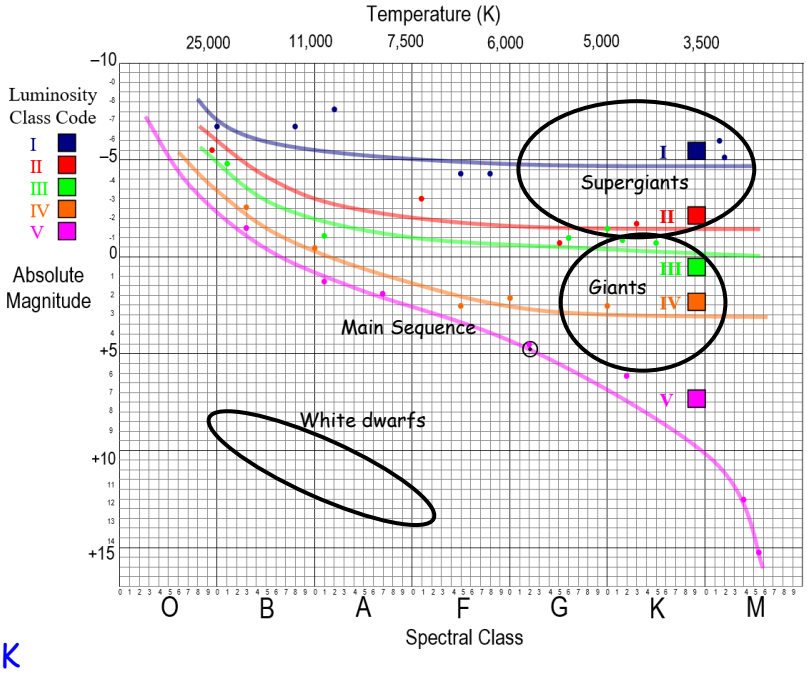
18. Hydrogen Spectrum

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, lluminosities 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}.

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

The star's radius is found using the Stefan-Boltzmann constant, $\sigma = 5.67 \times 10^{-8}$ W/m^{2}K^4 $R_\star = \sqrt{\frac{L_{\star,Watts}}{4\pi\sigma T^4}}$ 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.

$$E = mc^2 \begin{cases} E = \text{energy released by H fusing to He} \\ m = \text{mass lost } (m_{He} - 4m_H) \Rightarrow \text{energy} \\ c = \text{speed of light} = 2.998 \times 10^8 \text{ m/s} \end{cases}$$

22. Stellar Evolution in the Sky

Labeled an image of the sky with star names with colors corresponding to their luminosity classes and some objects (mostly nebulae) with their names, types and stages of stellar evolution.

