Summer Project'25

Astral Trails

SESSION 3

CONSTELLATIONS

Constellations

Constellations are recognizable star patterns named and cataloged by astronomers. These patterns resulted from lines of sight with stars at varying distances. Constellations aid navigation in the night sky, providing a convenient reference for locating celestial objects.

What are some examples of constellations?

Orion

The Orion constellation is renowned for its trio of aligned stars that resemble a belt, distinguishing it as a prominent feature on winter nights.

Andromeda

Andromeda constellation is characterized by a unique "V" shape created by its brightest stars. Its name is derived from the Greek mythology princess, Andromeda.

Ursa Major

Ursa Major, also known as the Great Bear, is an easily identifiable constellation located in the northern hemisphere. Its moniker is derived from a bear, with the Big Dipper forming the bear's hindquarters and tail.

Ursa Minor

Ursa Minor, also known as the Little Bear, is a constellation in the northern celestial hemisphere. One of the most recognizable features of Ursa Minor is the North Star, or Polaris, which is located very close to the north celestial pole.

CYGNUS

Cygnus, a summer constellation, becomes more conspicuous during the warmer months in the northern hemisphere.

Centaurus

Centaurus is notable for its resemblance to a centaur—a mythical creature with the upper body of a human and the lower body of a horse.

Scorpius

Scorpius, the Scorpion, is a prominent zodiacal constellation visible in the southern hemisphere and some parts of the northern hemisphere during summer. It is renowned for its characteristic shape, resembling a scorpion with a curved tail and stinger.

Pegasus

Pegasus, the Winged Horse, is recognized for its distinct pattern, forming a large square often referred to as the "Great Square of Pegasus." This square serves as a helpful guide for locating other celestial objects.

EARTH'S ROTATION

The Earth rotates on its axis once every 24 hours, which is why our day/night cycle is 24 hours long. Earth's rotation impacts how we view constellations.

DIURNAL MOTION

As the Earth rotates, your position on Earth changes relative to the stars. This phenomenon, known as **diurnal motion**, makes it appear as though the constellations move across the sky throughout the night, just like the Sun 'moves' from East to West each day.

THE VIEW FROM EARTH

12:00 AM

6:00 PM

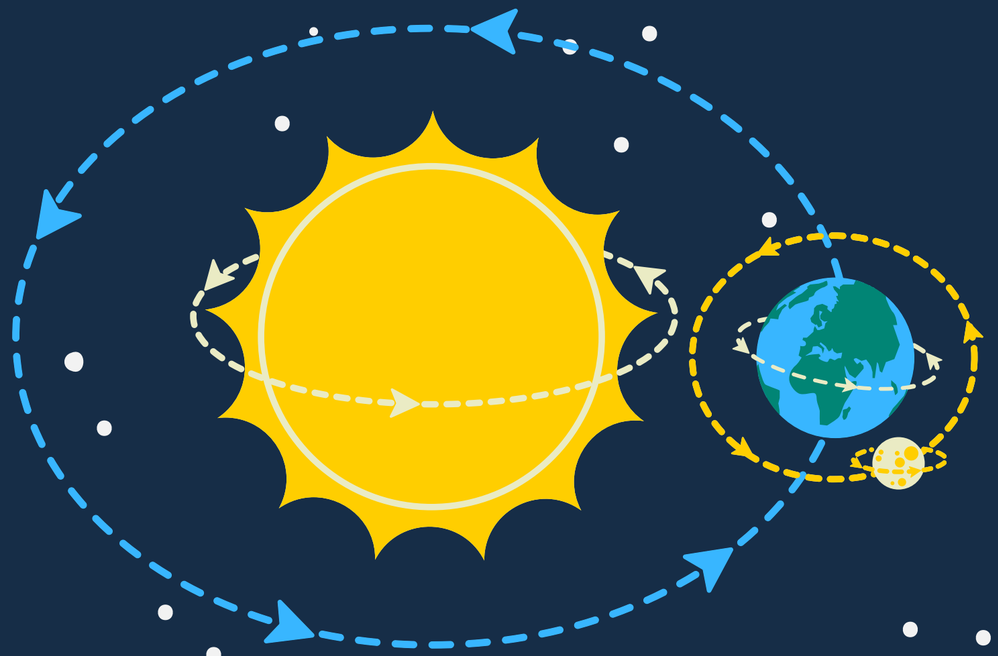
6:00 AM

E

W

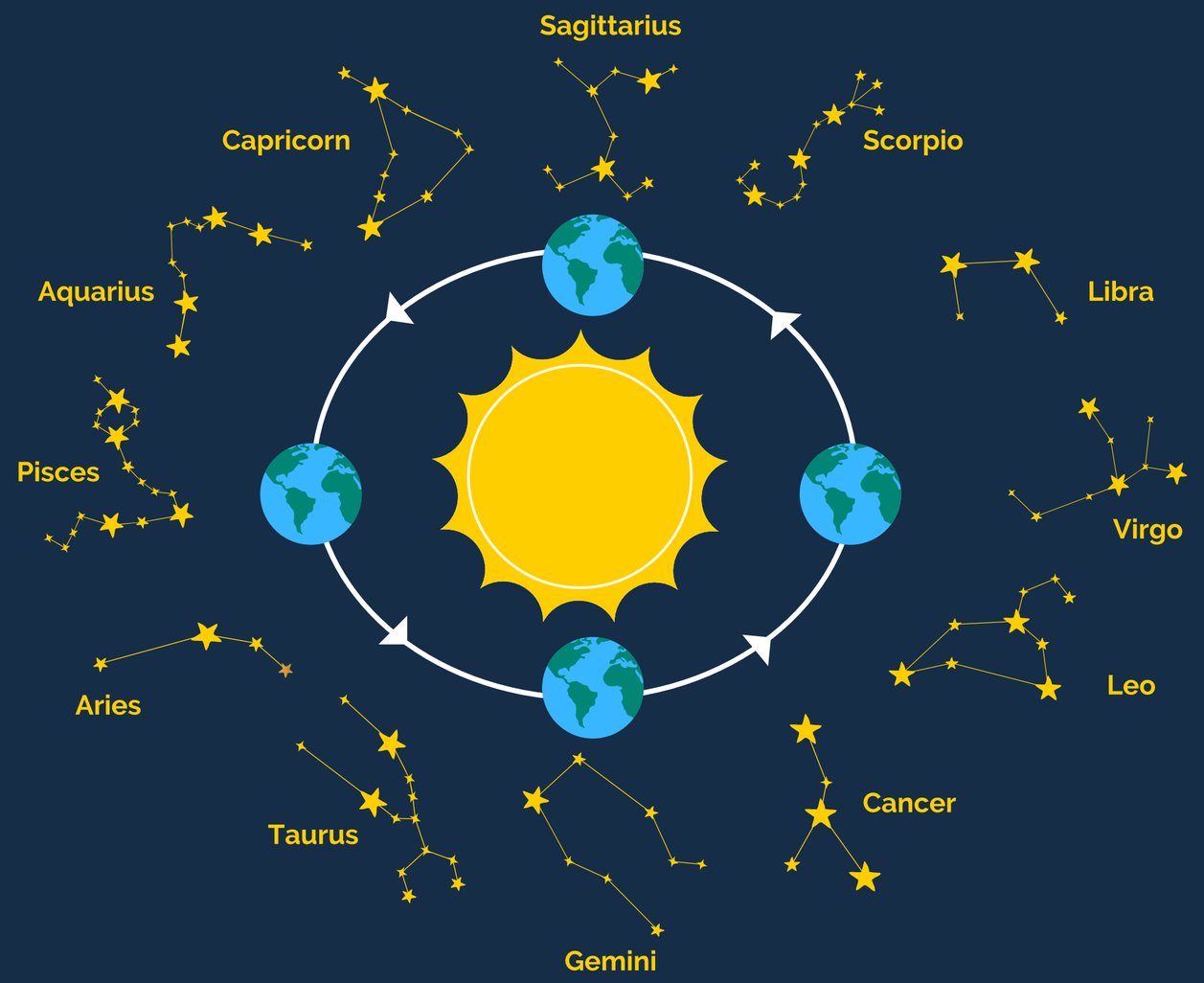
EARTH'S ORBIT

Just as the Moon orbits the Earth, the Earth orbits the Sun. It takes the Earth around 365 days to orbit the Sun, which is why our calendar year is 365 days long. Earth's orbit also affects how we view constellations.



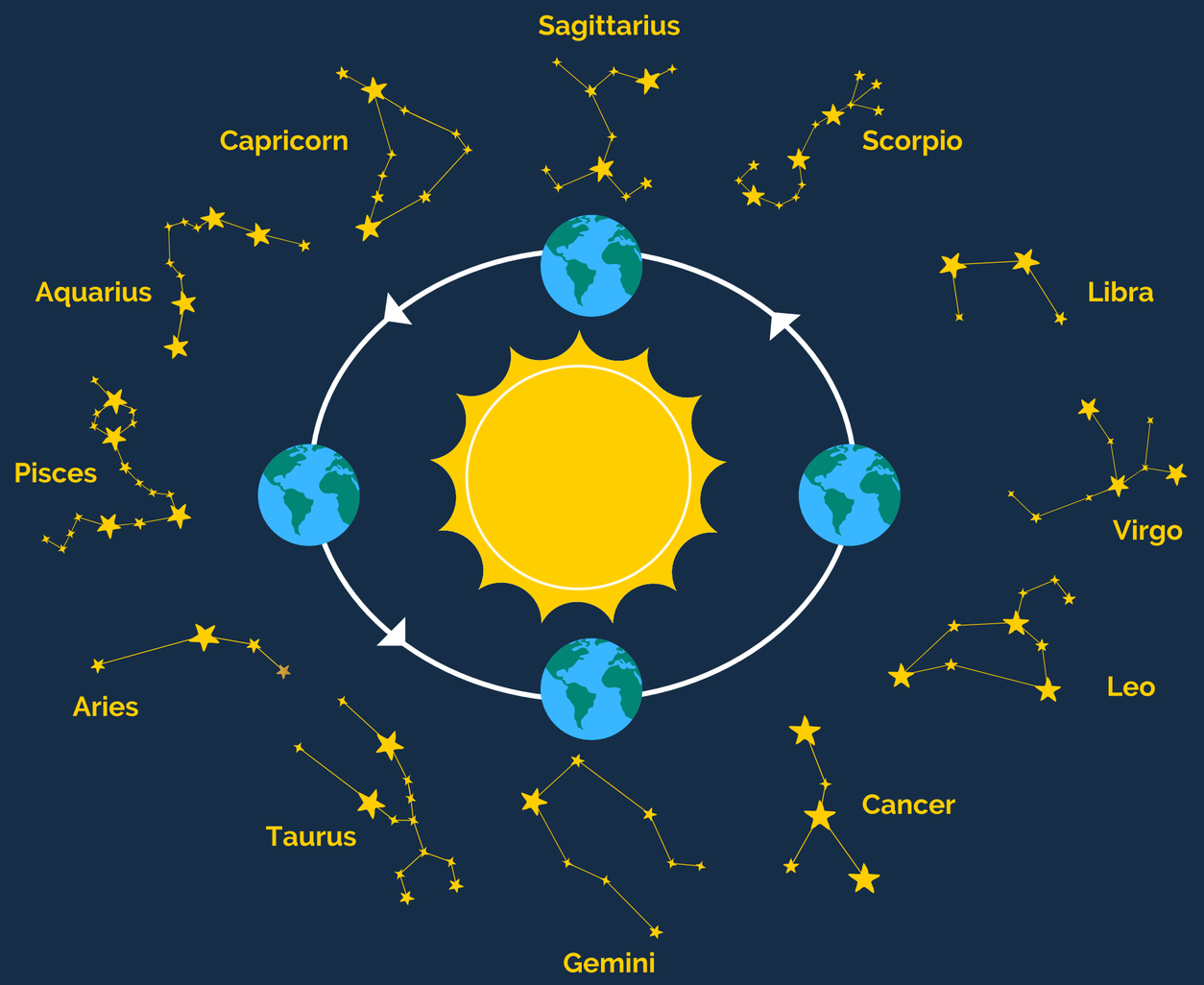
ANNUAL MOTION

Throughout the year, constellations gradually shift West due to Earth's revolution around the Sun. This is called **annual motion**. Since the Earth faces a different direction each season, some constellations are only visible during certain times of the year.



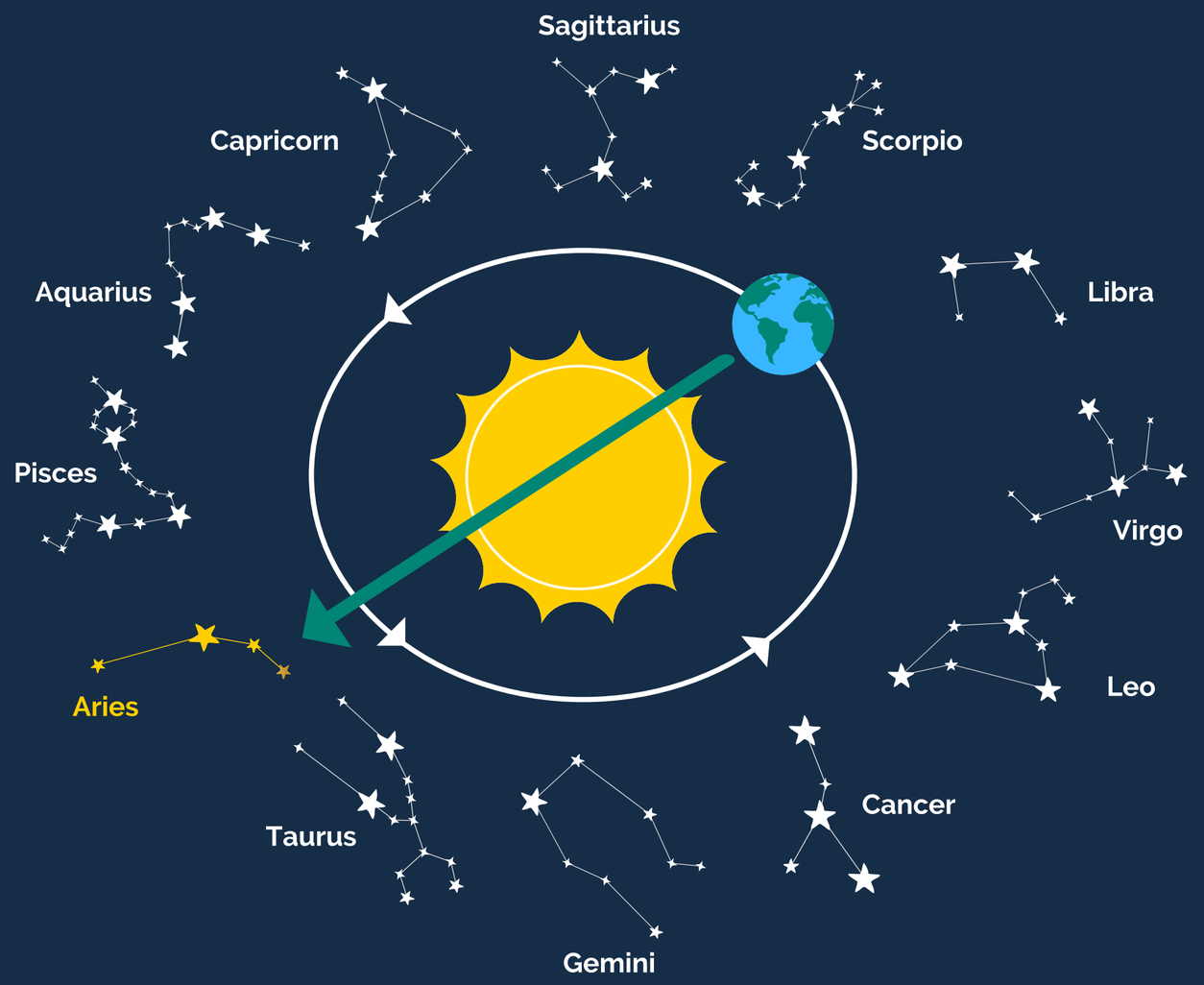
THE ZODIAC

One set of constellations visible along Earth's elliptical orbit belongs to the **zodiac**. These constellations are the foundation for zodiac signs and astrology.



THE ZODIAC

The months that correspond to each zodiac are based on the Sun's position relative to the zodiac constellations. For instance, the Sun faces the constellation Aries in April, so people born in (most of) April are of the Aries astrological sign.



CHECK FOR UNDERSTANDING #1

What will be the approximate position of the constellation in five hours?

A

B

C

1:00 AM

D

EAST

WEST

CHECK FOR UNDERSTANDING #1

The constellation will be in position D (approximately) after five hours because constellations appear to move from East to West in a 24 hour cycle.

1:00 AM

D

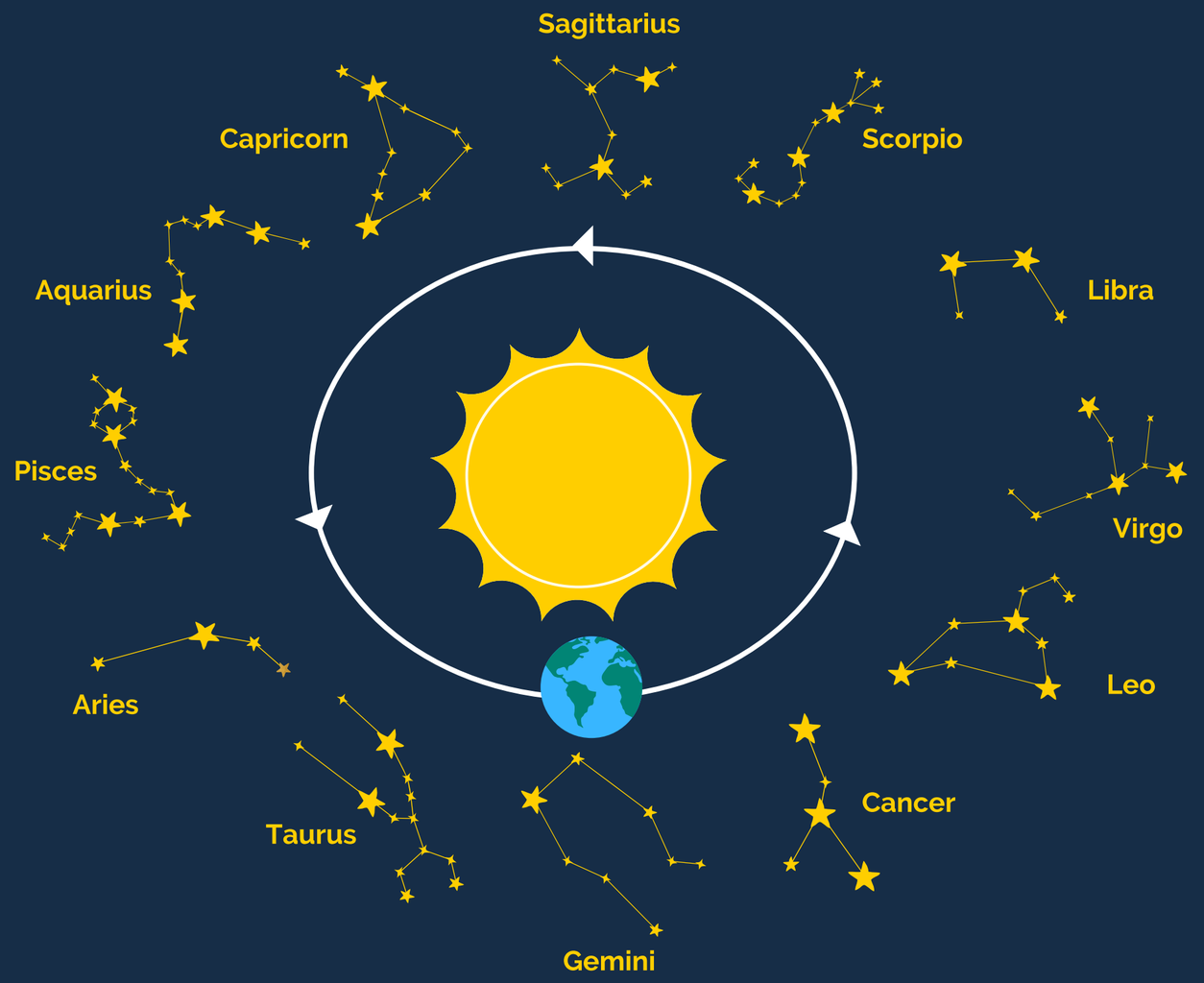
6:00 AM

EAST

WEST

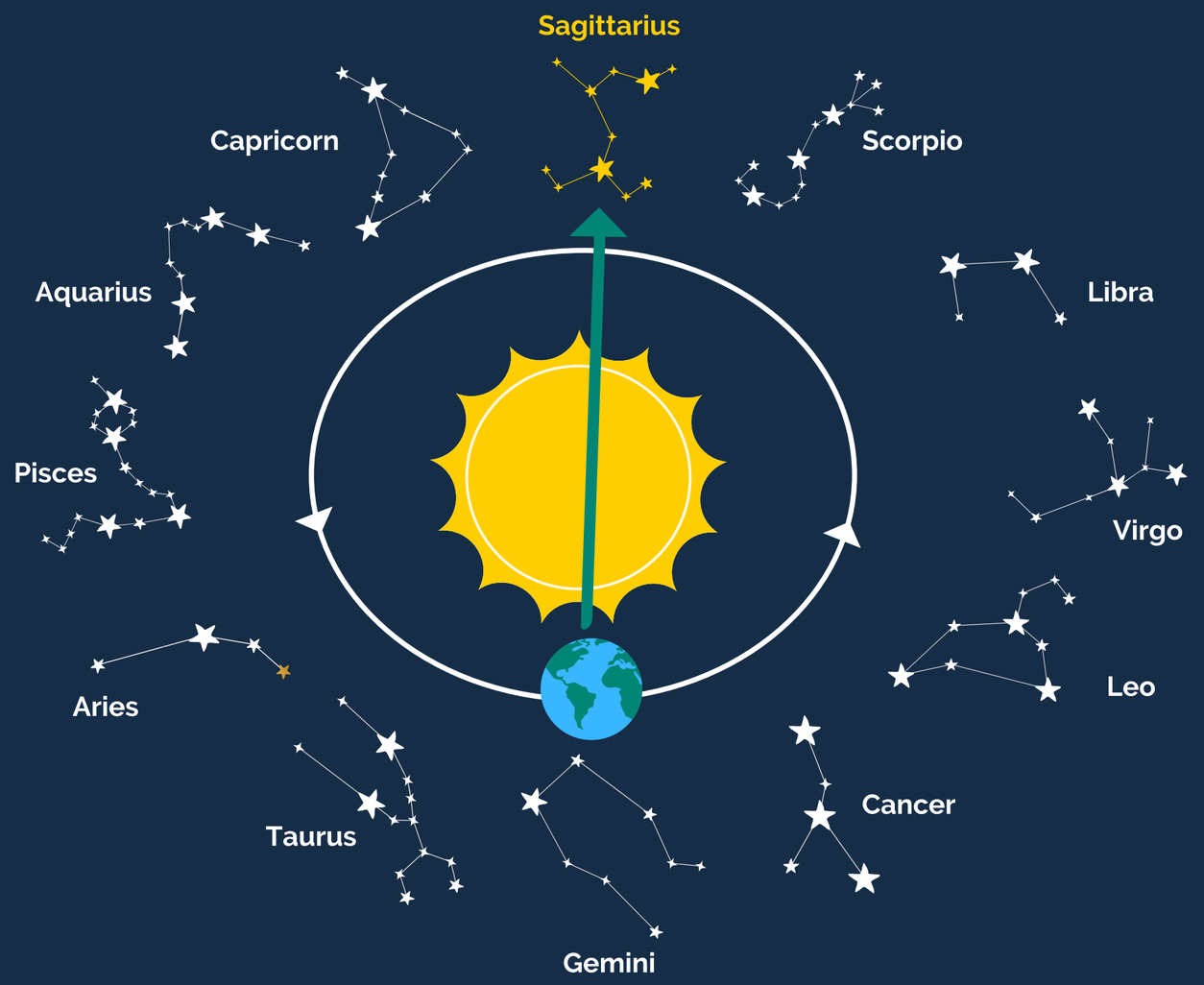
CHECK FOR UNDERSTANDING #2

Which zodiac constellation is the sun 'in' on the diagram to the right and, given that the Sun is in Aries for most of April, what month is it on Earth?



CHECK FOR UNDERSTANDING #2

The Sun is facing Sagittarius in the diagram and it is most likely December, but it could also be November.



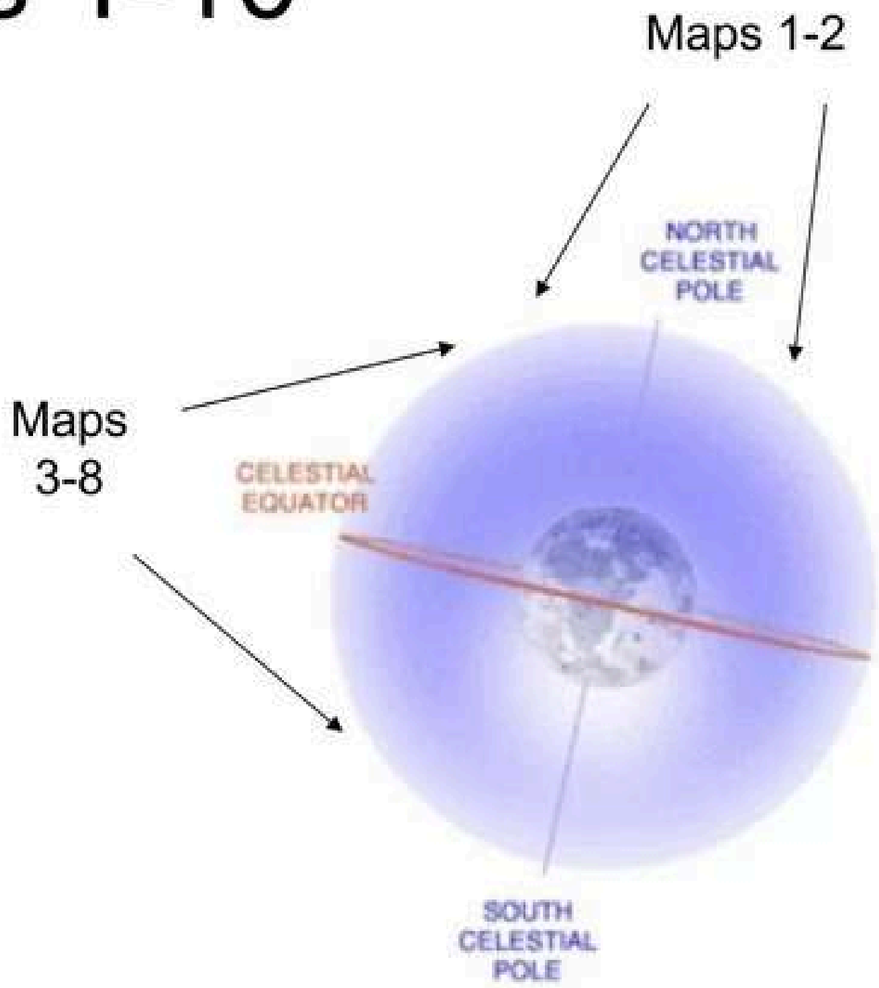
Introduction to the Celestial Sphere

Bright Star Atlas 2000

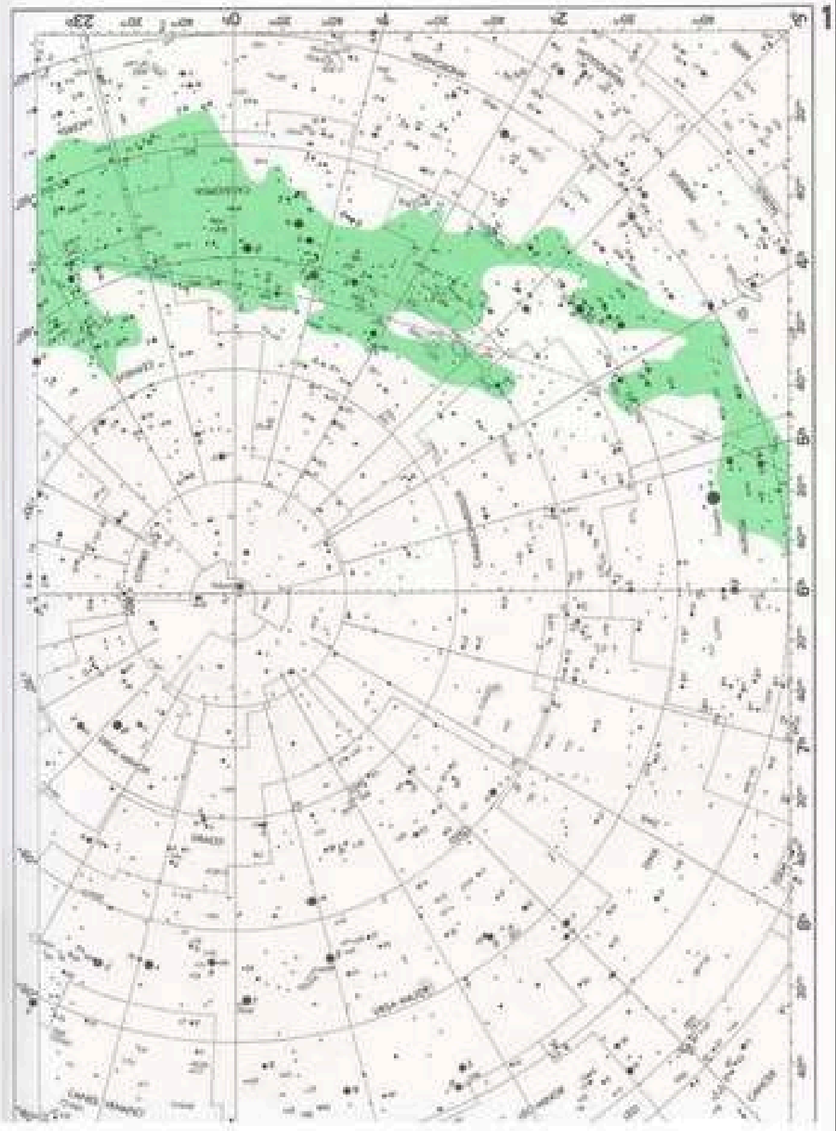
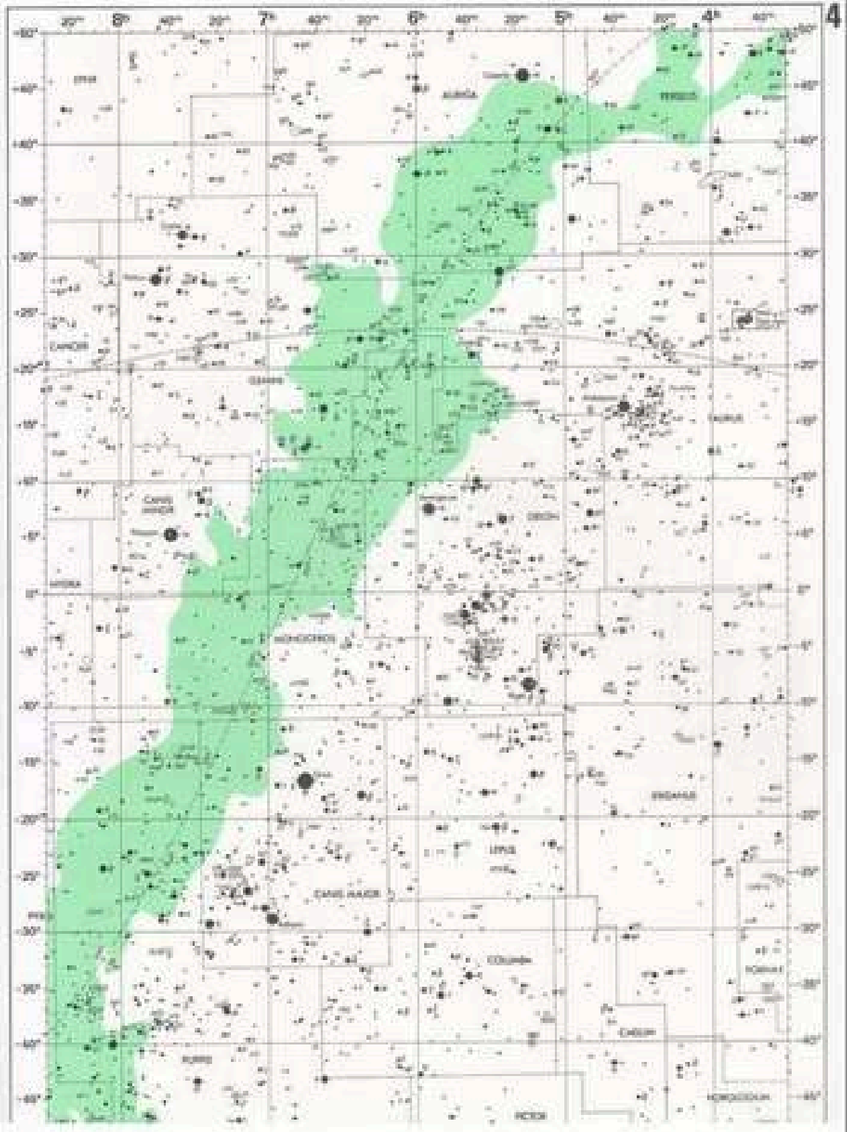
(Tirion) Maps

Maps 1-10

- Maps 1-2: North Celestial Pole
- Maps 3-8: Celestial Equator
- Maps 9-10: South Celestial Pole



http://upload.wikimedia.org/wikipedia/en/thumb/9/9b/Celestial_Sphere.gif/200px-Celestial_Sphere.gif

Map 1 (Polar)	Map 4 (Equatorial)
	

Stars

- Maps contain all stars visible to the naked eye (magnitude 6.0)
- Magnitude scale: -1 through 6 on maps
- Smaller number = Brighter star
- Stars represented as dots of differing size

Types of Stars (Map Key)

- Single Stars: Single dots
- Double Stars: Represented as dot with line drawn through
- Variable Stars: Represented as dot with rings indicating change in brightness (magnitude). Open dots mean star becomes too dim to be plotted (below Mag 6)
- Novas: Temporary stars, labeled “N” and year of appearance

Star Names

- Arabic, Greek, Latin etc. For example: Betelgeuse in constellation Orion. Name is from Arabic language
- Greek Letter Nomenclature: Brightest stars are also labeled with Greek letters
- Bayer labeled stars in a constellation in order of Greek alphabet with “alpha” usually reserved for the brightest star in the constellation

Using Bayer Names (Possessives)

- For example: Betelgeuse in Orion is labeled with a "α", Greek letter "Alpha"
- Bayer name for star would be Alpha Orionis
- Change "Orion" to possessive form "Orionis" (consult constellatio list for possessives)
- Betelgeuse is the Arabic name

Celestial Objects (Deep Sky)

Galactic (inside the galaxy)

- Stars
- Open Clusters
- Globular Clusters (Orbit about center of galaxy)
- Diffuse Nebulas
- Planetary Nebulas

Extra Galactic (outside the galaxy)

- Galaxies

Telescope Objects

- Objects plotted on maps are good for telescope viewing
- These maps were designed with this in mind, they are to be used outside with a telescope

Open Clusters

- Loosely packed groups of dozens to hundreds of stars
- Close to the plane of the Milky Way
- Represented on maps as dotted circles
- Famous example, the Pleiades-Map 4
- Color yellow on maps

M45--Pleiades

http://antwrp.gsfc.nasa.gov/apod/image/0212/pleiades_aao_big.jpg

Globular Clusters

- Tightly packed groups of hundreds to thousands of stars
- Generally found in sky away from the Milky Way
- Represented on maps as circles with plus signs in center
- Famous example, M13 in Hercules-Map 7
- Color yellow on maps

M13—Hercules Cluster (Notre Dame QuarkNet)

Diffuse Nebulas

- Glowing clouds of gas and dust
- Close to the plane of the Milky Way
- Represented as shapeless blobs or small squares
- Famous example, Orion Nebula-Map 4
- Color green on maps

M42—Orion Nebula

http://www.astroarts.jp/alacarte/messier/images/shimizu/m42.jpg

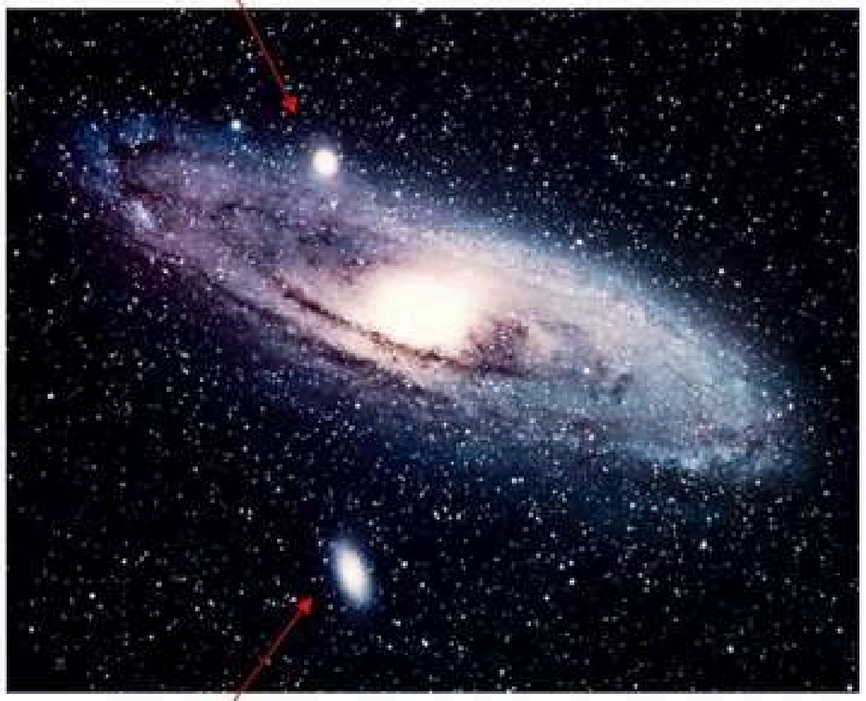
Planetary Nebulas

- Glowing clouds of gas ejected from dying stars
- Found anywhere in the sky, most rare object
- Represented as circles with radiating lines
- Famous example, M57 the Ring Nebula
- Color green on maps

M57—Ring Nebula (Notre Dame QuarkNet)

Galaxies

- Separate “island universes” like our Milky Way, composed of hundreds of billions of stars
- Found anywhere in the sky, but tend to be obscured by the Milky Way (Great concentration of galaxies in constellation Virgo, represents actual supercluster of galaxies-Map 6; large galaxy in the constellation Andromeda-Map 3)
- Represented as various sized ovals
- Color red on maps

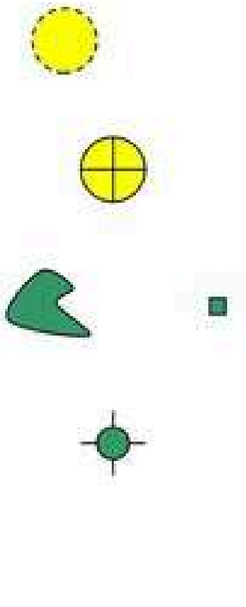


M31—Andromeda Galaxy

http://antwrp.gsfc.nasa.gov/apod/image/m31_oregon_big.gif

Celestial Objects

- Open Cluster
- Globular Cluster
- Diffuse Nebula
- Planetary Nebula
- Galaxy



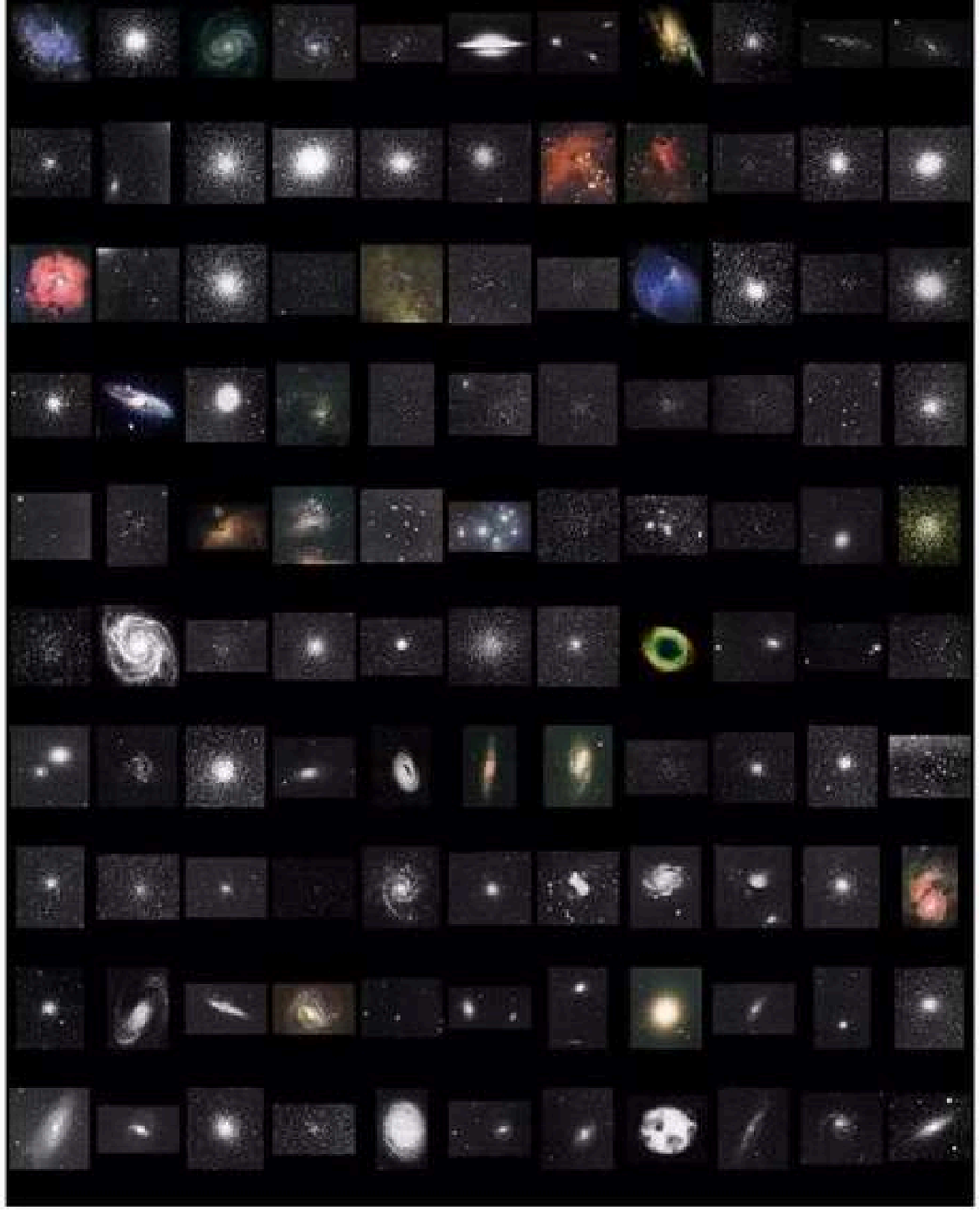
Celestial Object Names

- Messier or NGC numbers.
- Messier numbers from catalog of 110 objects compiled by astronomer Messier, considered skies “greatest hits”
- *Example: Nebula M78 in Orion (numbers preceded by an “M”)*

NGC numbers

- NGC (New General Catalog) numbers (just plain numbers) from a catalog of thousands of celestial objects compiled by astronomer Dreyer
- *Example: Open Cluster labeled 2301 in Monoceros. This object would be named NGC 2301 in the New General Catalog*

The Messier Objects

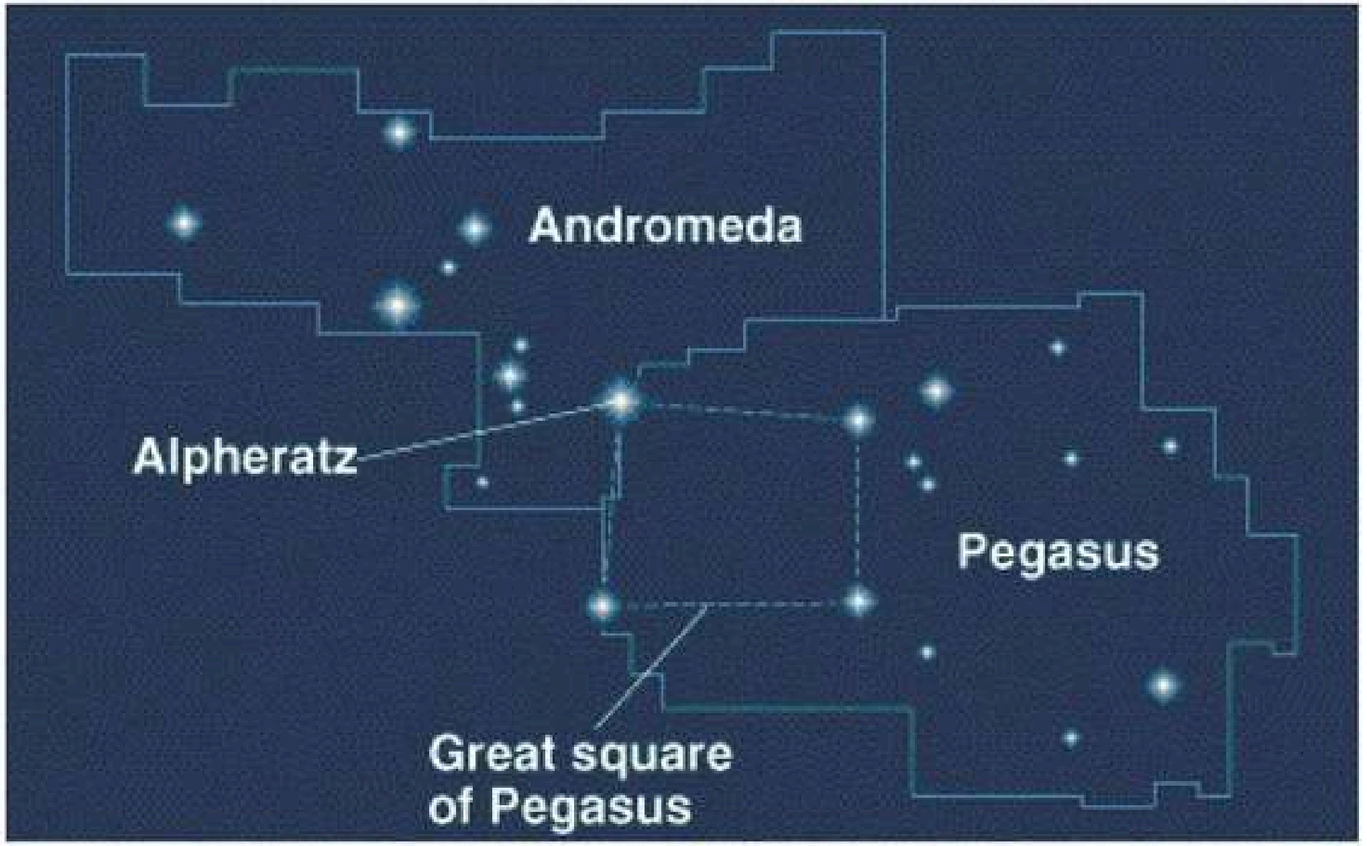


http://seds.lpl.arizona.edu/Messier/Pics/M/110Ms.jpg

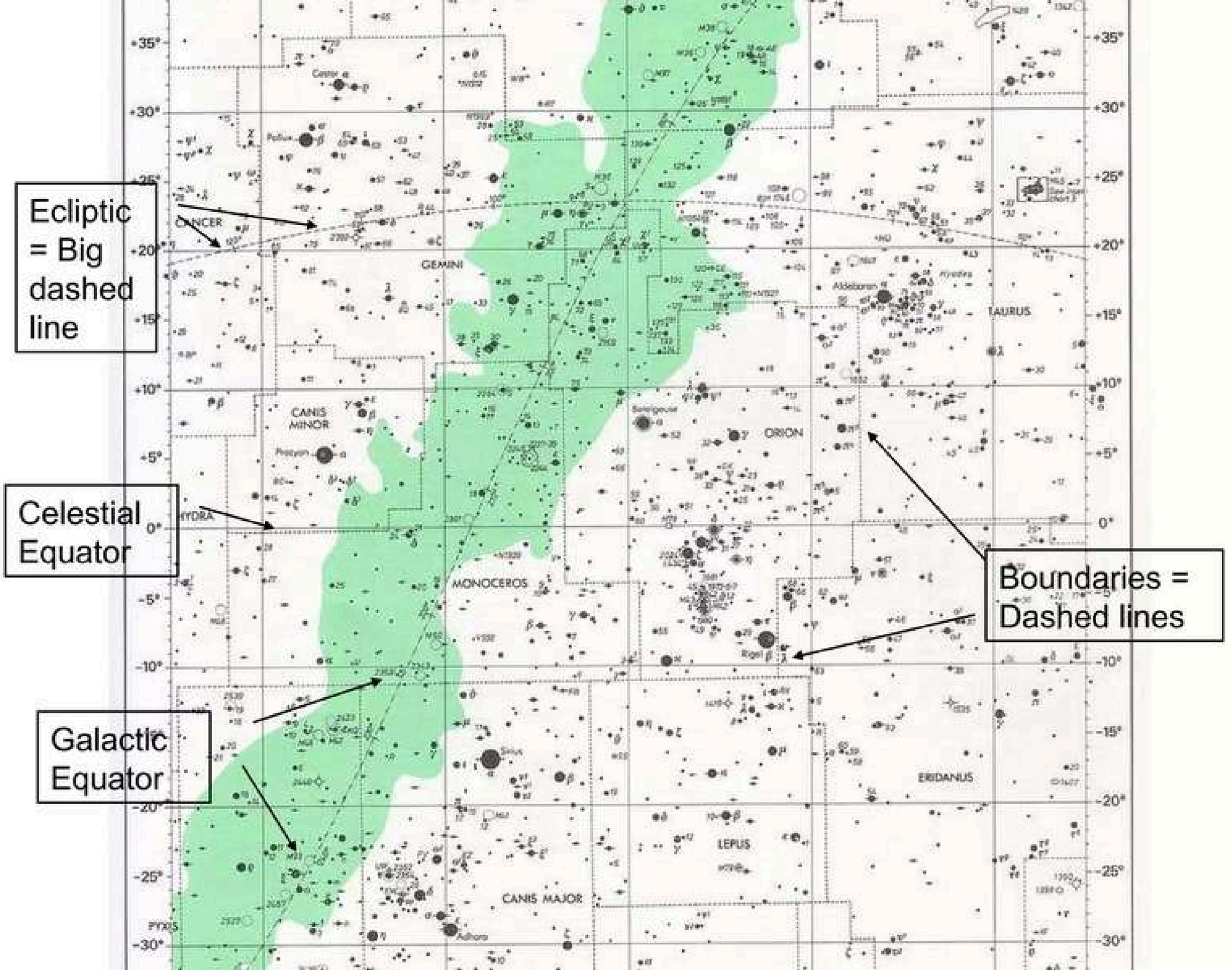
Boundaries

- Constellation Boundaries: Dashed line. Indicates areas of constellations.
- Ecliptic: Big dashed line. Indicates location of sun, moon, and planets throughout year. Also called "zodiac”
- Galactic Equator: Dash-dot-dash line that marks the middle of the Milky Way
- Milky Way: Wavy lines, drawn in by hand.
- Color light blue on maps.

Constellation Boundaries



http://montgomerycollege.edu/Departments/planet/AstroLink2.0_html/The_Sky/media/S02_03b.gif

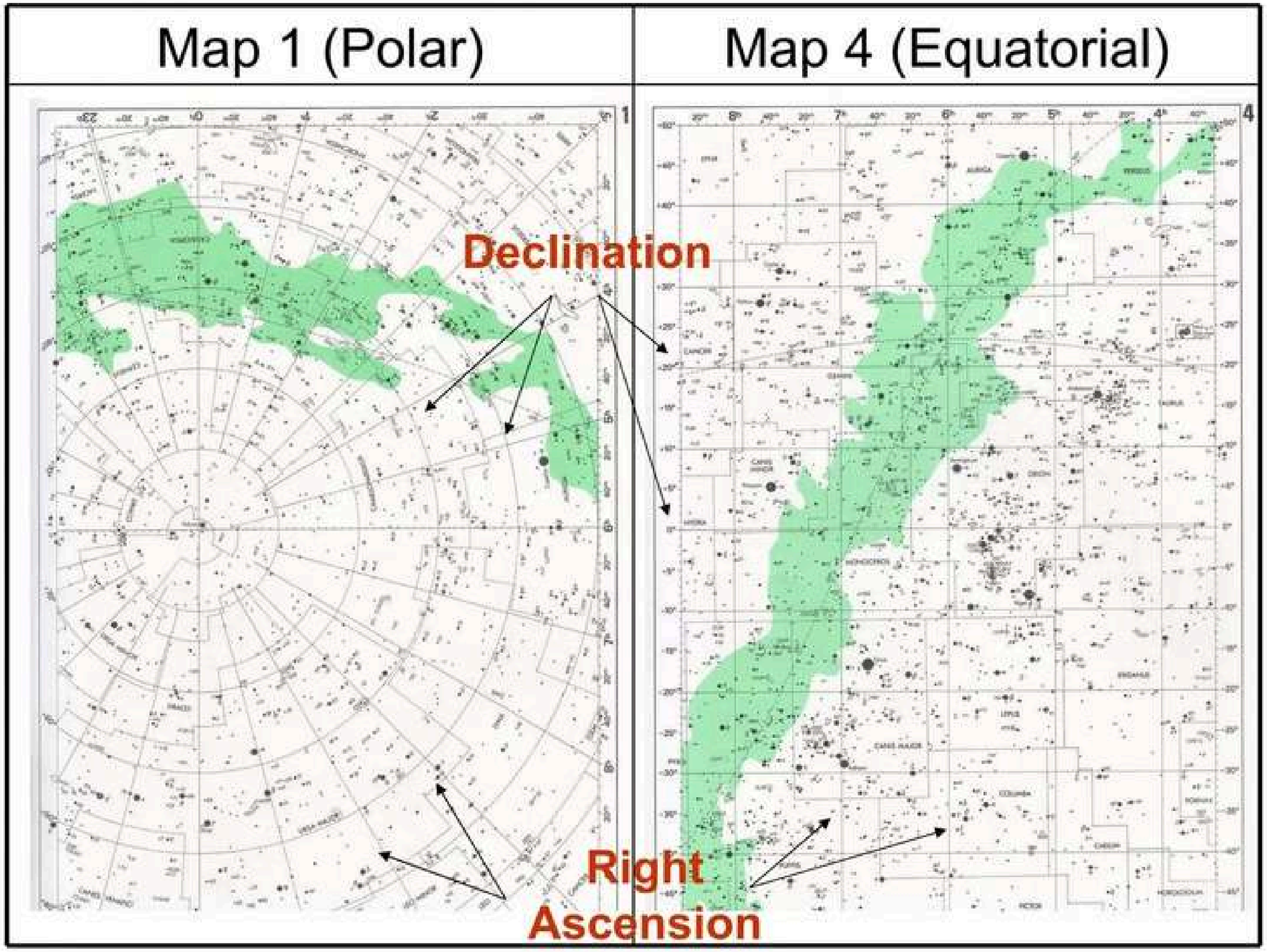

Ecliptic = Big dashed line
Celestial Equator
Galactic Equator
Boundaries = Dashed lines
GEMINI
CANCER
TAURUS
CANIS MINOR
ORION
MONOCEROS
HYDRA
CANIS MAJOR
LEPUS
ERIDANUS
PYXIS
Castor
Pollux
Procyon
Aldebaran
Rigel
Sirius
Adhara
+35°
+30°
+25°
+20°
+15°
+10°
+5°
0°
-5°
-10°
-15°
-20°
-25°
-30°

Right Ascension

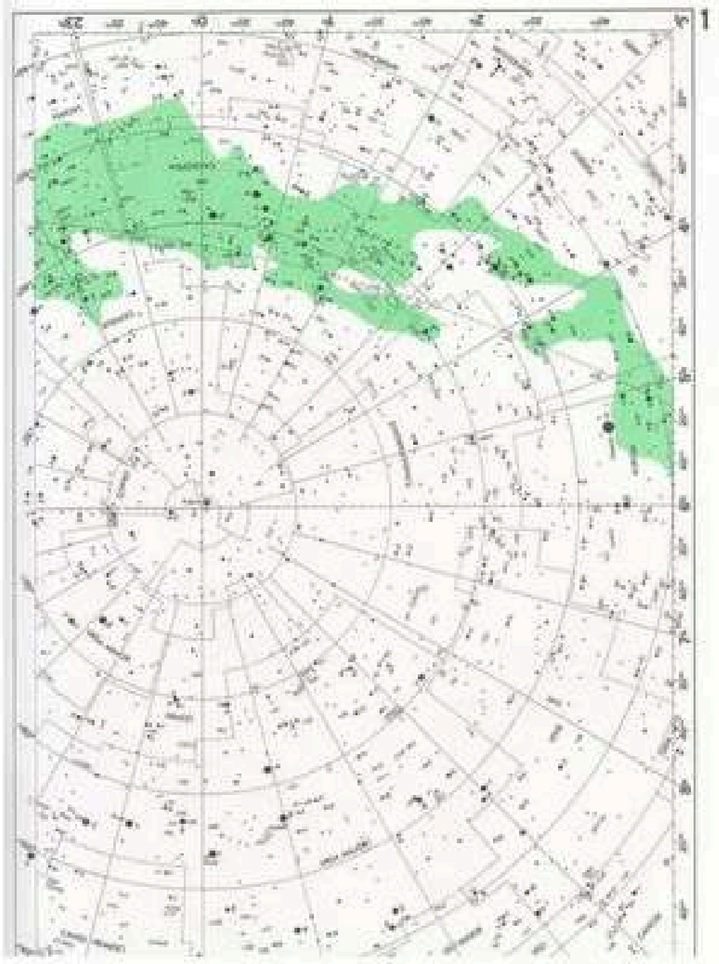
- Celestial coordinate, uses hours and minutes, 0-24 hours
- Analogous to earth's longitude
- Zero point is the vernal equinox (just like Greenwich meridian)
- Maps 1-2, 9-10: Radiating Lines; Maps 3-8: Vertical lines

Declination

- Celestial coordinate, uses degrees and minutes
- Positive degrees above the celestial equator (0°), negative degrees below the celestial equator
- Ranges 0º to ± 90º
- Analogous to earth's latitude
- RA and Dec are used to pinpoint the location of celestial objects just as latitude and longitude is used for earth locations
- Maps 1-2, 9-10: Circles; Maps 3-8: Horizontal lines

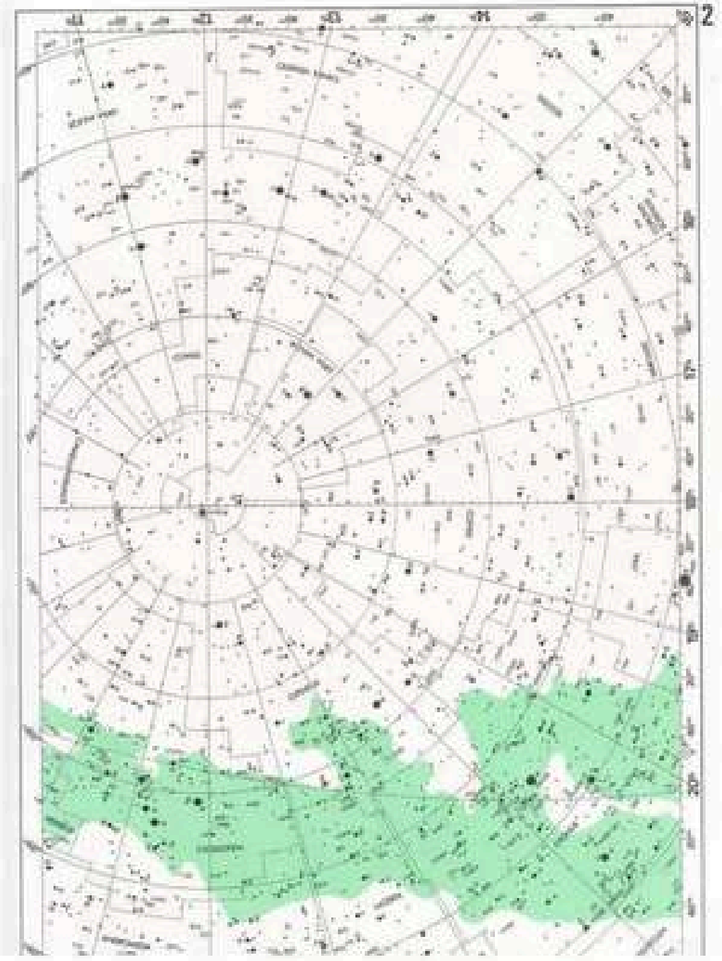

Map 1 (Polar)
Map 4 (Equatorial)
Declination
Right Ascension

- Ursa Major
- Lynx
- Draco (partial)
- Ursa Minor
- Cepheus
- Camelopardalis
- Cassieopeia
- Perseus



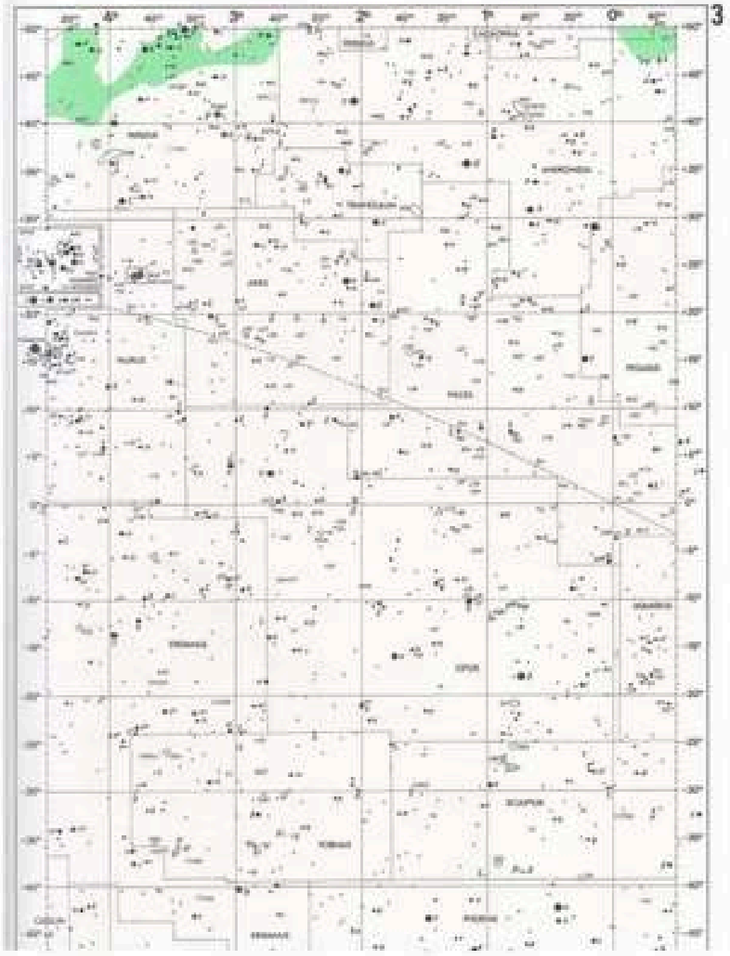
Map 2

- Big Dipper
- Draco
- Ursa Minor
- Cepheus
- Cassiopeia
- Lacerta
- Cygnus (partial)



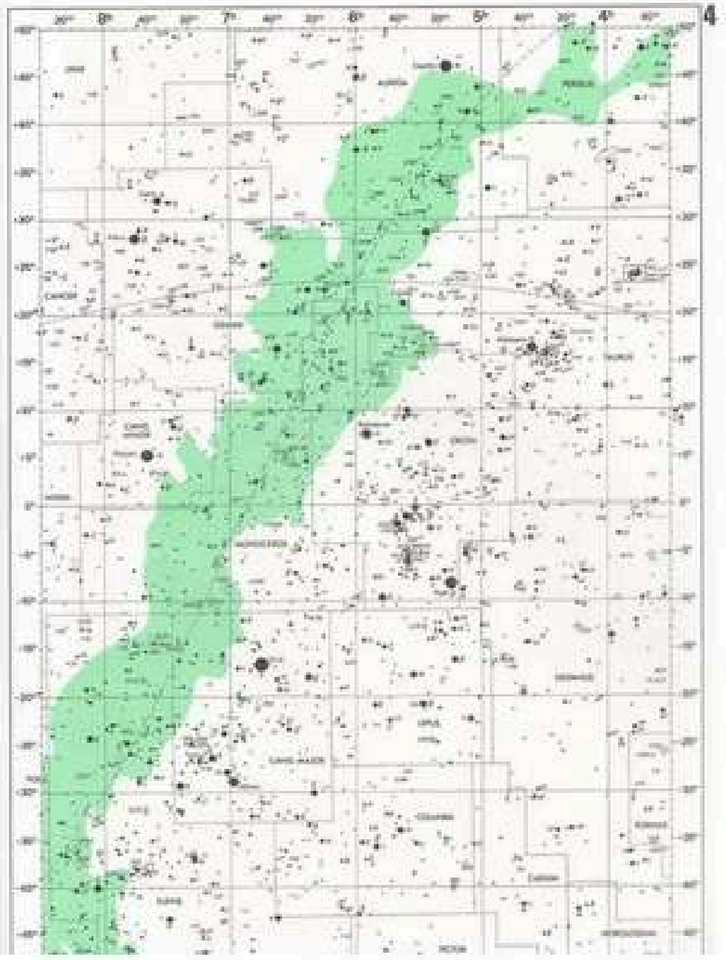
Map 3

- Andromeda
- Triangulum
- Aries
- Pisces
- Cetus
- Eridanus (partial)
- Fornax
- Sculptor



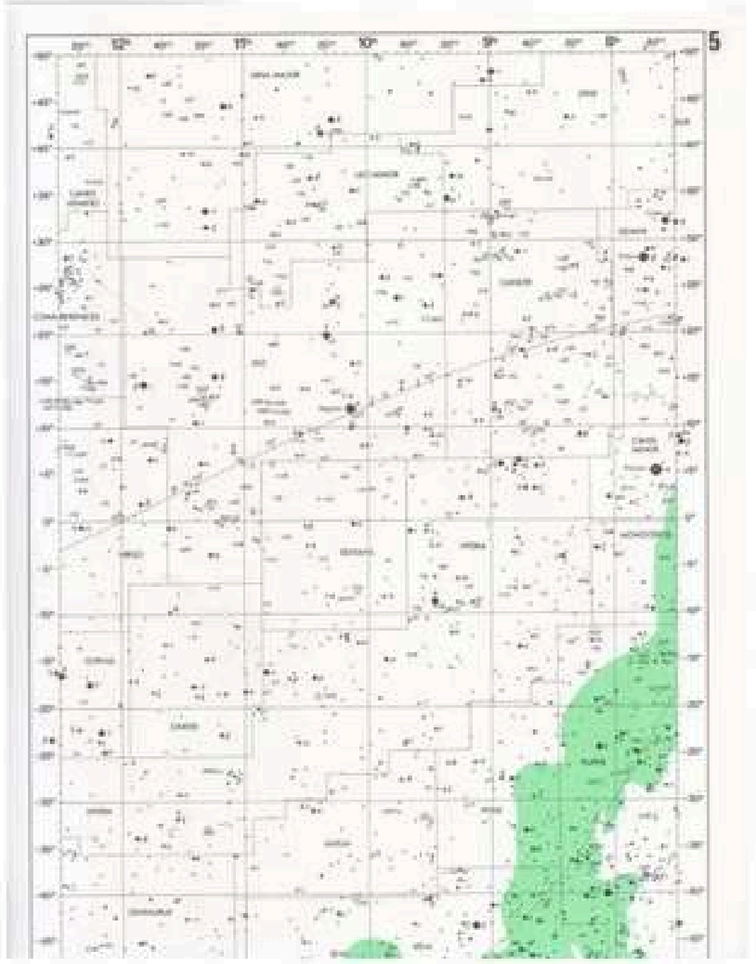
Map 4

- Auriga
- Gemini
- Taurus
- Orion
- Canis Minor
- Monoceros
- Canis Major
- Lepus
- Eridanus (partial)
- Columba
- Caelum
- Puppis (partial)



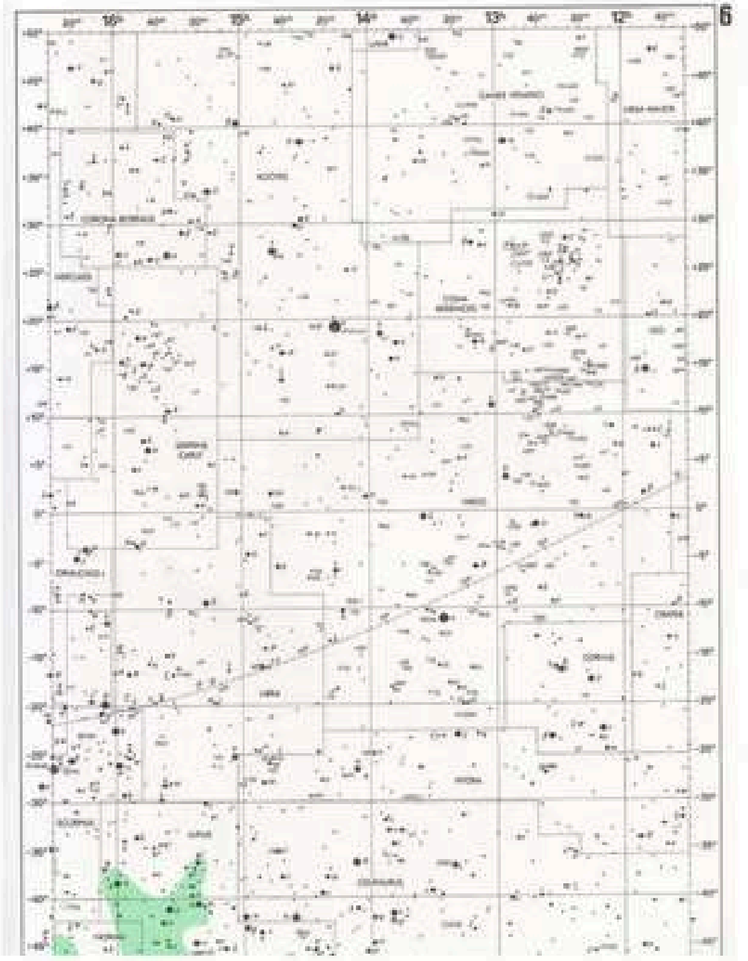
Map 5

- Leo
- Leo Minor
- Cancer
- Hydra (partial)
- Sextans
- Corvus
- Crater
- Antlia
- Pyxis



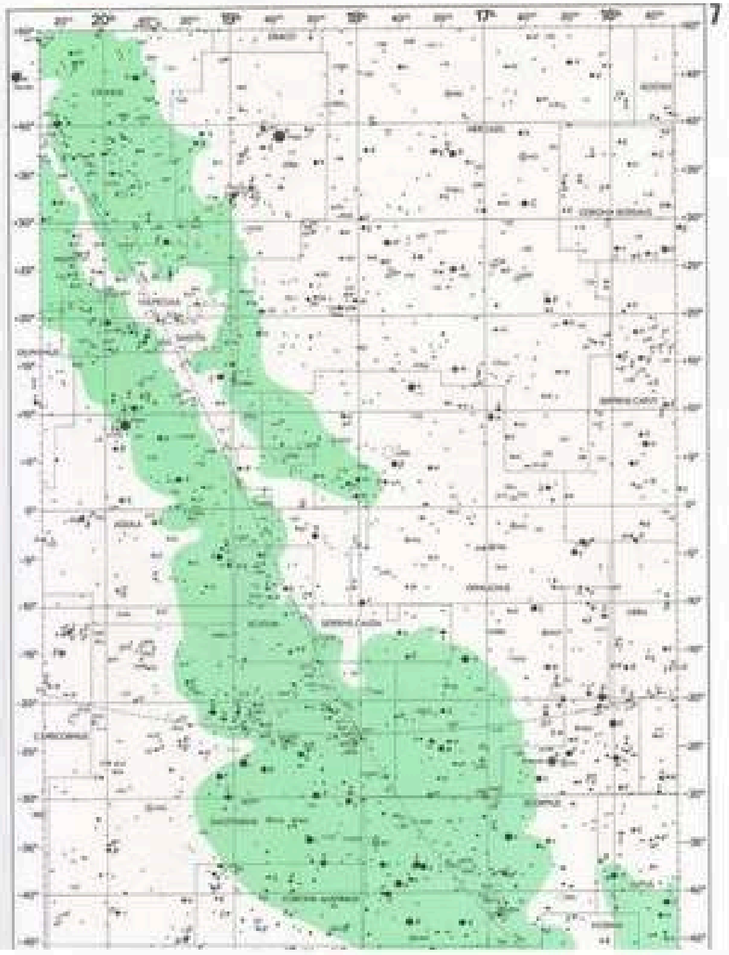
Map 6

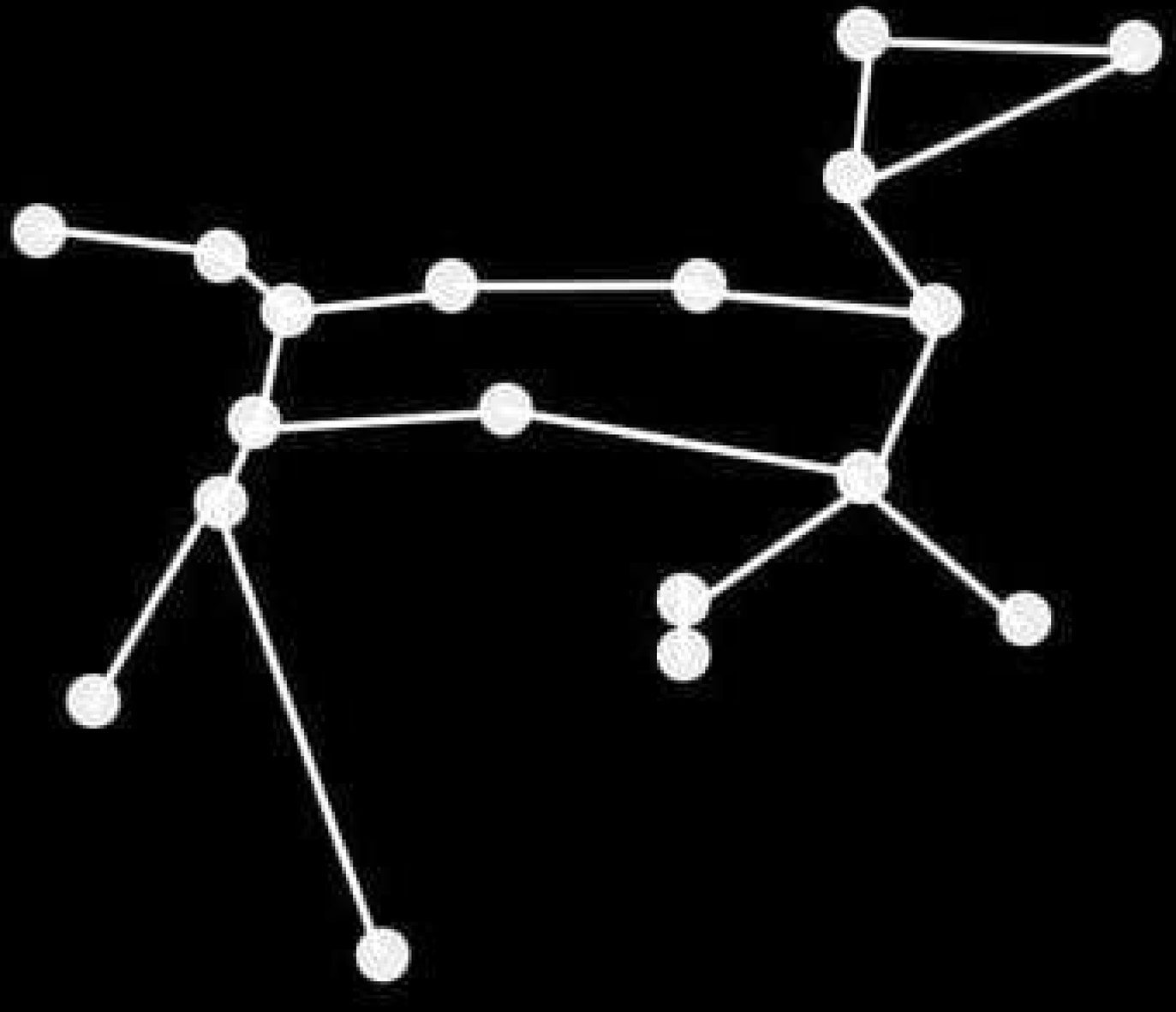
- Bootes
- Corona Borealis
- Canes Venatici
- Coma Berenices
- Serpens Caput
- Virgo
- Libra
- Corvus
- Hydra (partial)
- Centaurus (partial)

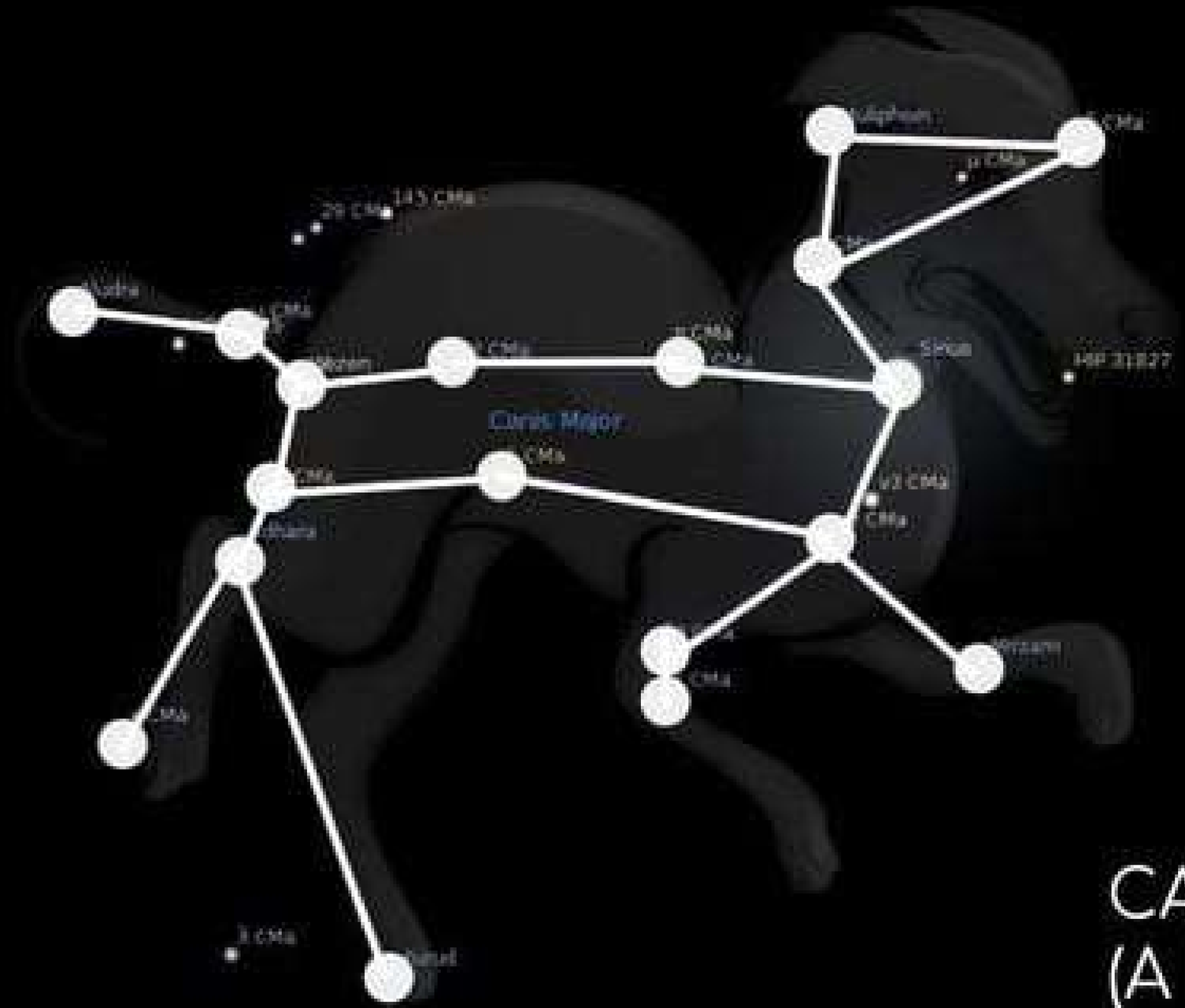


Map 7

- Hercules
- Corona Borealis
- Serpens Caput
- Ophiuchus
- Serpens Cauda
- Lyra
- Aquila
- Sagitta
- Vulpecula
- Cygnus (partial)
- Scutum
- Sagittarius
- Corona Australis
- Scorpius







CANIS MAJOR (A DOG)


Procyon
CANIS MINOR
(ANOTHER DOG)

SIGNIFICANCE

PAST

Agriculture
Farmers determined when to sow/harvest based on the stars that were present in the sky

Navigation
Sailors were able to calculate their position on Earth (latitude) based on how high Polaris (North Star) was in the night sky

HISTORY

Ancestors may have recorded the first constellations on the walls of their cave some 17 300 years ago

Ptolemy (Greek Astronomer) recorded 48 of the modern constellations in his book, *Almagest*, in the 2nd century

European astronomers and celestial cartographers added new constellations (16th to 17th century AD)

88 modern constellations recognised by the International Astronomical Union (IAU) since 1929

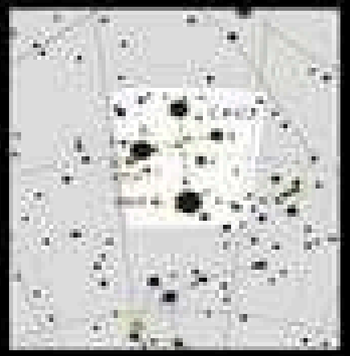
CONSTELLATION FACTS

Largest - Hydra (Serpent)
Smallest - Crux (Southern Cross)

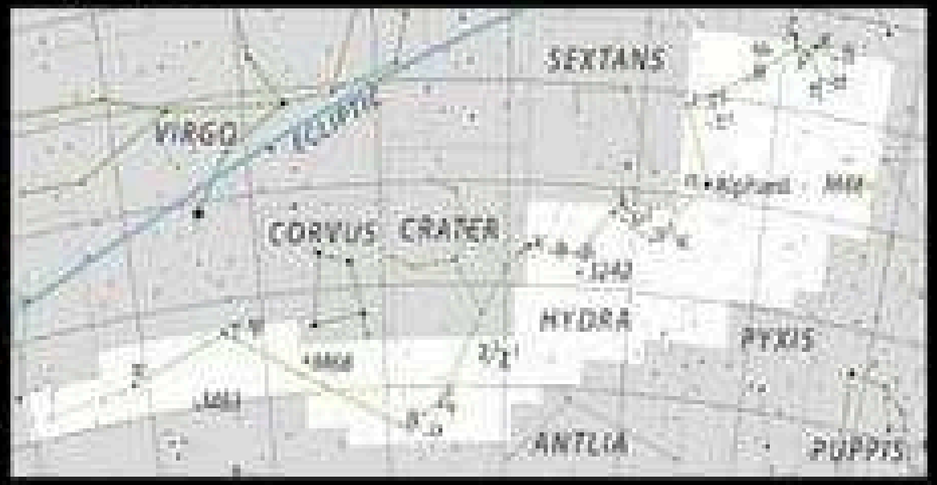
The 88 constellations depict:

- 42 animals (e.g. Chamaeleon)
- 29 inanimate objects (e.g. Microscopium)
- 17 humans or mythological characters (e.g. Orion)

Crux



Hydra



CONSTELLATION FAMILIES

Hercules
Ursa Major
Zodiac

Grouped based on proximity on the celestial sphere

Perseus
Orion

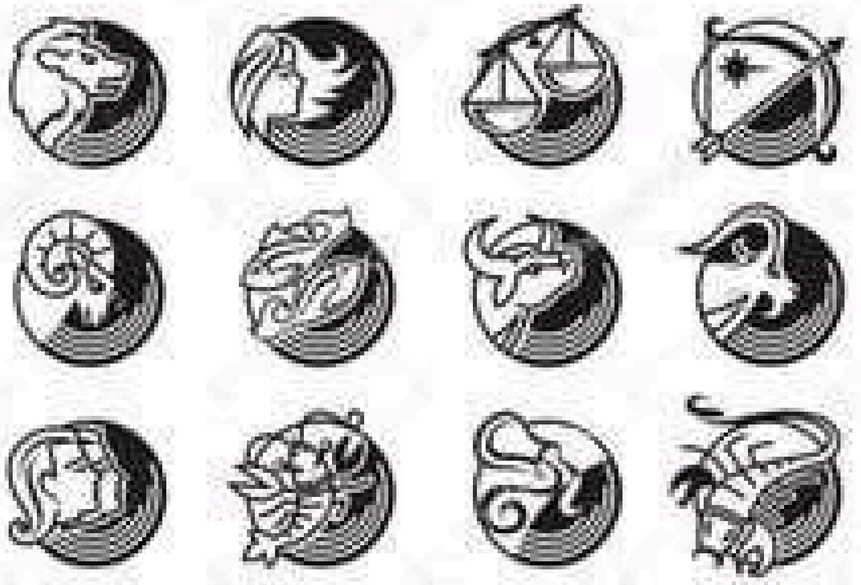
Grouped based on common mythological theme

La Caille
Bayer
Heavenly Waters

Grouped based on common historical origin

THE ZODIAC

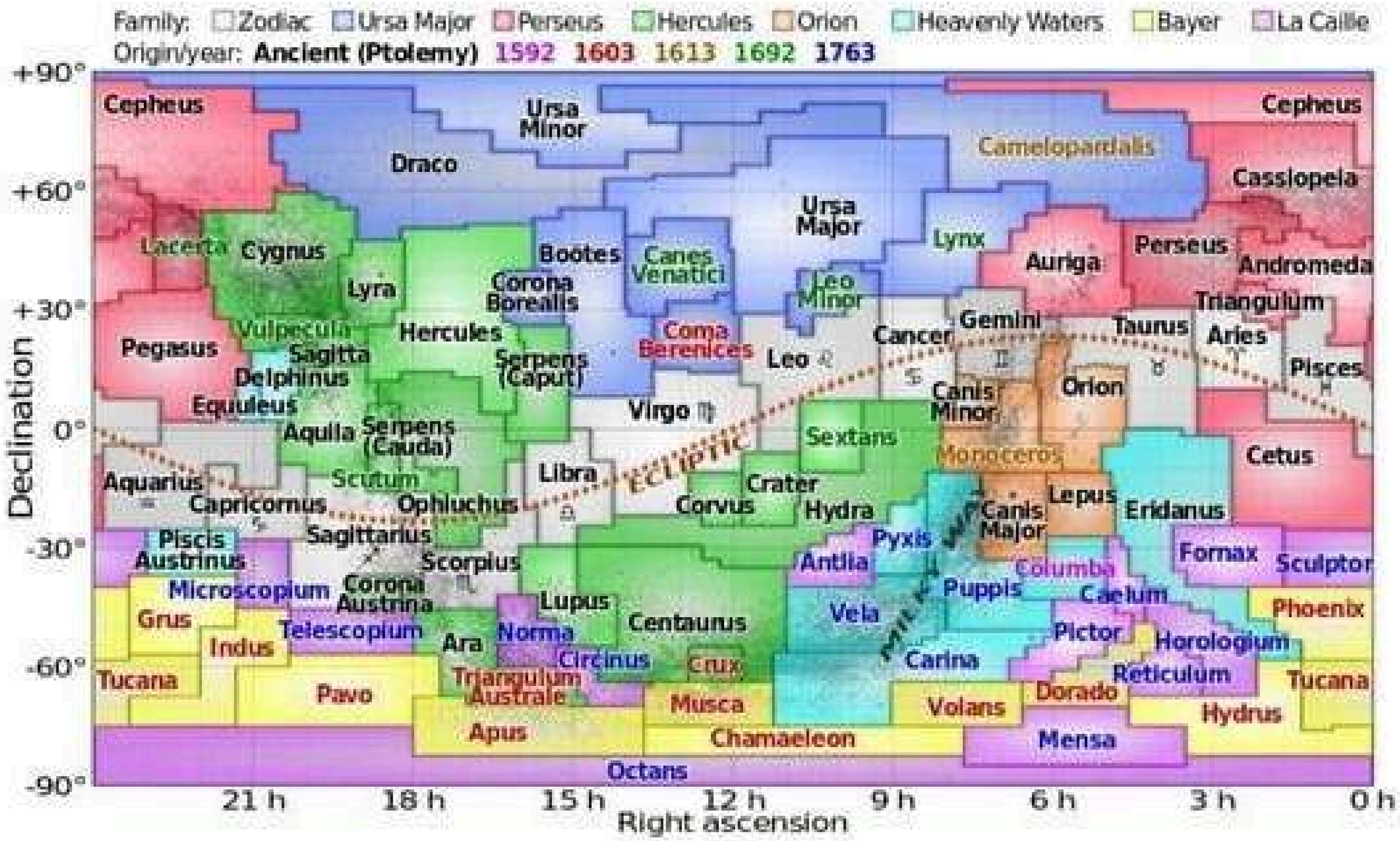
- A group of 12 constellations that lie on the ecliptic
- The path of the Sun actually passes through thirteen constellations
- Babylonians had a 12-month lunar calendar, they chose 12 constellations to divide the year up evenly
- The thirteenth constellation (Ophiuchus) was left out



THE ZODIAC IN ASTROLOGY

non-science

- The Zodiac is divided into twelve signs, each sign occupying equal sections of the celestial sphere
- Not accurate as constellations vary in physical size, so the Sun is not in each constellation for the same amount of time


Family: Zodiac Ursa Major Perseus Hercules Orion Heavenly Waters Bayer La Caille
Origin/year: Ancient (Ptolemy) 1592 1603 1613 1692 1763
+90°
+60°
+30°
0°
-30°
-60°
-90°
Declination
21 h
18 h
15 h
12 h
9 h
6 h
3 h
0 h
Right ascension
Cepheus
Ursa Minor
Draco
Camelopardalis
Cassiopeia
Lacerta
Cygnus
Bootes
Canes Venatici
Ursa Major
Lynx
Auriga
Perseus
Andromeda
Lyra
Corona Borealis
Leo Minor
Triangulum
Vulpecula
Hercules
Coma Berenices
Gemini
Taurus
Aries
Pegasus
Sagitta
Serpens (Caput)
Leo
Cancer
Pisces
Delphinus
Orion
Equuleus
Virgo
Canis Minor
Aquila
Serpens (Cauda)
Sextans
Monoceros
Cetus
Aquarius
Scutum
Libra
Ecliptic
Crater
Capricornus
Ophiuchus
Corvus
Hydra
Lepus
Eridanus
Canis Major
Sagittarius
Pyxis
Piscis Austrinus
Scorpius
Antlia
Columba
Fornax
Sculptor
Microscopium
Corona Australis
Puppis
Caelum
Lupus
Vela
Grus
Centaurus
Phoenix
Telescopium
Norma
Pictor
Horologium
Indus
Ara
Circinus
Crux
Carina
Tucana
Triangulum Australe
Reticulum
Tucana
Pavo
Musca
Volans
Dorado
Hydrus
Apus
Chamaeleon
Mensa
Octans

THE 3 SHORT STORIES

1. Perseus and Andromeda
2. Hercules
3. Orion

#1 PERSEUS & ANDROMEDA

1. **Perseus** (The Hero)
2. **Andromeda** (The Princess)
3. **Cassiopeia** (The Queen)
4. **Cepheus** (The King)
5. **Cetus** (The Sea Monster)

#1 PERSEUS & ANDROMEDA

- **Andromeda** was the daughter of **Cepheus** (King of Aethiopia) and **Cassiopeia** (Queen)
- **Cassiopeia** boasted that she was more beautiful than the Nereids (sea nymphs)
- This angered Poseidon, who promptly sent a sea monster (**Cetus**) to ravage the coast
- **Cassiopeia** and **Cepheus** were told that Poseidon could be appeased only by sacrificing their daughter, **Andromeda**, to the monster
- **Andromeda** was duly chained to a rock on the coast, fully exposed to the monster
- **Perseus** happened to be flying by on his way back from killing the Gorgon Medusa
- **Perseus** killed the sea monster in exchange for marriage with **Andromeda**


Girafe
Taureau
Perseus
Cassiopeia
Cepheus
Triangle
Bélier
M31
Andromeda
Baleine
Poissons
Lézard

CONSTELLATIONS

- **Perseus** was immortalized as a constellation at his death many years later
  - Depicted with a sword in one hand and the head of Medusa in the other
- **Andromeda** is represented in the sky as the figure of a woman with her arms outstretched and chained at the wrists
- **Cepheus and Cassiopeia**
  - To humiliate **Cassiopeia** for eternity, Poseidon placed in the sky such that she is seated on her throne, spending half of every night upside-down
- **Cetus**

#2 HERCULES

- Hercules was the Roman adaptation of Heracles, a Greek divine hero
- Heracles was the son of Zeus and Alcmene, a mortal woman, and the great-grandson of Perseus and Andromeda (all Greek people are related :/)
- Hera was furious at her husband's infidelity, but could not kill Heracles since he was immortal, so she could only make life difficult for Heracles
- She later cast a spell that made him go insane and kill his children

#2 HERCULES

- To atone for his deed, Heracles was sent to serve Eurystheus, king of Mycenae, for a period of 12 years, during which he performed the twelve labours, including:
  - Wrestling and killing the Nemean Lion (**Leo**) in its den, then wearing its impenetrable hide as protection
  - Killing the Lernaean **Hydra**, a poisonous monster which could regenerate its heads (While battling the Hydra, his feet were nipped by a crab (**Cancer**) sent by Hera)
  - Killing a dragon, Ladon, guardian of the garden of Hesperides, to obtain the golden apples

CONSTELLATIONS

- Heracles was placed in the sky as the constellation **Hercules**
  - Fifth-largest constellation in the sky, but rather dim
  - Interesting parallel with Hercules himself, who was famed for his brawn, but his wits were rather lacking
- **Leo** and **Hydra** placed as constellations in the sky by Zeus and Hera respectively
- Hera placed the crab (**Cancer**) in the heavens as a reward for its faithful service
- Ladon, the dragon guarding the golden apples, is represented by the constellation **Draco**


Hercules


Draco


Cancer
Leo
Hydra
Crater
Corvus

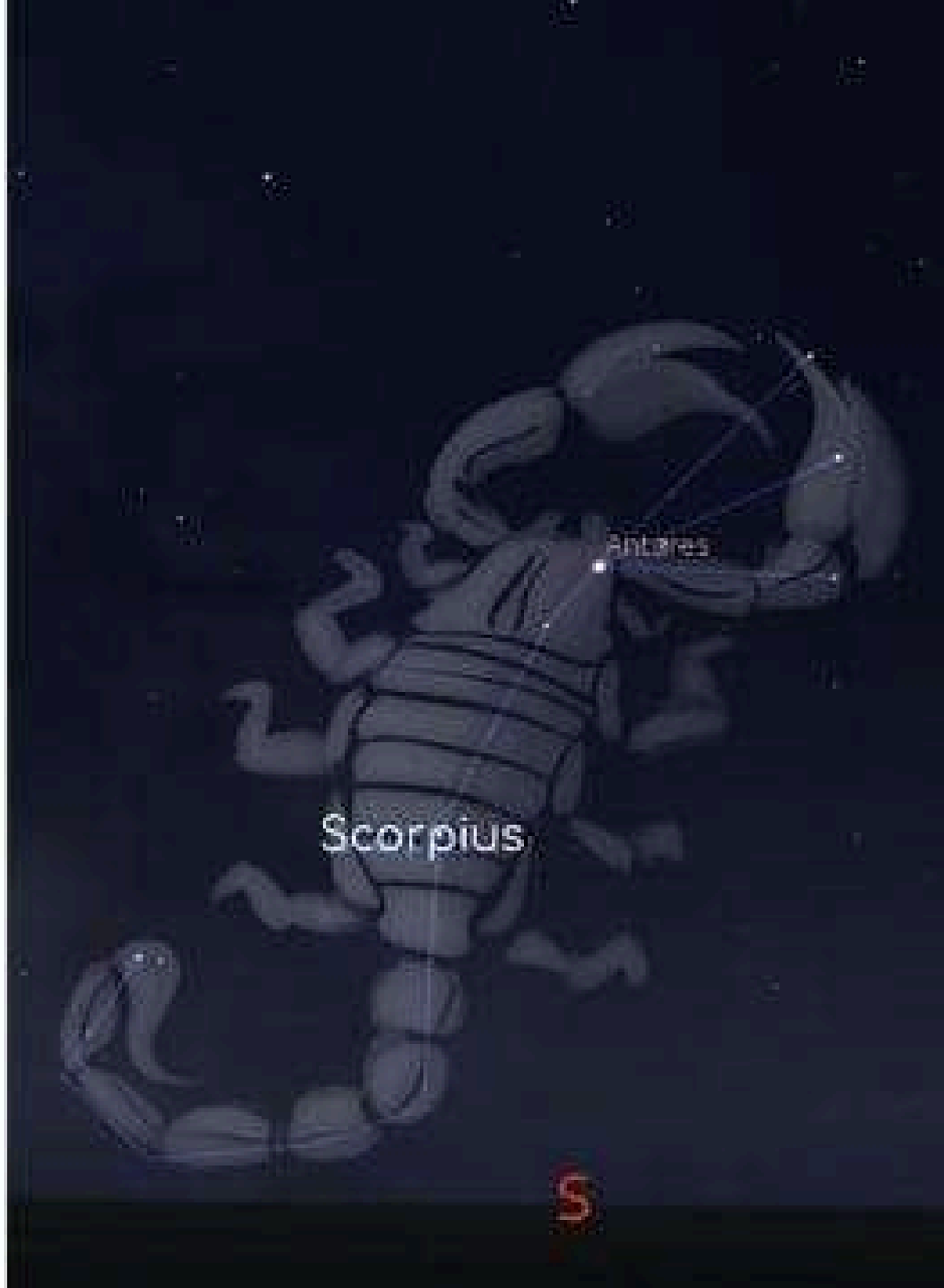
#3 ORION

- **Orion** was the son of the Poseidon and Euryale, and one of the greatest hunters in the world
- While hunting with the goddess of hunt Artemis and her mother Leto, he was so enthusiastic that he declared he would kill every animal in the world
- Gaea, the goddess of the Earth, got angry and sent a giant scorpion which fought and successfully killed **Orion**, getting killed as well
- Artemis and Leto asked from Zeus to put their fellow hunter in the sky; Zeus agreed and turned Orion into a constellation, as well as the scorpion that killed him (Scorpius)

CONSTELLATIONS

- Scorpius was placed in the opposite side of the sky from Orion so as to avoid any further conflict
- Orion is depicted together with his hunting dogs (Canis Major and Canis Minor) chasing a rabbit (Lepus)


Orion
Canis Minor
Procyon
Lepus
Canis Major


Antares
Scorpius
S

THANKYOU :D