Activity #2: Stars and Constellations

Use the Stellarium for questions 1 and 2. Be sure to have bottom buttons 1 and 2 ON. You will want bottom button 4 On for part 1 (off for part 2) and button 5 On for part 2 (off for part 1). You may want to zoom out or in (using your mouse) for some of the parts.

1. Circumpolar stars are stars that circle around the North Star (Polaris) and from our view from DeKalb, never set below the northern horizon and so are always visible. Start up Stellarium, click On bottom button 4 (equatorial grid) and change the time (left button 2) to 9:00 PM.

a. Note the date and time.

b. Point towards the North and locate the North Star (last star in little dipper, constellation name Ursa Minor) about ½ way up from the horizon and right at the center of your grid lines.

c. Find the Big Dipper (in constellation Ursa Major) and the constellation Cassiopeia (looks like a W). Using the hands of a clock with the North Star at the center and 12 being Up, 3 being towards the East, 6 being Down, and 9 towards the West, note about where the Big Dipper and Cassiopeia are.

d. Change time to 3:00 AM and note where the Big Dipper and Cassiopeia are now. As they are almost opposite each other, one can usually see one even if the horizon blocks the other.

e. Change the date to about three months from now give or take a day and stop at either 9:00 PM or 3:00 AM and then note the date, time and locations of the Big Dipper and Cassiopeia. Why are these different then the earlier locations in c. and d.?

2. The stars directly overhead of us change through the year as the Earth orbits the Sun. and are not visible for the entire year in the night sky. Start up Stellarium, turn on button 5 Azimuthal grid, and then change time to about 9:00 PM (don't need to be exact) and then stop.

a. Note the date and time.

b. Point towards the South (which is the default) and then drag the S horizon downward to locate the constellation directly overhead. You can tell what is directly overhead by having button 5 on and moving to the center of the imposed grid. Write what constellation you find that is closest to that central point.

c. Advance to 11:00 PM on the same day and note the time and what constellation is now closest to being directly overhead.

d. Change date to one month ahead and about 9:00 PM on that day and note the day and time and what constellation is directly overhead.

e. Which time of the night from parts b and c (that is one month earlier) had the same constellation directly overhead as seen in part d? Give the easy explanation for why constellations seem to "move" by about 2 hours each month.

Stars in Orion

purpose

The sky is not eternal, not fixed. It is continuously changing as the stars change, grow old, die, as new stars are born, and as the stars move a cross the sky. This exercise will acquaint you with how a familiar constellation is changing.

proper motions

The regular change in position of a star per year across the sky is called its proper motion and is represented by the symbol μ. Proper motion is measured in seconds of arc per year and is determined by measuring the position of the star on two dates separated by many years.

Just as we might measure the motion of a ship at sea by the number of miles it travels north or south per day and the number of miles it travels east or west per day, we measure the motion of a star by the distance in seconds of arc it travels north or south per year and the distance in seconds of arc it travels east or west per year. The north-south motion represents a change in declination, and this component of μ is called the proper motion in declination, μ_δ. The component of μ in the east-west direction is called the proper motion in right ascension, μ_α. If the star moves northward, μ_δ is positive. If it travels eastward, μ_α is positive. If it travels in the other directions then the corresponding proper motions are negative.

The proper motions of most bright stars are much less than 1″ of arc per year. This is a very small angle. A sheet of paper viewed edge on at arms length is about 30″ of arc thick. It would take most stars 30 to 3000 years to move that far across the sky.

Figure from class

Plot in Figure 39–2 the positions of the stars in Orion by consulting the right ascensions and declinations listed in Table 39–1. The result will be a star chart showing the constellation Orion as it appears in our sky. Compare this with the ~~star chart following the appendices~~ in your book or star sheet.

Trace the scale shown in Figure 39–2 and use it to draw in lightly arrows representing μ_α and μ_δ for each star as shown in Figure 39-1. Since μ_α and μ_δ are so small, plot the distance the star would travel in 1,000,000 years instead of in 1 year. Thus, Alpha Orionis has a μ_α of 0.027″ of arc per year. In 1,000,000 years it will travel 27,000″ of arc. Since μ_α is positive we conclude that the star is traveling eastward (to the left) in the constellation.

Now draw in the hypotenuse of the triangle for each star, showing its total motion across the sky for a period of 1,000,000 years.

SKIP
We will discuss

We have also assumed that these stars will still be bright stars in 1,000,000 years, and that they were bright stars 1,000,000 years ago. Look up the spectral types of these stars and estimate their ages and life expectancies. Consult your observer's handbook for spectral types and your text book to estimate life expectancies. Now write a paragraph or two describing how the brightness and the color of the stars in Orion might change in the future and how they might have looked in the past.

Stars in Orion

3600 seconds of arc = 1 degree

Table 39–1 The Stars in Orion seconds of arc / year

Star	*R.A.*	*Dec.*	μ_α	μ_δ	*Spectral Type*
Alpha	$5^h\ 54^m$	$+7°\ 24'$	0.027	0.007	
Beta	5 13	−8 14	0.001	0.000	
Gamma	5 24	+6 19	−0.006	−0.014	
Delta	5 30	−0 19	0.001	−0.001	
Epsilon	5 35	−1 13	0.000	0.000	
Zeta	5 39	−1 57	0.004	−0.002	
Kappa	5 46	−9 41	0.004	−0.002	
Iota	5 34	−5 56	0.003	0.004	
Theta	5 34	−5 25	0.003	0.003	

In Table 39-1 only the components of the proper motion are given because the total proper motion μ may be determined from the components, μ_α and μ_δ. See Figure 39–1.

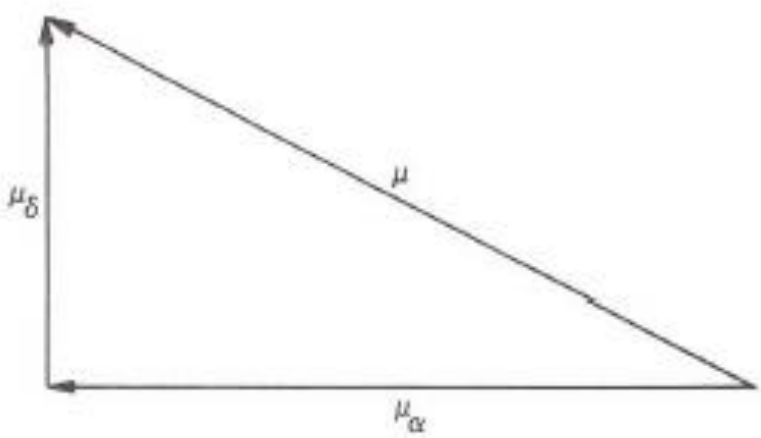
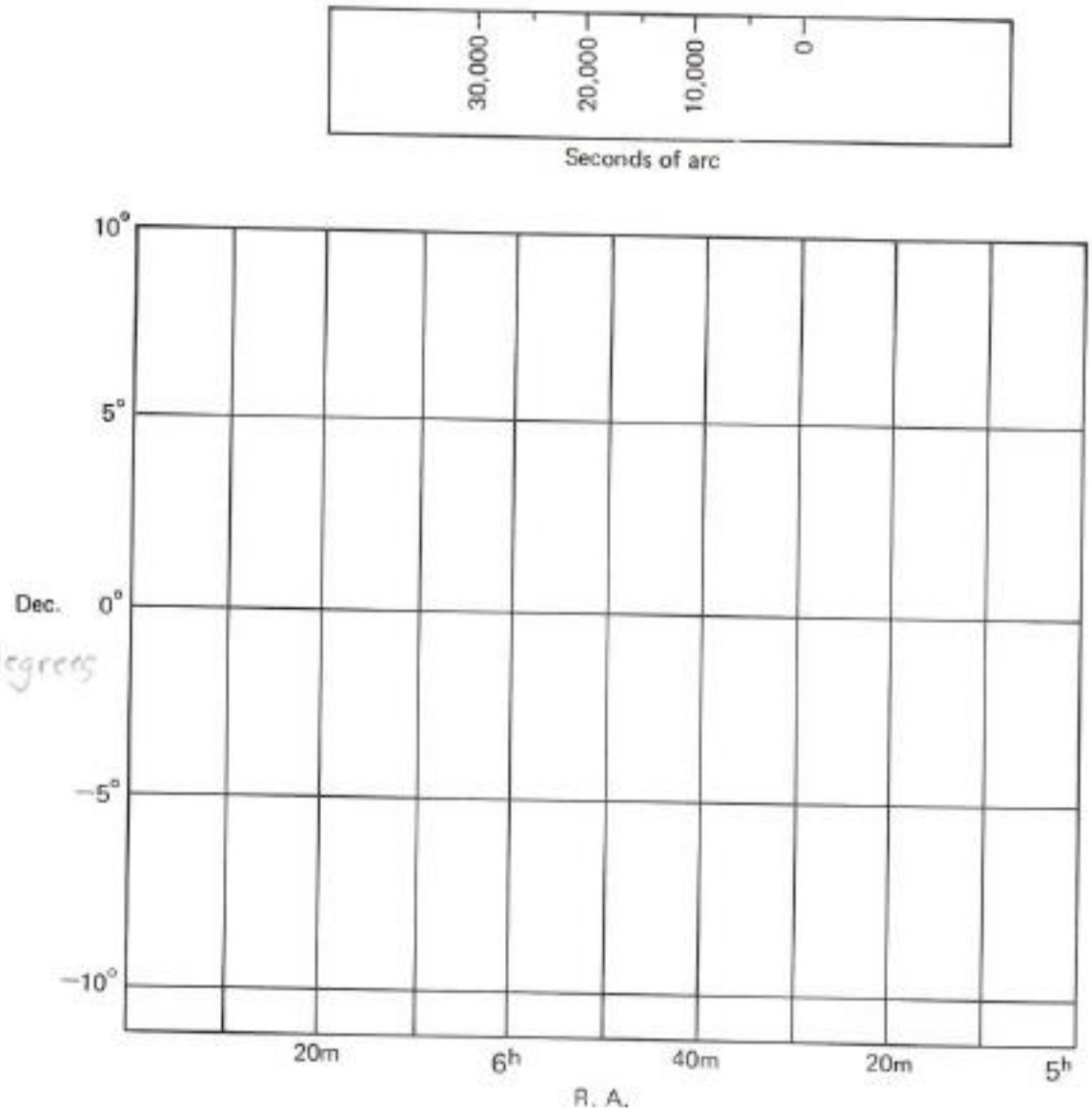


Figure 39-1. The relation between the proper motion in right ascension μ_α and declination μ_δ, and total proper motion μ of a star near the celestial equator.



in degrees

Figure 39-2. Area of sky near Orion. Plot star positions according to right ascension and declination. Scale for measurement of proper motion is in seconds of arc.

24 hours (RA) = 360 degrees
1 hour = 15 degrees 20 m = 5 degrees
= 1800 seconds of arc

Orion in 1,000,000 years

Place a blank piece of paper over your diagram and draw dots or stars at the tip of each arrow, μ, to show where the star will be 1,000,000 years from now. Would Orion be recognizable? use different symbol

Stellarium Control Buttons

ON LEFT

1 Allows you to change location. Ignore if your default location is in northern Illinois (like DeKalb or Sycamore) but note different location if you are further south

2 Changes (easily) date and time. Very useful for many exercises.

ON BOTTOM

1,2,3 Constellation lines, names, art (want first 2 ON)

4,5 equatorial and azimuthal grid. Want ON for some questions

6,7,8 ground,cardinal points(N,E,S,W),atmosphere. Want ON

9 Deep sky objects (like galaxies) leave off. May use later

10 Planets, want ON

11-13 Skip

14 Full screen versus partial screen toggle (useful)

15-16 Exoplanets and meteor showers. Skip for now

17-20 skip (20 is blank spot)

21 Fast reverse <<

22 Forward/Stop (>/=)

23 Set time to now

24 >> Fast Forward (each click increases speed)

25 Exit