

## **Exploring the Winter Sky**

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**You Will Need:**

- One clear night (preferably without a Moon) for observing
- Planisphere
- Binoculars of at least 7x magnification or a small telescope

**Purpose:** To explore the night sky with binoculars or telescope, using the technique of "star hopping"

### **Background:**

For general viewing of the sky, binoculars and telescopes have some advantages over the eye. Since both have a greater diameter (aperture) than the pupil of the human eye, they have a greater light-gathering power: objects seen through them appear brighter than they would if viewed with the eye alone. One immediate consequence of this is that more stars may be seen as having distinct COLORS, because more of them are brightened above the eye's color vision threshold.

Both binoculars and telescopes gather more light, and also magnify objects' images, to a greater degree than the eye can. However, telescopes generally have such long focal lengths in comparison to binoculars that their magnification is almost TOO large, unless one wants to study planets; the field of view of a telescope is usually restricted to around one degree or less. In contrast, binoculars have reasonable amounts of magnification (say, 7 or 9 times) but a wider field of view (typically, 5 to 10 degrees). Binoculars do not "flip" the images of objects (left for right) as some telescopes do. Also, as BOTH eyes are used when viewing through binoculars, the entire eye-brain sensing/processing system is utilized, leading (some say) to a better contrast between celestial objects and the background sky.

### **Procedure:**

Consult the Reference Guide for information on the magnification and field of view of a pair of binoculars or a small telescope. Though binoculars of 16 to 20x magnifications are manufactured, for general sky-scanning as well as terrestrial viewing it is best to stick with the lower-magnification but lighter weight binoculars, such as 7x35 or 7x50.

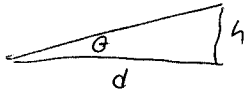
Establish the field of view of your binoculars or telescope, in degrees. There are several ways of doing this:

- (1) If the manufacturer specifies the width of the field at a certain distance, you can calculate the field of view (see the Reference Guide).

### **Exercise 8: Exploring the Winter Sky**

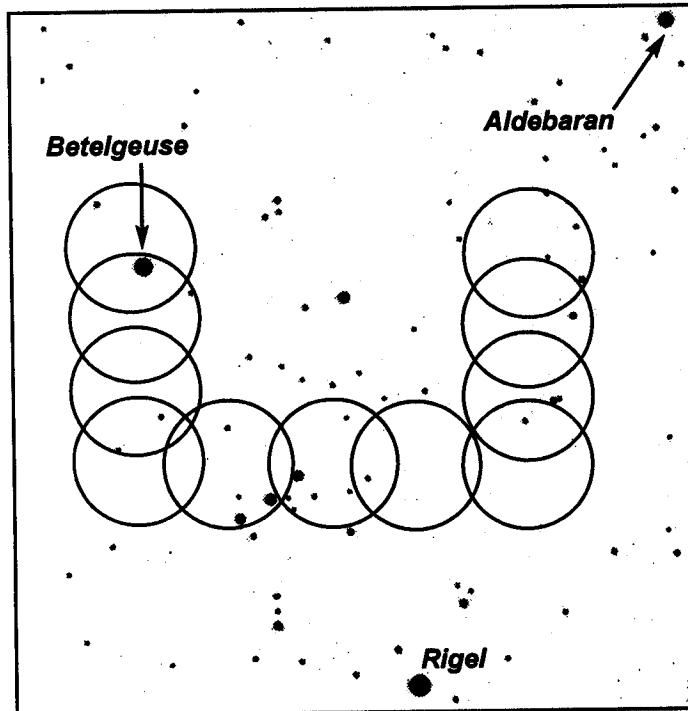
- (2) Look at the two Pointer Stars (*Merak* and *Dubhe*) in the end of the bowl of the Big Dipper (farthest from the stars of the handle). Those stars are 5.4 degrees apart. Estimate how many times the distance between *Merak* and *Dubhe* will fit across your binocular view, then multiply by 5.4 to convert to degrees.
- (3) Look at the Full Moon through your binoculars or telescope. The Full Moon's angular diameter is about 0.5 degree. Estimate how many Full Moons could fit across your field of view, then multiply by 0.5.
- (4) During the day, look at an object (such as a utility pole or house) of KNOWN HEIGHT. Move toward it or away from it until the object just fills the field of view; then measure your distance from the object. If the object's height is "h" and your distance from it is "d," the angular field of view is approximately  $(h/d) \times 57.3$  degrees.

$$\frac{h}{d} = \tan \theta \approx \sin \theta \approx \theta$$



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Figure 1 illustrates the technique of "star hopping" used by amateur astronomers to point their binoculars or telescopes toward objects which might be too faint to be easily spotted with the naked eye. A planisphere or star chart is necessary, as is a knowledge of the angular field of view of the binoculars or telescope. The trick to star hopping is to start with a bright star, then move it to an edge of the field of view so that another star becomes visible near the opposite edge; it in turn becomes the new starting point for hopping to still other stars.



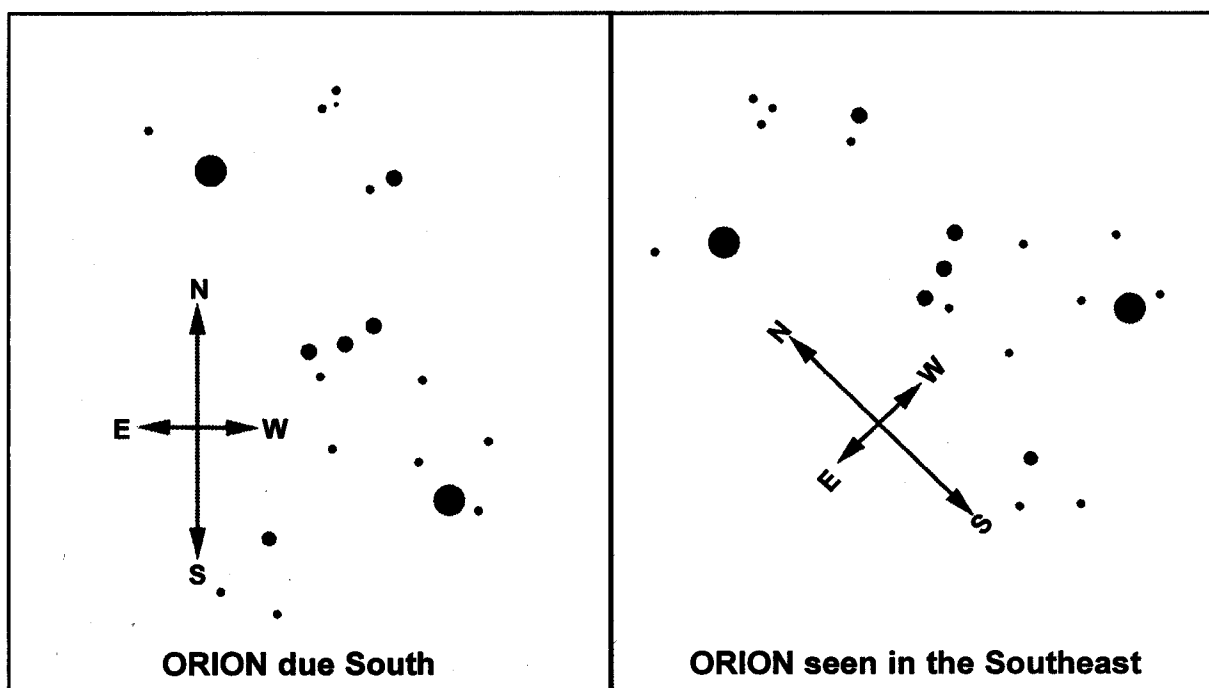
Star chart courtesy of Voyager II / Carina Software

Figure 1

**Exercise 8: Exploring the Winter Sky**

In the figure, you are looking at objects in the constellation Orion. Starting with the bright star *Betelgeuse*, you proceed downward toward the region of Orion's Belt; then you turn toward the right (westward) and eventually upward again as you explore the fainter stars in Orion's Shield.

It is useful to always move your binoculars around in a north-south and east-west fashion because this duplicates the directions used on star charts. However, you should be aware that on star charts, "north-south" refers to the direction between the celestial poles and "east-west" to the path followed by rising and setting objects. At our (temperate) latitude, the "north-south" direction is ONLY vertical for objects lying due north or due south in the sky; if a constellation is observed while RISING, the "north-south" direction is actually TILTED toward the left. (See *Figure 2*.)



*Figure 2*

### Observations:

*Figure 3* shows the southern sky as it would be seen from mid-Northern latitudes on evenings of late fall or early winter: specifically, around midnight (Standard Time) in mid-December, 10 p.m. in mid-January and 8 p.m. in mid-February. North is at the top, East to the left.

Establish the field of view of your binoculars or telescope, in degrees.

Use the planisphere to help you identify the constellations and bright stars in this part of the sky. Starting from one of the bright stars, "star hop" to each of the

### **Exercise 8: Exploring the Winter Sky**

CIRCLED AREAS on the chart and observe the object or objects there.

For each circled area:

- Make a sketch of what you see there, in the circular field of view of your binoculars or telescope.
- Describe the appearance of the object(s), such as color or shape.
- Note the date, time, and weather conditions.

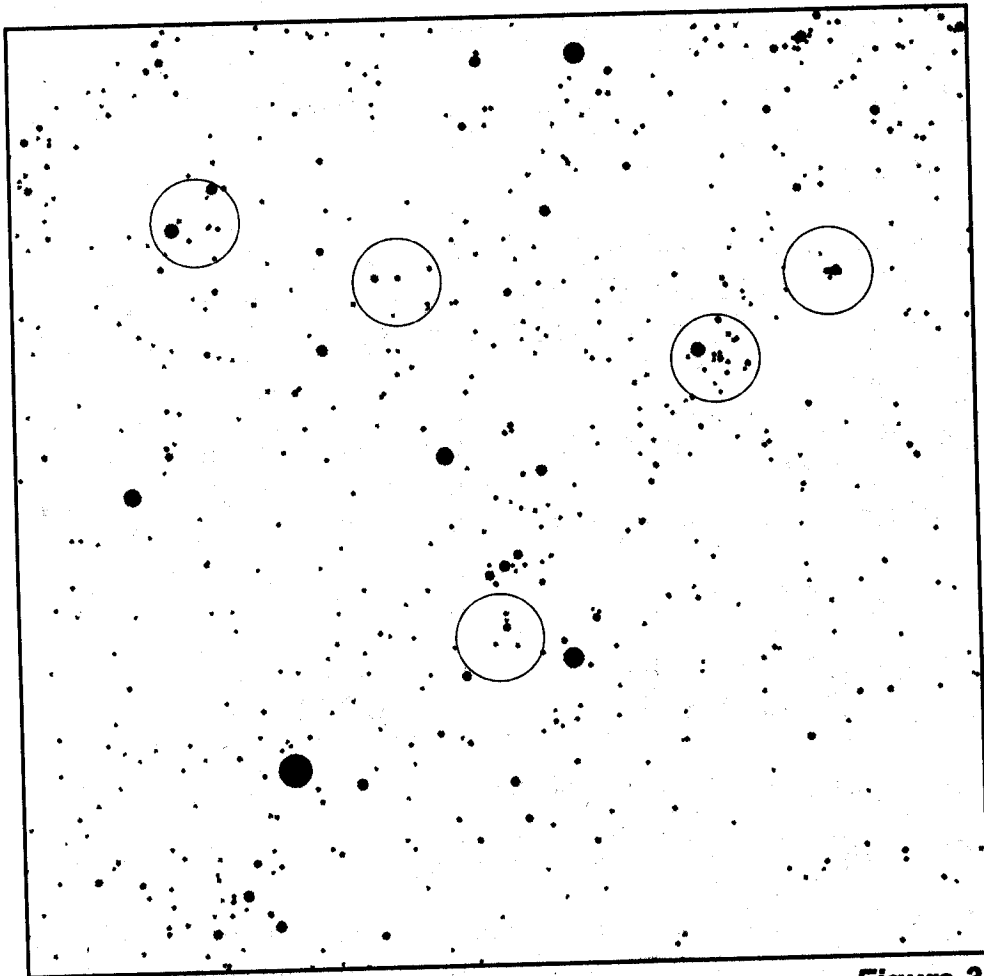


Figure 3



See the LAB REPORT CHECKLIST for guidelines in preparing your lab report.

## Exploring the Spring Sky

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- You Will Need:**
- One clear night (preferably without a Moon) for observing
  - Planisphere
  - Binoculars of at least 7x magnification or a small telescope

**Purpose:** To explore the night sky with binoculars or telescope, using the technique of "star hopping"

### Background:

See the exercise "Exploring the Winter Sky" for information on star hopping and finding the field of view of your equipment.

Establish the field of view of your binoculars or telescope, in degrees.

### Observations:

*Figure 1* shows the southern sky as it would be seen from mid-Northern latitudes on evenings of late winter or early spring: specifically, around midnight (Standard Time) in mid-March, 10 p.m. in mid-April and 8 p.m. in mid-May. North is at the top, East to the left.

Use the planisphere to help you identify the constellations and bright stars in this part of the sky. Starting from one of the bright stars, "star hop" to each of the CIRCLED AREAS on the chart and observe the object or objects there.

For each circled area:

- Make a sketch of what you see there, in the circular field of view of your binoculars or telescope.
- Describe the appearance of the object(s), such as color or shape.
- Note the date, time, and weather conditions.



See the LAB REPORT CHECKLIST for guidelines in preparing your lab report.