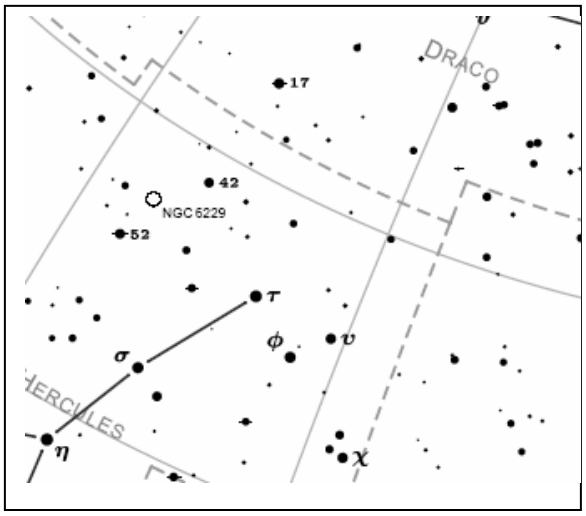
One of the earliest methods used by astr onomers to study the Milky Way galaxy was to count stars. They would phot ograph a pa rticular piece of the sky, and count the number of stars they found in a range of apparent magnit ude bins. From these 'star gauging' histograms across the sky, they created mathematical models of the shape of the Milky Way that fit the colle ction of histograms. In this activity, you will le arn how to construct a histogram for the stars in a star field, bin them according to their apparent magnitude, and answer a few questions.



Compare the size of each star in the chart with the legend using a millimeter ru ler. C ount the n umber of stars with th e sa me magnitude, en tering them in th e table below.

Magnitude	Tally	Total
+0.0		
+1.0		
+2.0		
+3.0		
+4.0		
+5.0		
+6.0		
+7.0		

From the tabulated data, construct a histogram of the number of stars in each magnitude bin, versus the apparent magnitude of the star.

Question 1) How many stars are there in the Draco Field that are fainter than apparent magnitude +0.0?

Question 2) The area of the Draco Field is 17 degrees x 20 degrees. How many square degrees does the field cover?

Question 3) If the total area of the sky is 41,266 square degrees, about how many stars are there in the sky brighter than magnitude +7.0?

Question 4) Using the histogram, what would you predict as the number of stars with a magnitude of +8.0? +9.0?

Question 5) From your answer to Question 4, how many stars are there in the sky brighter than magnitude +8.0?

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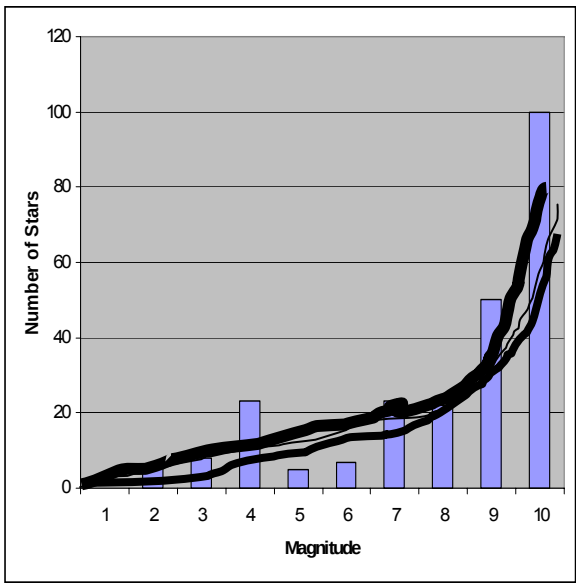

Magnitude	Tally	Total
0.0	0	0
1.0	I I I I I I	6
2.0	I I I I I I I I	8
3.0	I I I I I I I I I I I I I I I I I I I I I I I I	23
4.0	I I I I I	5
5.0	I I I I I I I	7
6.0	I I I I I I I I I I I I I I I I I I I I I I I I	23
7.0	I I I I I I I I I I I I I I I I I I I I I I I	22

Question 1) How many stars are there in the Draco Field that are fainter than apparent magnitude 0.0? **Answer: Add the histogram bins for all of the magnitudes to get 6+8+23+5+7+23+22 = 139 stars in the Draco Field. Note, counting is a statistical process so have students average their numbers for each bin to get a 'class average' histogram. This also teaches students about averaging, and observer biases.**

Question 2) The area of the Draco Field is 17 degrees x 20 degrees. How many square degrees does the field cover? **Answer: The Draco Field covers an area of 340 square degrees.**

Question 3) If the total area of the sky is 41,266 square degrees, about how many stars are there in the sky brighter than magnitude 7.0? **Answer: There are 41,266/340 = 121.4 patches of the size of the Draco Field across the sky, so if the Draco star counts are typical of all these patches, there are 121.4 x 139 stars = 2,306 stars. Note: This is smaller that the commonly cited 6,000 stars because the Draco Field actually has fewer stars than the average sky patch.**

Question 4) Using the histogram, what would you predict as the number of stars with a magnitude of +8.0? +9.0 ? **Answer: Each student will extrapolate the trend seen in the bins in a slightly different way. There would be, perhaps 50, +8.0 stars and 100, +9.0 stars. The trend should be that there is a rapid increase in the number of faint stars.**

Question 5) From your answer to Question 4, how many stars are there in the sky brighter than magnitude +9.0? **Answer: Add up the estimate for the stars in the +8.0 and +9.0 bins to your answer to Question 1. Typical answers might be about 250 brighter than +9.0. Based on the answer to question 4, you can estimate about 121.4 x 250 or about 30,000 stars. This estimate will vary depending on how students decide to extrapolate the histogram from apparent magnitudes +5.0 to +6.0 to predict the fainter bin values.**