Prelab Exercise for Determining our Position in the Milky Way

1. What is the Milky Way? How does it appear in our night sky? Why does it appear *Milky*? What is the Milky Way composed of?

2. What shape is the Milky Way in reality? Is it typical or unusual for the type of object it is? How are objects like this typically seen elsewhere in the Universe?

3. Why is it that we typically cannot see the Milky Way from inside Phoenix? What causes this problem?

DETERMINING OUR POSITION IN THE MILKY WAY

What will you learn in this Lab?

What is the Milky Way? How was our location in it initially determined? How is the Milky Way oriented with respect to the Solar System? Is the Milky Way uniformly populated with stars, as we see it?

What do I need to bring to the Class with me to do this Lab?

For this lab you will need:

- A copy of this lab script
- A pencil
- Your star charts
- Audubon Field Guide

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Introduction:

The purpose of this lab is to chart the Milky Way from the light polluted skies of Tempe. In general, seeing the Milky Way with the naked eye requires a clear, dark sky (e.g. Flagstaff) – a situation seldom found near a large city. Tonight you will be investigating the Milky Way in two ways – completing an indoor exercise using compiled data and confirming what you have learned from the indoor part of the lab by using binoculars to look at star fields in different regions of the sky.

PART I: Indoor Exercise

Exercise

This exercise will help you visualize the process of taking observations and plotting them on a map. Imagine that you are inside a large cloud of fireflies. This cloud of insects is analogous to the cloud of stars that you see dotting the night sky. Discuss among yourselves what you would see if you were in the following scenarios. Take some notes since these will be useful for the following exercises. Also sketch the distribution of fireflies on the maps next to each scenario. The maps are printed flat, but like maps of the world they represent a spherical surface – imagine an orange peel cut off the orange and laid flat.

1. You are at the center of a uniform sphere of fireflies:
2. You are at the edge of a uniform sphere of fireflies:
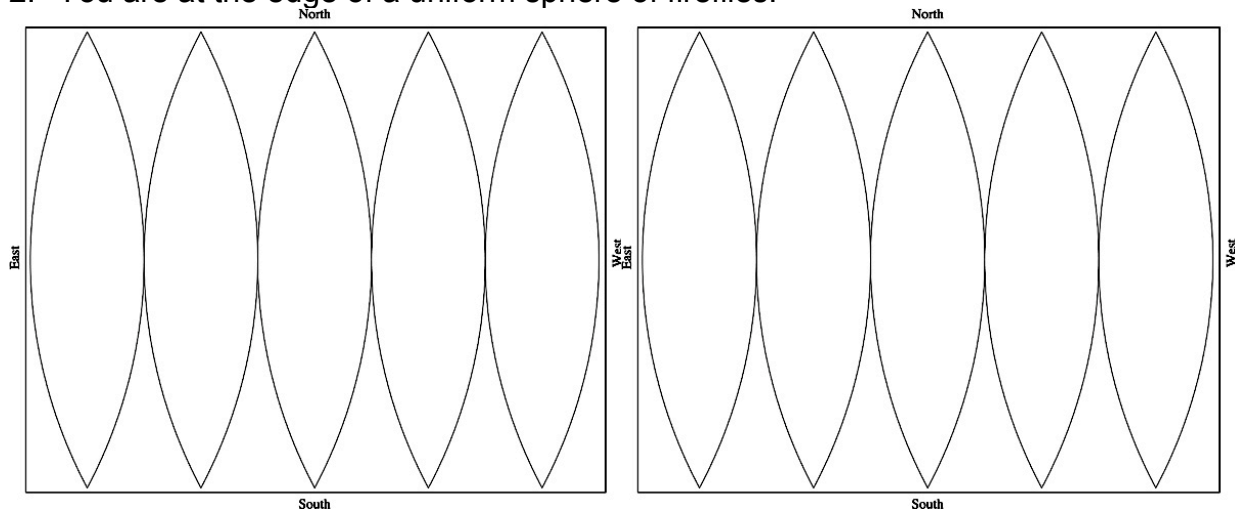
3. You are at the center of a very thin disk of fireflies:
4. You are at the edge of a very thin disk of fireflies:
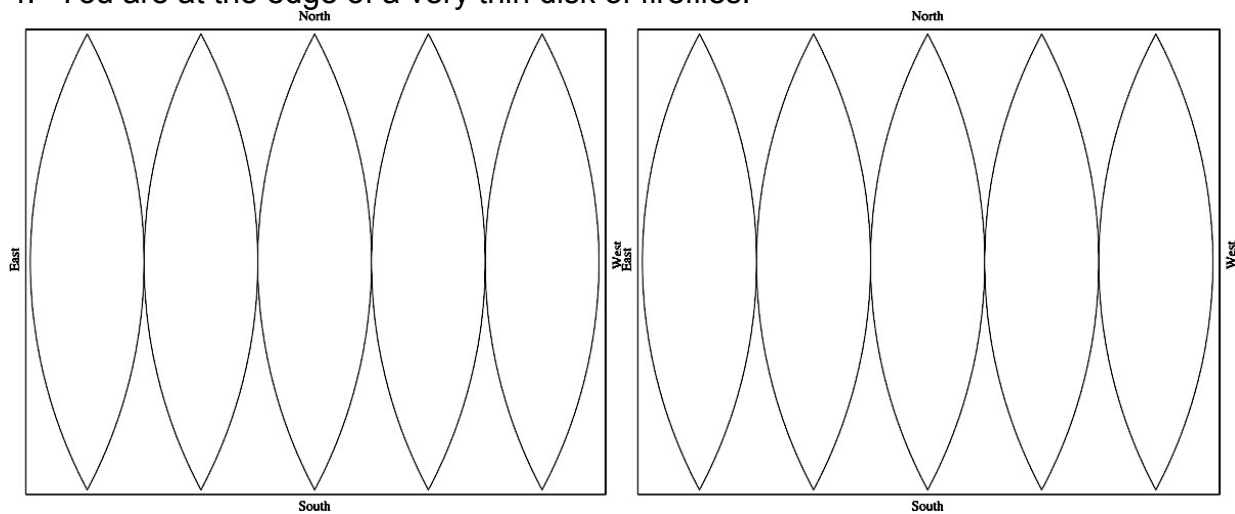
Now we are going to create a map that shows the distribution of some of the different types of celestial objects visible in the night sky – globular clusters, spiral galaxies, open clusters, gaseous nebulae. At the end of the lab script you will find a list of constellations within which certain numbers of each type of object can be found. The number count for each type is listed. With that you will find a map of the sky with the constellations delineated. The Milky Way is already shown. Using the table, choose a symbol for each type of object, and mark the appropriate number of object/symbols within each constellations boundary. Follow this procedure:

•   Mark the location of each object on the map toward the center of the zone that defines the constellation. Make the symbols dark enough that you can see them through the paper.
•   Use a different symbol for each class of object.

- Lightly color the Zodiacal constellations.
- Cut out the map carefully.
- Construct the globe using tape

Note: The globe you've made is inside out. We would typically view the "celestial globe" from the inside, but in this case we've taken a map of the sky and made a globe out of it with the inside on the outside. This means that the order of the constellations on the outside of the globe is reversed from what it should be.

Questions for Part I

1. Examine the globe that you've built and pay particular attention to each class of object. Make a clear statement about the distribution of Globular Clusters, Spiral Galaxies, Open Clusters and Gaseous Nebulae. Describe what you see and be as detailed as you can in describing the distributions. Make particular reference to the path of the Milky Way.

2. Compare the distributions you observed for each of the types of objects with the patterns you generated for the fireflies. Do any of them match? Do any of them partly resemble each other? What does this tell you about the real spatial distribution of each type of object relative to the Earth?

3. Now consider the overall structure of our Galaxy, as represented by the Milky Way on your globe. What do the answers for **question 2** tell you about the distribution of the various types of objects within the Galaxy? Be specific for **each** type of object – globular clusters, spiral galaxies, open clusters, emission nebulae.

4. Using your answers now draw a sketch of the Galaxy showing where in the structure each type of object can typically be found. Be sure to add labels to make the sketch clear.

PART II: Outdoor Exercise

Based on your model of the cloud of fireflies and your description of the Milky Way structure that you determined in part I, you are able to make predictions as to the distribution of stars on the sky and the shapes of some galaxies, like our own. Predict the answers to the following questions, based on what you've learned.

- Should you see a higher density of stars away from the Milky Way or within the Milky Way?
- Are all galaxies spherical in nature or should some galaxies look like disks?

Now you will go to outside and make some observations to test your predictions. With the help of your TA, you will use two pair of binoculars to look at two locations on the sky to test your prediction about the density of stars.

Two locations:

Location 1: located in constellation _____
Location 2: located in constellation _____

Questions for Part II

1. Inspect the two constellations by eye. Which location has the higher density of stars?

2. You determined a constellation that had a high density of stars. Look at your constellation model from Part I. Does your outdoor observation match a constellation near or within the Milky Way? Does your observation match your prediction?

PART III – Additional Questions

1. Where in the Milky Way are we? How can you tell?

2. What is the approximate shape of the Milky Way? Be precise in this description.

3. Look at your star charts or starwheel and answer the following questions:
    a. Do the brighter stars correlate with the location of the Milky Way? What does this tell you about the distance of the brighter stars compared to the size of the Milky Way?

    b. Are there any dense concentrations of stars away from the Milky Way?

4. Through which constellations does the Milky Way pass? How is it oriented with respect to the ecliptic (zodiacal constellations)?

Conclusion:

Constellation	# Globulars	# Spirals	# Opens	# Gaseous
Cepheus			3	6
Pegasus	4	2		
Aquarius	1			
Capricornus	4			
Grus		2		
Draco		5		
Cygnus			7	6
Vulpecula				4
Aquila			3	2
Sagittarius	20		2	3
Telescopium	8			
Hercules	4			
Ophiuchus	8			
Scorpius			6	
Lupus			2	1
Norma			4	
Ursa Majoris		16		
Canes Venatici		10		
Bootes	2			
Coma Berenices	3	12		
Virgo	2	11		
Centaurus	2	5	1	4
Leo		8		
Hydra	1	2		
Camelopardalis		4		
Monoceros				8
Canis Major			6	3
Puppis			5	1
Perseus			4	5
Taurus			3	3
Orion			3	6
Eridanus		8		
Dorado	3	4		
Cassiopeia			8	7
Andromeda		4		
Triangulum		7		
Pisces		3		
Cetus		7		
Fornax		2		
Sculptor	1	5		