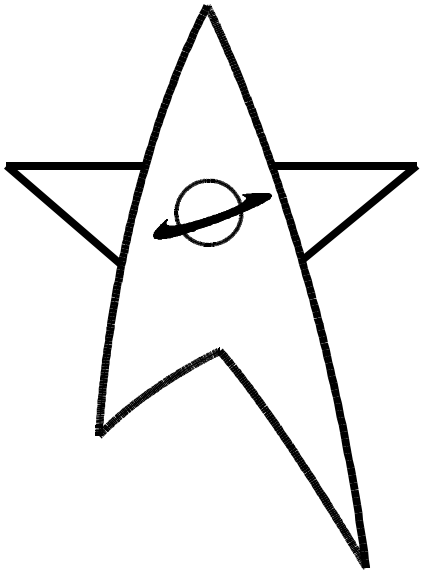
SKY TREKKER

OBSERVERS' PROGRAM



THIS BOOKLET
BELONGS TO:_____
(PRINT NAME CLEARLY)

SKY TREKKER PROGRAM LEVEL ACHIEVED: I II
(CIRCLE ONE)

INDIANA FAMILY STAR PARTY

Sky Trekker Observer's Program

Welcome to the Indiana Family Star Party and welcome to the hobby of astronomy!

At this star party, you can qualify for either a Sky Trekker I or Sky Trekker II certificate and badge (and ice cream treat!). The Sky Trekker I Program is designed for absolute beginners or those who would like to increase their knowledge of constellations. The Sky Trekker II Program is designed for those with a little more experience.

For the Sky Trekker I certificate, you will need to:

1. Identify and point out the six constellations/asterisms featured in this manual
2. Locate the following three bright stars: Polaris, Deneb, and Antares.

For the Sky Trekker II certificate, you will need to do the following:

1. Identify and point out the six constellations/asterisms featured in this manual, as well as the "Summer Triangle" asterism
2. Locate Polaris, Antares, and the stars of the "Summer Triangle" asterism: Deneb, Vega, and Altair
3. With binoculars or a telescope, find three deep space objects from the given list (see page 13). No two objects can be from the same category.
   Sorry, but GOTO telescopes are not allowed.
4. Provide a sketch of one of the three solar system objects listed in the manual (see page 14).

When we say that the Sky Trekker II Program is designed for kids with a little more experience, we mean it. To try the Sky Trekker II Program, you should have previous experience observing through binoculars and telescopes. This program assumes that you can actually identify and know more constellations/asterisms than you are being asked to find (see **NOTE**, page 13). If you are a beginner with your telescope or binoculars, you can try for the Sky Trekker II certificate, but still qualify for the Sky Trekker I certificate if you can't or don't want to locate all of the items required for the Sky Trekker II certificate.

You may use the planisphere provided, or any other planisphere or star map that you own (or borrow).

Note that this is a "program", not a contest. Everyone can "win". Share your maps, share your telescopes and/or binoculars (if it's OK with your parents), and share your knowledge. Help each other succeed! Have fun!

Some Definitions

Note: By some terms you may see a small number up and to the right. This is a footnote number. Check the "Addendum: Footnotes" Section, page 15, for explanations of these terms.

Constellations and Asterisms:

Simply put, constellations are groupings of stars identified by the ancients to tell stories. In the past, different cultures "connected the dots" in different ways to tell different stories, but now the International Astronomical Union has formally recognized an official set of star groupings that are used world-wide so that all astronomers will have a common reference, no matter what their cultural heritage is.

Asterisms are parts of the official constellations that make clear and common pictures across the sky. They're not complete, they're not official, but they can make a great starting point for learning your way around the sky.

Deep-Space Objects:

There are several different types of deep-space objects; each of the kinds that Sky Trekker IIs will be asked to find are described briefly below:

Star Clusters:

Star Clusters come in two basic types: Open Clusters, and Globular Clusters. Both types are groups of stars that are bound together by gravity, an attractive force. Both types are on the Sky Trekker II Objects list.

Globular Clusters: Globular Clusters are basically spherical groupings of stars whose members number from 10,000 to several million. Some of them are only a few tens of "light-years"[1] across and some of them are up to 200 light-years across! All of them have a common characteristic: they're OLD—and made up of mostly yellow and red stars weighing a bit less than 2 "solar masses"[2]. Being, as they are, little satellites of the galaxy—and being just a few hundred million years less old than the universe itself, these clusters tend to be populated with old stars simply because the bigger and hotter stars that they once may have contained have all exploded as "supernovae" (see Nebulae: Planetary Nebula, below) or collapsed into "white dwarf stars" (again, see Nebulae: Planetary Nebula, below) by now. Oh, they may have an occasional "blue straggler," a rare blue star in a globular thought to be formed by star collisions in the crowded inner regions of the cluster, but they are generally old objects with generally old stars.

Open Clusters: Unlike Globular Clusters (see above), which are distributed about a galaxy in a basically spherical (ball) shape, Open Clusters are found in the galactic plane[3] and are just about always found within a galaxy's spiral arms. In general, they contain less than a few hundred member stars—which are often hot, young, and blue—within a region that's up to about 30 light-years across. Being less crowded and more loosely populated than globular clusters, the gravity holding the stars together is not as tight so, over time, open clusters can be disrupted by the gravitational influence of giant gas or dust clouds, or other clusters as they move through the galaxy. Some cluster members can also be lost by a process known as "evaporation": when the close passing of two stars in the cluster results in a change of direction of one of them, setting it on a path that makes it eventually wander

out of the cluster. Even if this happens, cluster stars will still continue to move in the same basic direction through space even if they are no longer held together by gravity. If it happens that all of the cluster's stars are no longer held together by gravity, but are just all moving in a similar direction, the stars are then called a “stellar association”, or a “moving group”.

NEBULAE:

“Nebulae” is the plural (more than one; for example, “dogs” is the plural of “dog) of the word “nebula”, a word that comes from the Greek word for “cloud.” Some nebulae are the shells of gas thrown off by dying stars: Planetary Nebulae and Supernova Remnants are this type. Other nebulae represent the gas and dust surrounding young stars: Reflection and Emission nebulae are of this type. Yet another type of nebula is seen not by reflecting light, or glowing itself, but by blocking light. This type is called a “Dark Nebula” or an “Absorption Nebula.” The Sky Trekker II Objects list includes only some emission nebulae and some planetary nebulae. All types are briefly described below.

Planetary Nebulae: These are formed when old stars of a size similar to our Sun's have used up most of their hydrogen fuel after burning for billions of years. Their hydrogen gets converted to helium and as the star's gravity and nuclear forces (big explosions in the very center of the star) wobble and war, it throws off shells of gas and expands to become a Red Giant. At the Giant phase, the star does not so much explode as much as it ejects (or throws off) gases at much lower speeds and at different times. As the star continues to evolve (change over time), its central core becomes a very hot White Dwarf, whose high temperature radiation causes the thrown off shells of gas to become “ionized” (a chemistry term) and glow. A very long time after this, those glowing shells can drift away altogether leaving nothing but the very hot, very small (some are Earth-sized—which is TINY for a star) White Dwarf Star.

Supernova Remnants: A Supernova happens when a high-mass star reaches the end of its life and nuclear forces stop in its core. Without the nuclear forces to prop up the star's mass, it all comes collapsing in toward the center where it all then either bounces rapidly back or gets so strongly heated (or both) that it expands rapidly back outward in a violent explosion A shell of glowing gas expands away from the blast, putting out its own light.

Reflection Nebulae: Sometimes, the light of new stars gets reflected off the gas and dust around them so we can see it. This type of nebula is called a “Reflection Nebula”.

Emission Nebulae: Also born from the influence of young stars, an Emission Nebula glows because the heat and radiation energy of young stars excites the atoms (tiny particles of a single element, like hydrogen) in the gas of the nebula, causing the gas to “emit” or put out its own light. Note that, in this case, the gas makes its own light, it doesn't just reflect light back.

Dark/Absorption Nebulae: Dark nebulae are clouds of gas and dust that absorb some light from behind them. This absorbed light heats up the gas and dust particles, causing them to re-radiate or emit some of the absorbed energy as infrared light, which can't be seen with our eyes. What we *do* see, when we *can* see dark nebulae, are dark clouds in front of more distant stars or in front of emission nebulae. Sometimes they look like big

dark holes in an otherwise well-dotted, rich, field of stars—they're the big blank spots, where it looks like there's nothing there. It can sometimes be tough to determine dark nebulae from actual blank spots in space.

Double Stars:

When we look at the the sky through binoculars and telescopes, we often find that what looked like one single star to our naked eyes turns out to be two or more stars. Sometimes these small groups of stars are bound together by gravity; sometimes they're not, they're light-years apart, but only appear close together due to our line of sight. Sometimes these small groups or pairs of stars have different colors or brightnesses, making them interesting objects to observe and study.

Astronomers usually separate double stars into two groups: two stars close enough together to be bound by gravity are called “binaries”; two stars that only look close together are called “optical doubles.”

Binaries: Stars form from nebulae, nebulae tend to be pretty big and it is usually the case that more than one star forms from the same nebula. At least half and possibly many more stars in our galaxy are members of double- or multiple-star systems. Binary stars are two stars that are held together by gravity and orbit each other as if they were tied together by a string.

Astronomers like to study binaries to see how long it takes them to go around each other: some take a couple of days and some take hundreds of years. Often the brightness of binaries will change when one star blocks the light of the other as they orbit. These systems are called “eclipsing binaries.”

While the *definition* of “binaries” refers to just two stars, the *term* “binary” is sometimes used in general to refer to “Multiple Star Systems,” systems of three stars or more.

Optical Doubles: These stars only appear to be together in space, but are actually not bound together by gravity at all. In fact, these stars can be hundreds of light-years apart. Sometimes these pairs appear to have differing brightnesses because one of the stars in the pair is so much farther away that its light is much weaker by the time it reaches Earth.

The Sky Trekker II Objects list contains several double stars. Most star charts use a special symbol to mark binary stars.

Galaxies:

Galaxies are groupings of billions of stars that form starry islands in the great emptiness of space. Our galaxy is the Milky Way; there are MANY others.

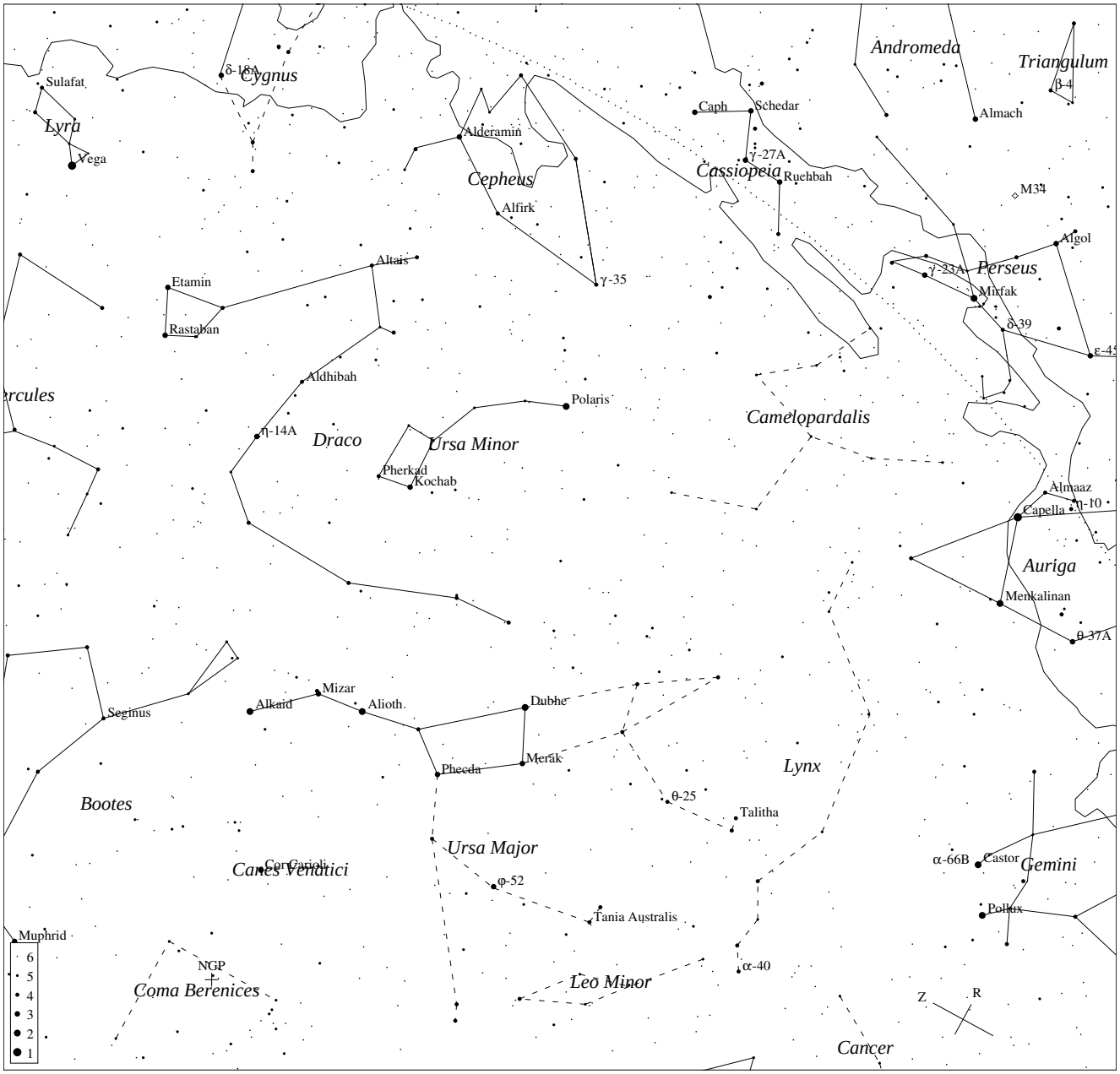
Spiral galaxies have two or more arms encircling a bright center. The “tightness” of the wind of the spiral arms and the character of their flow to the galactic center make for different types of spirals.

Elliptical galaxies are basically plain, spherical systems of stars with a bright center, but they have a wide range of different masses, making for different classes of ellipticals.

There are also Irregular galaxies whose weird, irregular shapes suggest past collisions of galaxies and the disruption of order that follows such events. The Sky Trekker II Objects list contains only a few galaxies and they're difficult to find with small telescopes.

Star Map Practice

To help you practice your constellations/asterisms, three To-6th-Magnitude[4] star maps are provided on the following pages. Each map contains constellations (or asterisms) from the Sky Trekker I & II lists. One map will show the constellations with lines drawn in, and then the next will show the same region of sky without the lines. Can you draw in the lines in without looking back at a star map? Try it!



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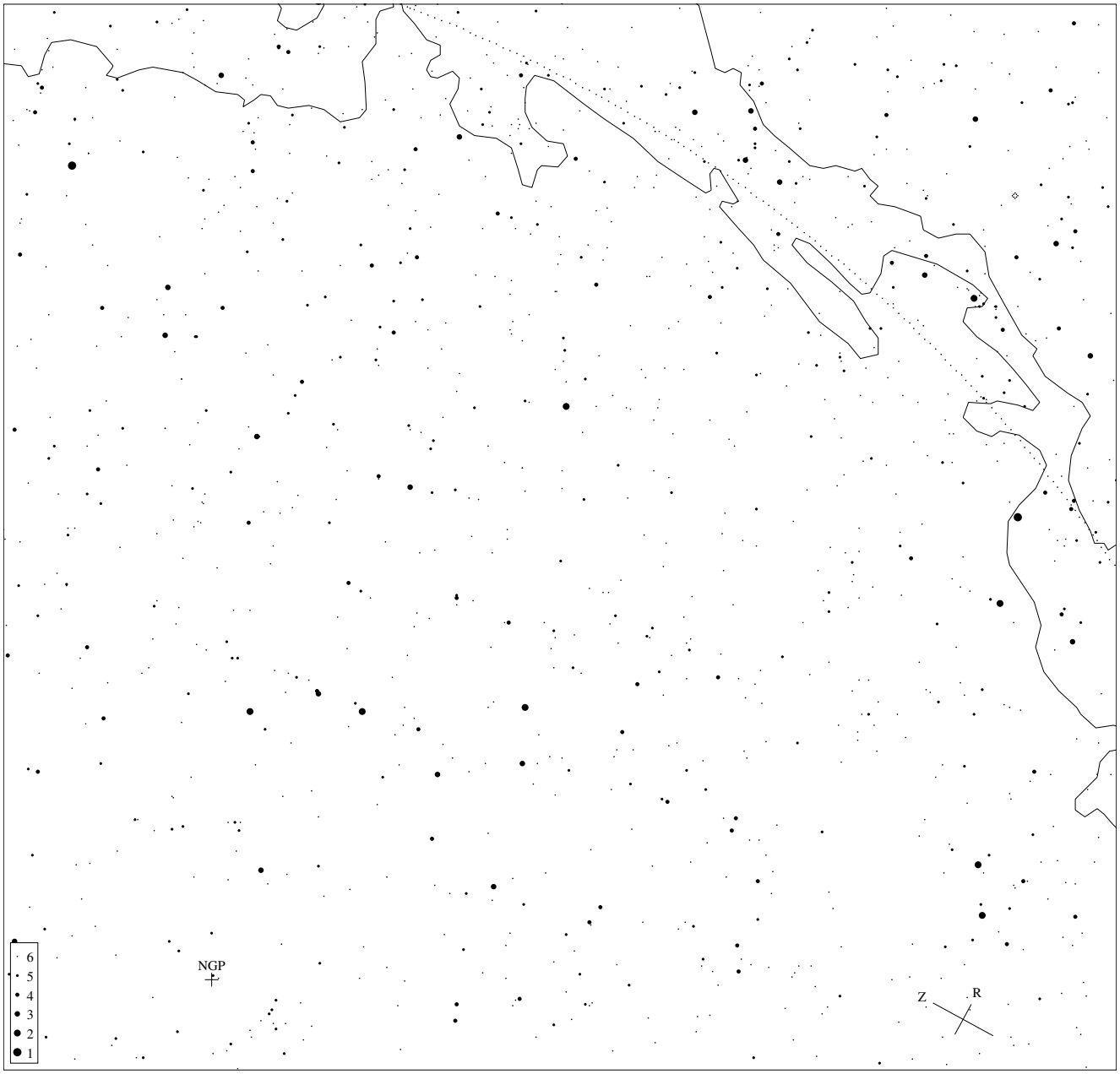

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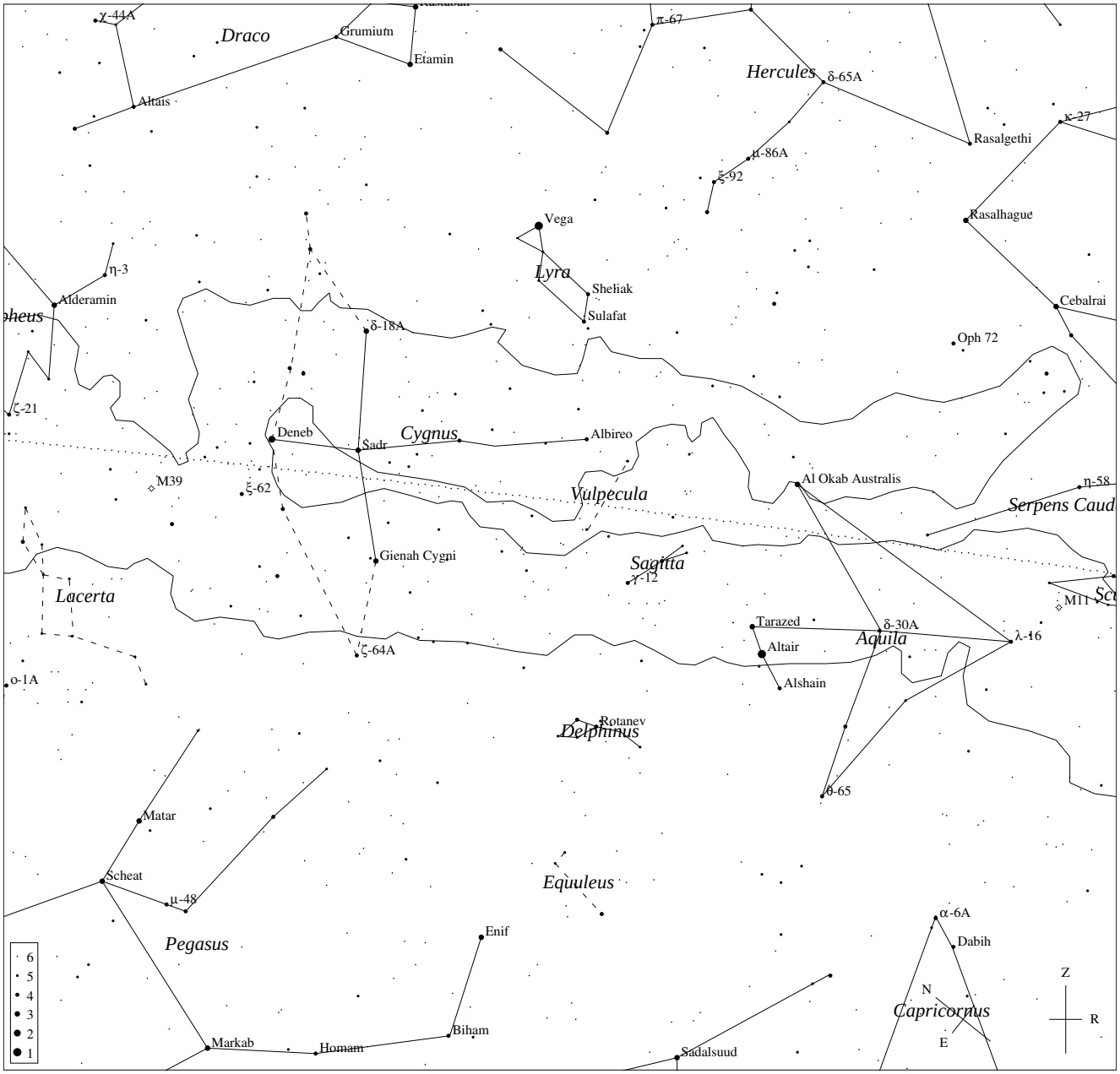

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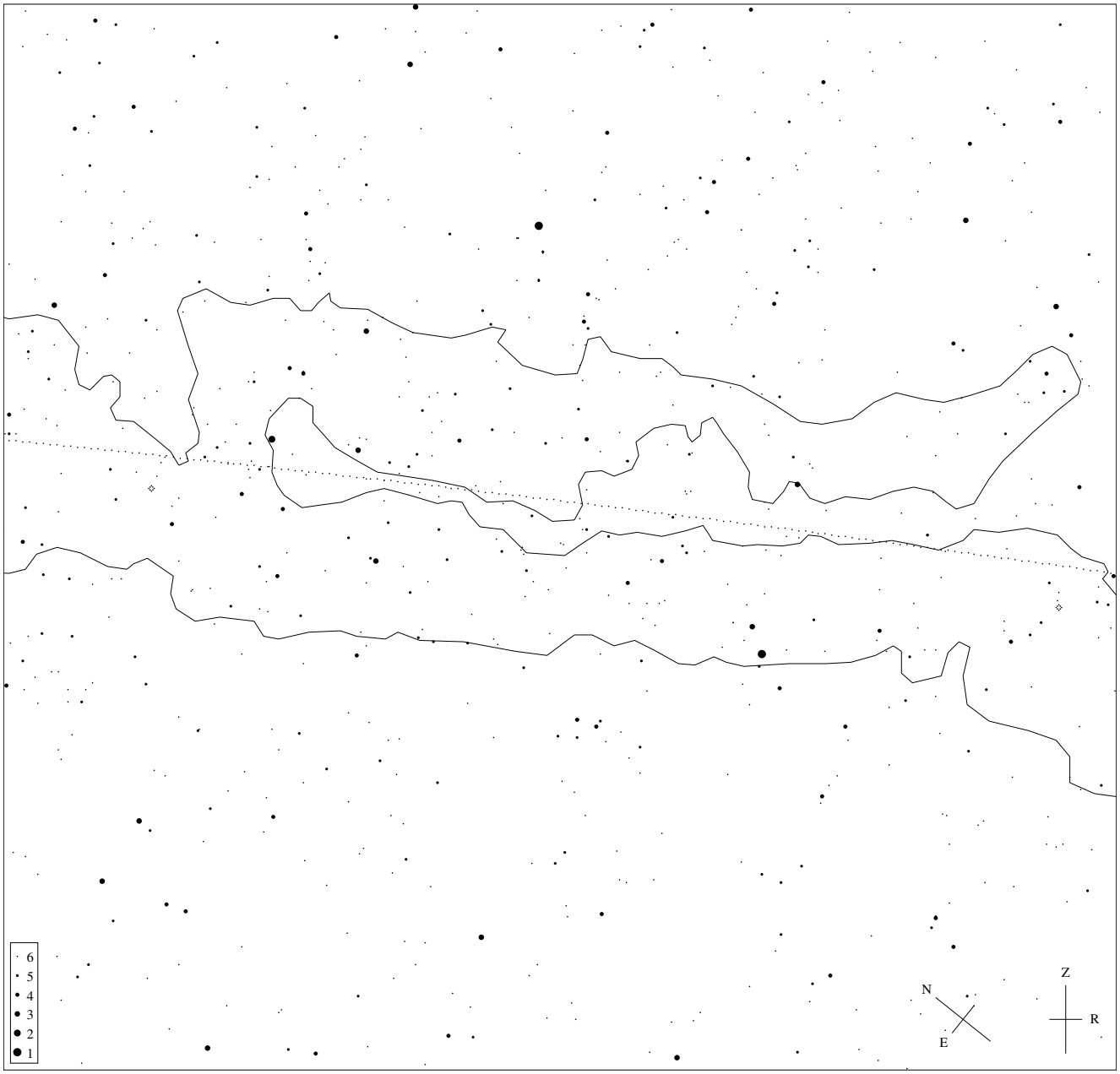

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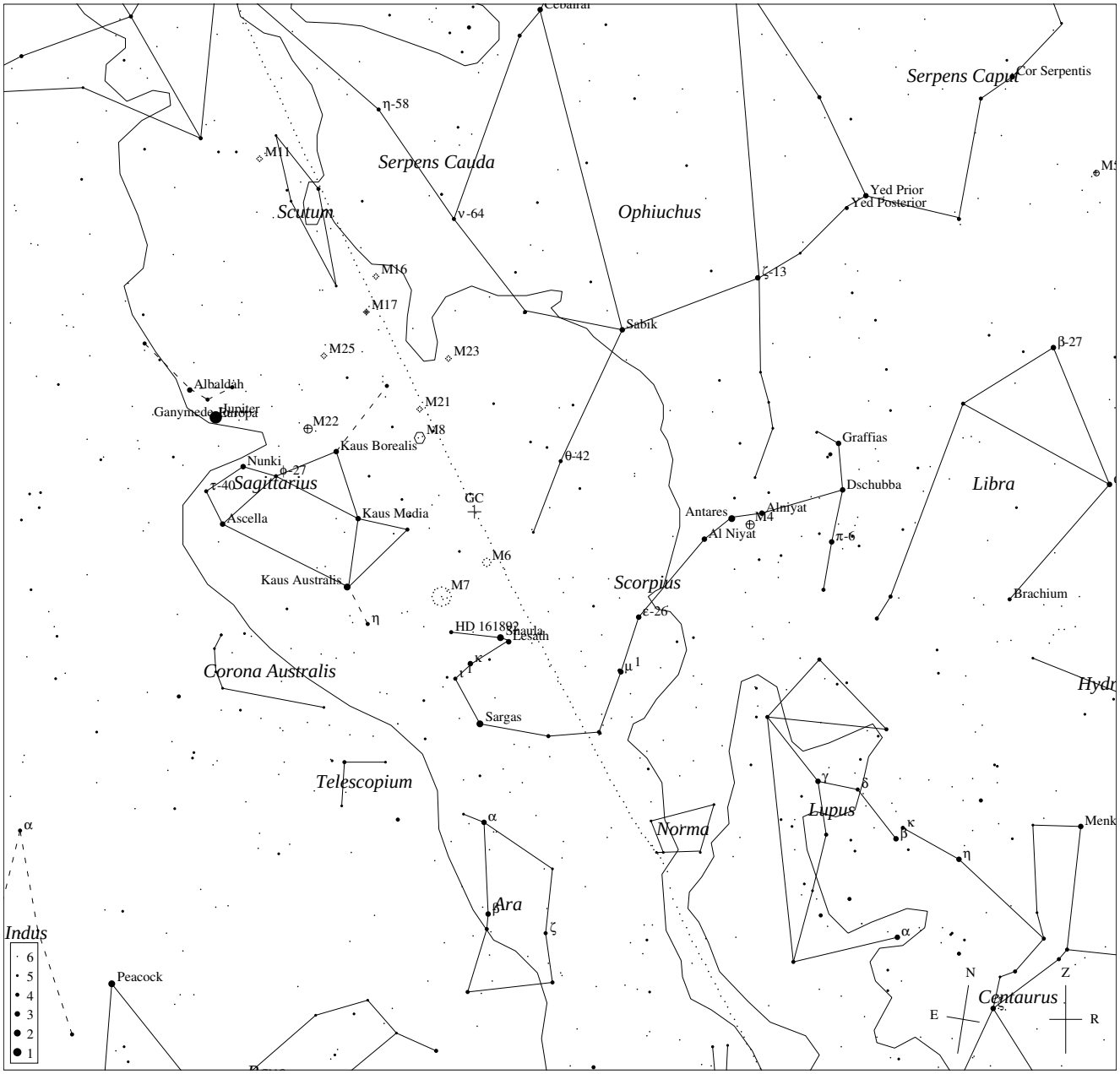

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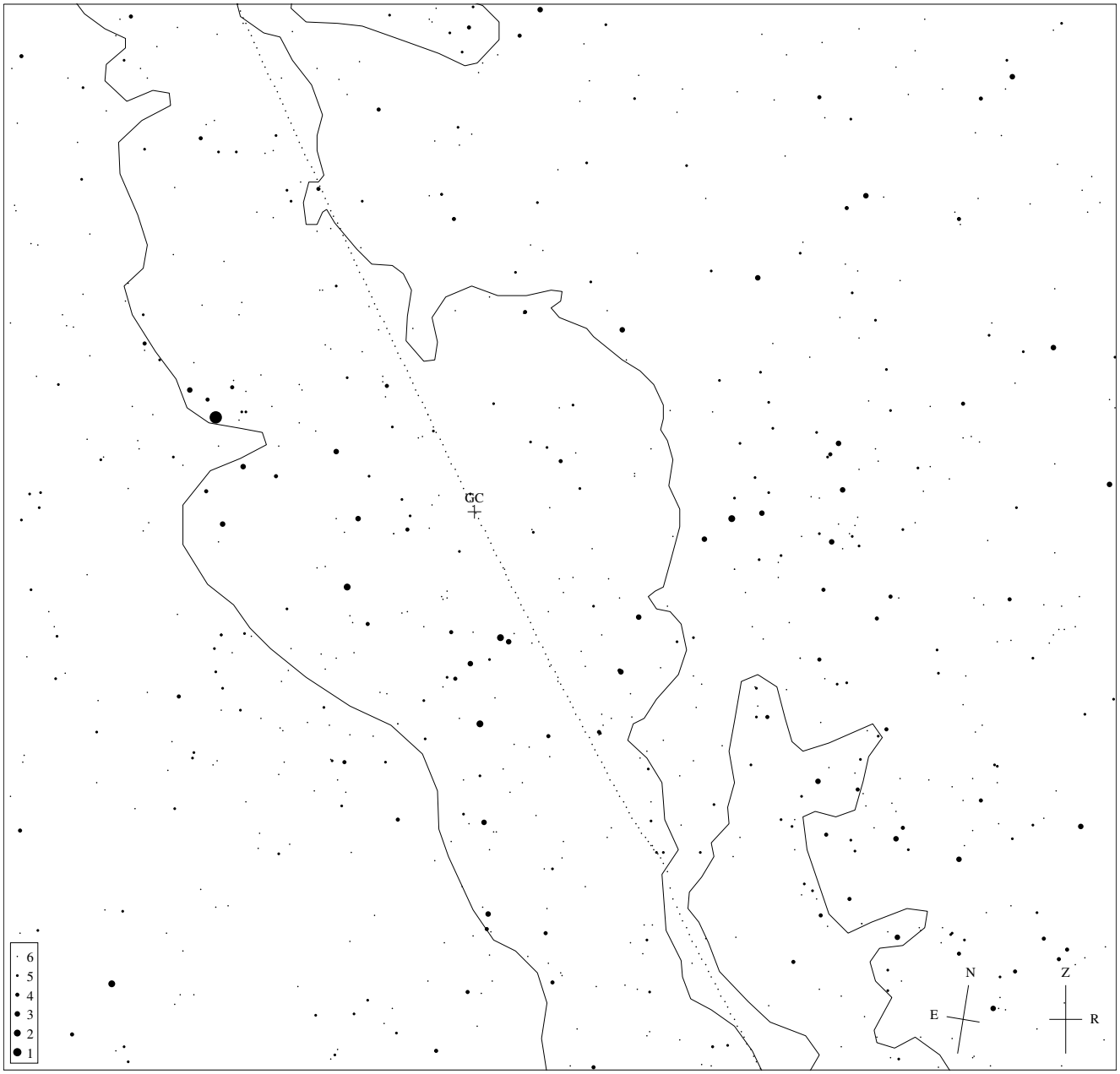

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Sky Trekker I Observer's Program

Sky Trekker I Observer's List:

Constellation/Asterism	Examiner's Signature	Date
Ursa Major (Big Dipper Asterism)		
Ursa Minor (Little Dipper)		
Cassiopeia		
Cygnus		
Sagittarius (Teapot Asterism)		
Scorpius		
Bright Stars	* * * * * * * * * * * * * * * * * *	* * * * * * * * *
Polaris		
Deneb		
Antares		

Sky Trekker II Observer's Program

Sky Trekker II Observer's List:

Constellation/Asterism	Examiner's Signature	Date
Ursa Major (Big Dipper Asterism)		
Ursa Minor (Little Dipper)		
Cassiopeia		
Cygnus		
Sagittarius (Teapot Asterism)		
Scorpius		
Summer Triangle		
Bright Stars	* * * * * * * * * * * * * * * * * *	* * * * * * * * *
Polaris		
Antares		
Deneb		
Vega		
Altair		

Deep Space Objects:

Sky Trekker IIs must find three deep space objects using binoculars or a telescope of choice; sorry, **GOTO scopes are not allowed**. Each object found must be from a different category. For example, you can find one globular cluster, one open cluster and one nebula, or one globular cluster, one galaxy, and one double star, etc., but not two globulars, and one nebula, etc.

Note: To find these objects, you should be famililar with at least some of the following additional constellations: Canes Venatici (near the Big Dipper), Serpens (near Ophiuchus, above Sagittarius), Vulpecula (near Cygnus), Pegasus (east of Cygnus), Andromeda (near Pegasus), Aquila (near Cygnus), Scutum (near Aquila), Lyra (near Cygnus), and Herculeus (near Boötes, which is near the Big Dipper)

Categories:

(See "Addendum" page 15 for explanation of constellation abbreviations and list of Greek letters.)

Globular Clusters: M3 (in CVn), M5 (in Ser, cap), M13 (in Her), M15 (in Peg), M22 (in Sgr)

Open Clusters: M6 (in Sco), M7 (in Sco), M11(in Sct), M23 (in Sgr), M25 (in Sgr), NGC 869 & 884 (Double Cluster in Per), M52 (in Cas)

Double Stars: Albireo (β Cyg), θ Cyg, Alcor&Mizar (ζ UMa), δ Lyr, ϵ Lyr, ζ Lyr, 15 Aql, κ Her

Nebulae: M8 (Lagoon Neb in Sgr), M17 (Swan* Neb in Sgr), M20 (Trifid Neb in Sgr), M27 (Dumbbell Neb in Vul)
*Also known as the Horseshoe, the Omega, or even the Lobster nebula

Galaxies: M31 (in And) , M51(in CVn), M101 (in UMa), Milky Way

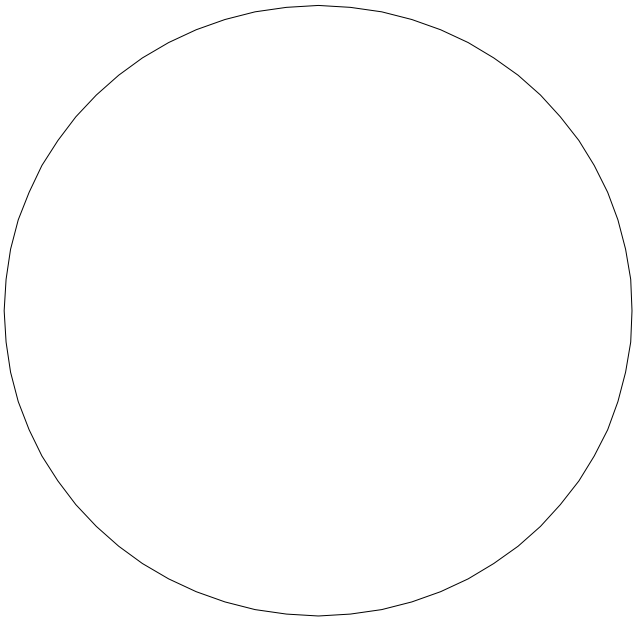
Object Type	Object Found	Examiner's Signature	Date
Globular Cluster			
Open Cluster			
Double Star			
Nebula			
Galaxy			

Solar System Sketch:

Draw one from the following list:

(Circle your selection.)

- Jupiter and as many of its four Galilean moons as can be seen
- Young Moon of August 2, 2008
- Sunspots



Examiner's Signature:_____

Addendum

Footnotes:

1: Light-Year: A light year is a measure of distance, like an inch or a foot, only it's MUCH larger: it's the distance that light can travel in one year: about 5,865,696,000,000 miles per year (read: 5 trillion, 865 billion, 696 million miles/year). That's a long way.

2: Solar Mass: The amount of material (number of atoms) that make up our star, the Sun.

3: Galactic Plane: If you could take a really big piece of paper and stick it through the middle of a galaxy as if you were cutting a bagel, some of the galaxy's stars would be above the paper, and some would be below the paper, but all of the visible stars would be close to the paper, and the paper would be called the "galactic plane." An actual galactic plane isn't made of paper though, it's imaginary.

4. Magnitude: A measure of brightness of stars. The magnitude scale, however, seems more set up to measure dimness: the higher the number given for magnitude, the dimmer the star.

Glossary:

Atoms: Teensy particles that are made of varying numbers of protons, neutrons, and electrons (that is, the subatomic particles, all even teensier particles). The variation in the numbers of the subatomic particles make for the different, naturally occurring chemical elements.

Hydrogen: The most abundant gaseous element ("element" as in naturally occurring chemical element found on a chemistry class Table of the Elements) in the universe.

Helium: The number 2 gaseous element in the universe. It is created in stars when two Hydrogen atoms fuse together in the intense heat and pressure at the core of a star.

Light Speed: The speed of light is about 186,000 miles per second.

The Greek Alphabet:

α Alpha	ν Nu
β Beta	ξ Xi
γ Gamma	ο Omicron
δ Delta	π Pi
ϵ Epsilon	ρ Rho
ζ Zeta	σ Sigma
η Eta	τ Tau
θ Theta	υ Upsilon
ι Iota	ϕ Phi
κ Kappa	χ Chi
λ Lambda	ψ Psi
μ Mu	ω Omega

Some Summer Constellation Abbreviations:

Andromeda: And	Cepheus:Cep	Libra: Lib	Serpens: Ser (Ser cap = S. caput)
Aries: Ari	Corona Borealis: CBr	Lyra: Lyr	Ursa Major: UMa
Aquarius: Aqr	Corvus: Cor	Ophiuchus: Oph	Ursa Minor: UMi
Aquila: Aql	Cygnus: Cyg	Pegasus: Peg	Virgo: Vir
Boötes: Boo	Draco: Dra	Perseus: Per	Vulpecula: Vul
Cassiopeia: Cas	Delphinus: Del	Sagittarius: Sgr	
Canes Venatici: CVn	Hercules: Her	Scorpius: Sco	
Capricornus: Cap	Leo: Leo	Scutum: Sct	

ACKNOWLEDGEMENTS

BOOKLET AUTHOR: Lisa M. Wieland, Wabash Valley Astronomical Society

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A HUGE thank you goes to my husband, Jeff (WVAS): without his expertise (and patience) with computers, this booklet, the badge pins, and the certificates would not exist! Thanks goes also to my daughter, Deedee, who created the prototype logo that Mr. Arvin used to make the final version.

Sky Trekker Logo by Scott Arvin, Graphic Artist.

—LMW