The Moon:
Our Neighbor

Culpeper Astronomy Club Meeting
February 26, 2018

Overview

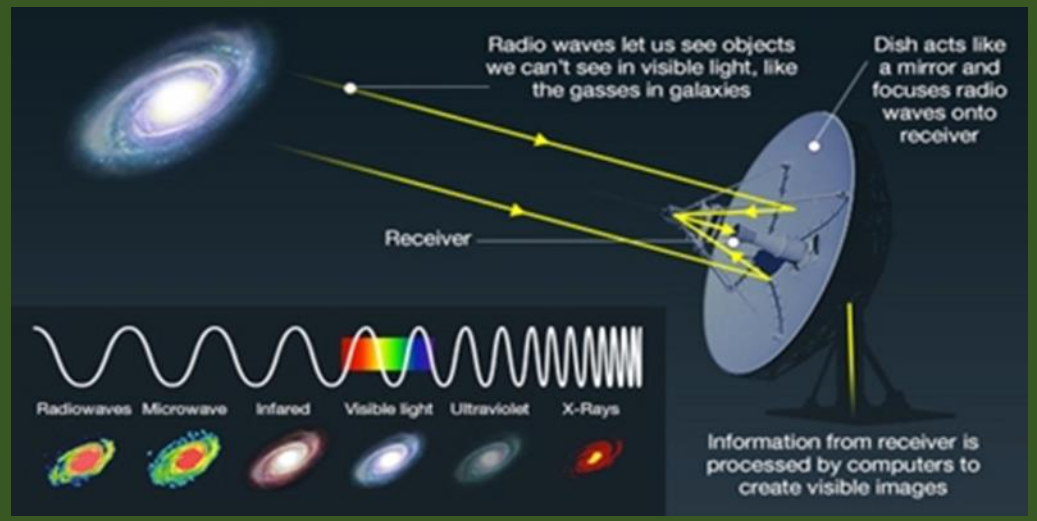
- Introductions
- Radio Astronomy: The Basics
- The Moon
- Constellations: Monoceros, Canis Major, Puppis
- Observing Session (Tentative)

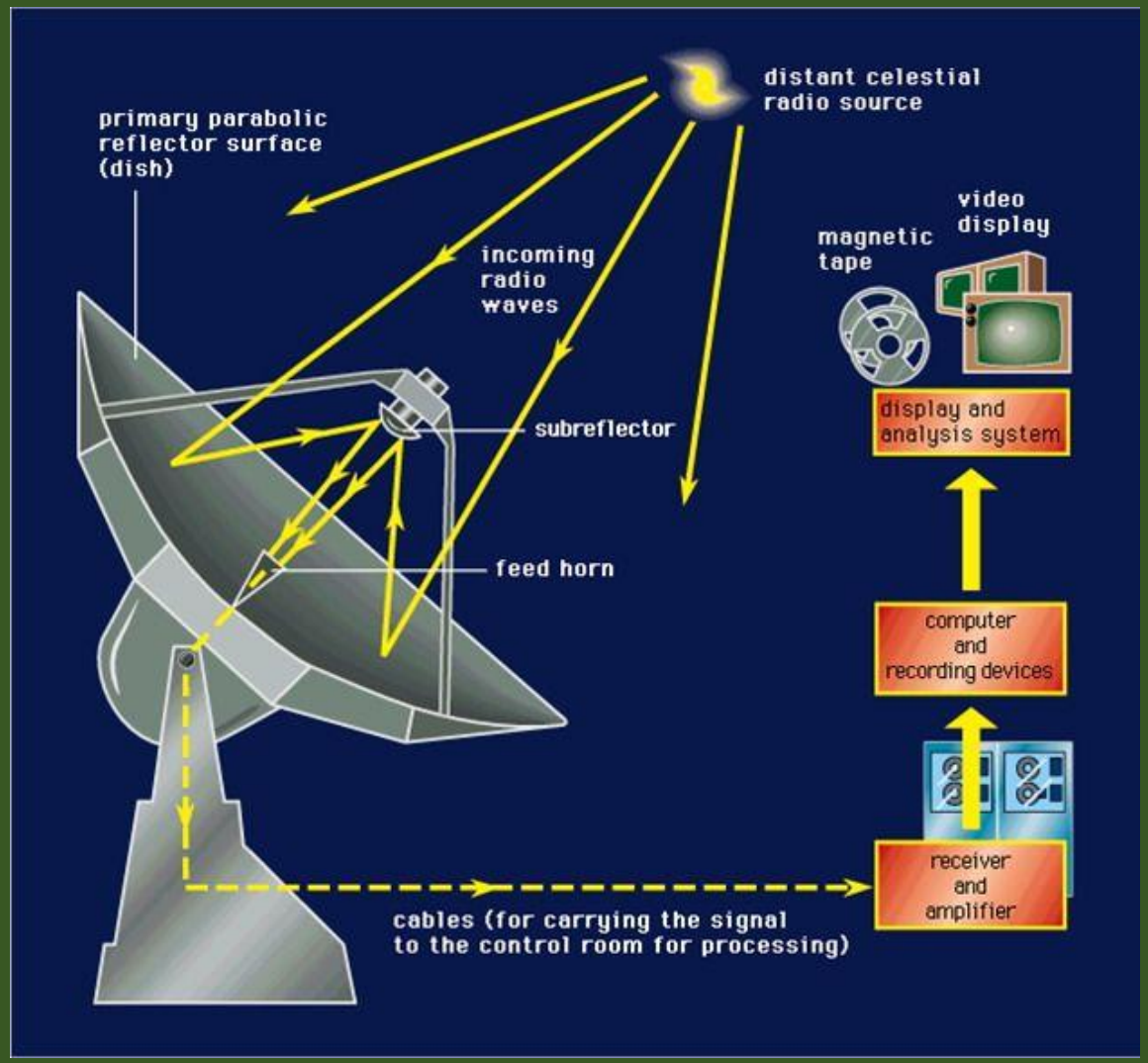
Radio Astronomy

- Stars, galaxies and gas clouds emit visible light as well as emissions from other parts of the electromagnetic spectrum
  - Includes radio waves, gamma rays, X-rays, and infrared radiation
- Radio astronomy is the study of the universe through analysis of celestial objects' radio emission
  - the longest-wavelength, least energetic form of radiation on the electromagnetic spectrum
- The first detection of radio waves from an astronomical object was in 1932
  - Karl Jansky at Bell Telephone Laboratories observed radiation coming from the Milky Way

Radio Astronomy

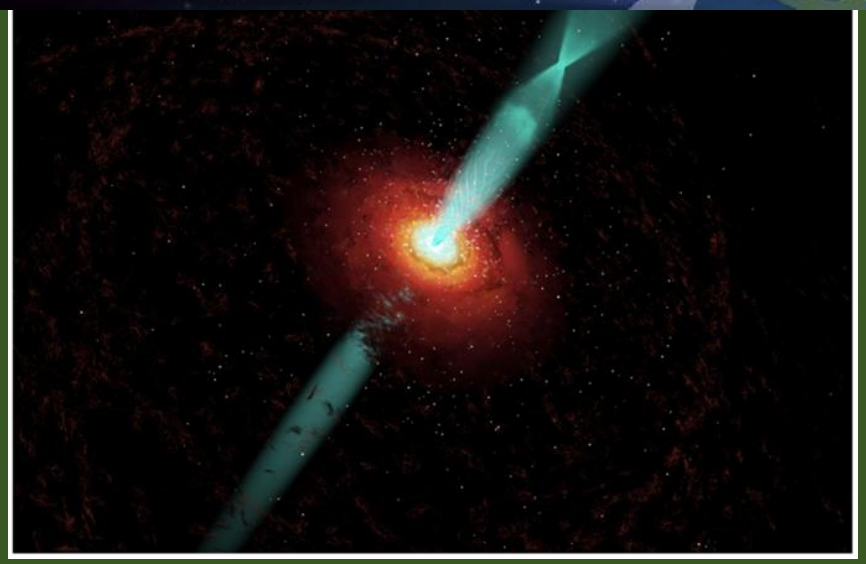
- A radio telescope has three basic components:
  - One or more antennas pointed to the sky, to collect the radio waves
  - A receiver and amplifier to boost the very weak radio signal to a measurable level, and
  - A recorder to keep a record of the signal





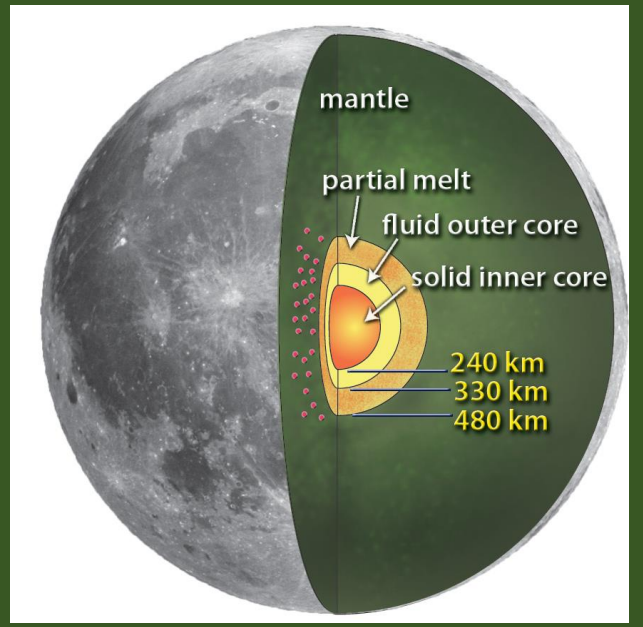
Radio Astronomy

- Subsequent observations have identified a number of different sources of radio emission
- Include stars and galaxies, as well as entirely new classes of objects, such as:
  - Radio galaxies: nuclei emit jets of high-velocity gas (near the speed of light) above and below the galaxy -- the jets interact with magnetic fields and emit radio signals
  - Quasars: distant objects powered by black holes a billion times as massive as our sun
  - Pulsars: the rapidly spinning remnants of supernova explosions that send out regular flashes of radio waves much like the beam from a lighthouse



The Moon

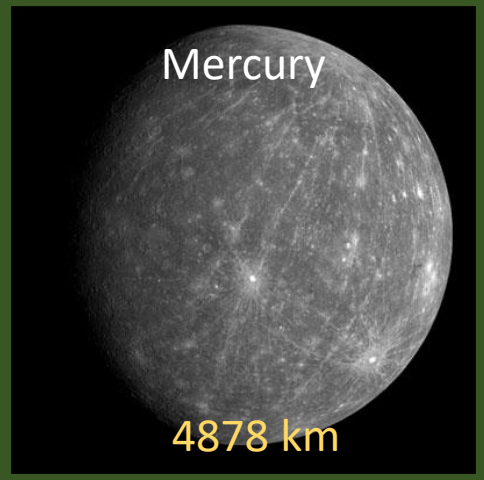
- The Moon, with a diameter of about 2,159 miles, is larger than Pluto
  - Is a bit more than 27% the size of Earth, a much larger ratio than any other planets
  - Has a great effect on the planet and very possibly is what makes life on Earth possible
- The Moon's orbit around Earth is elliptical
  - Orbit ranges from 225,623M to 252,088M
  - Average distance of 238,855 miles
  - “Supermoon” is Full Moon at perigee
- Like the Earth, the Moon has a crust, mantle and core
  - May have a solid iron core surrounded by a softer, somewhat molten liquid iron outer core
  - The outer core may extend as far out as 310 miles (500 km)



The Moon

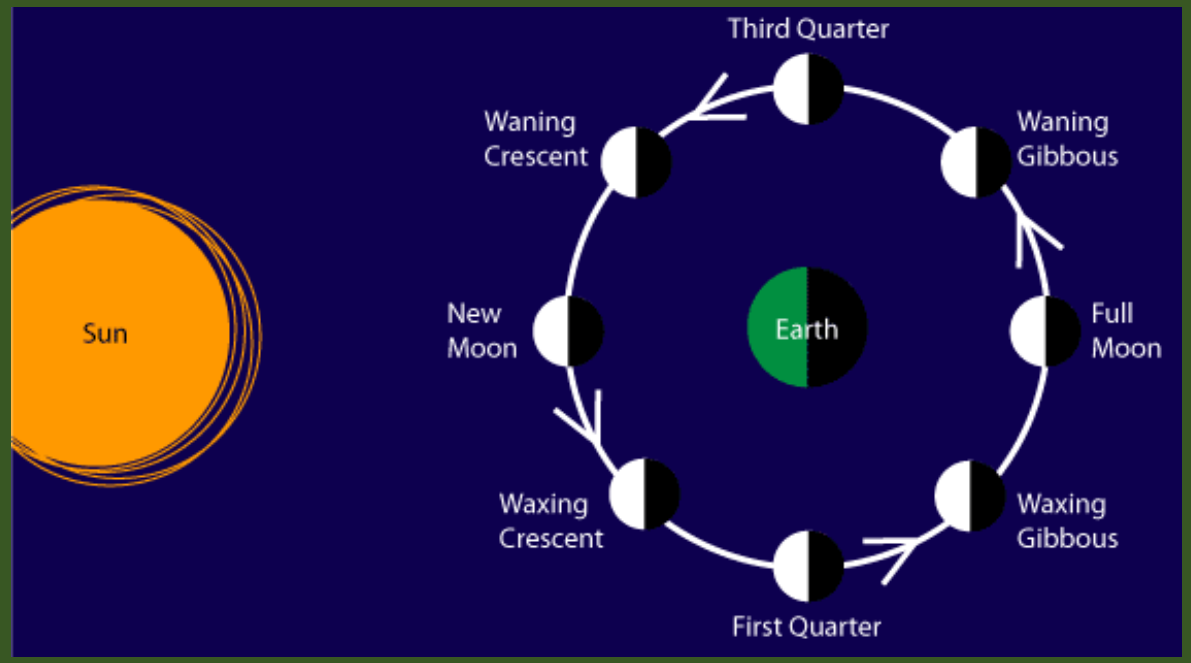
- Our moon makes Earth a more livable planet by moderating our home planet's wobble on its axis:
  - Leading to a relatively stable climate
  - Creating a tidal rhythm that has guided humans for thousands of years
- Most obvious manifestation of the influence of the Moon on the Earth is the “Tidal Affect”
  - Rise and fall of sea level creates an unique environment in the Solar System, where life is exposed to both immersion in water and exposure to air in the space of a few hours
  - This interface between two distinct ecological niches is thought by many to be crucial in evolutionary terms
  - This affect may well have sparked the spread of organisms from the sea to the land

Largest Moons of the Solar System



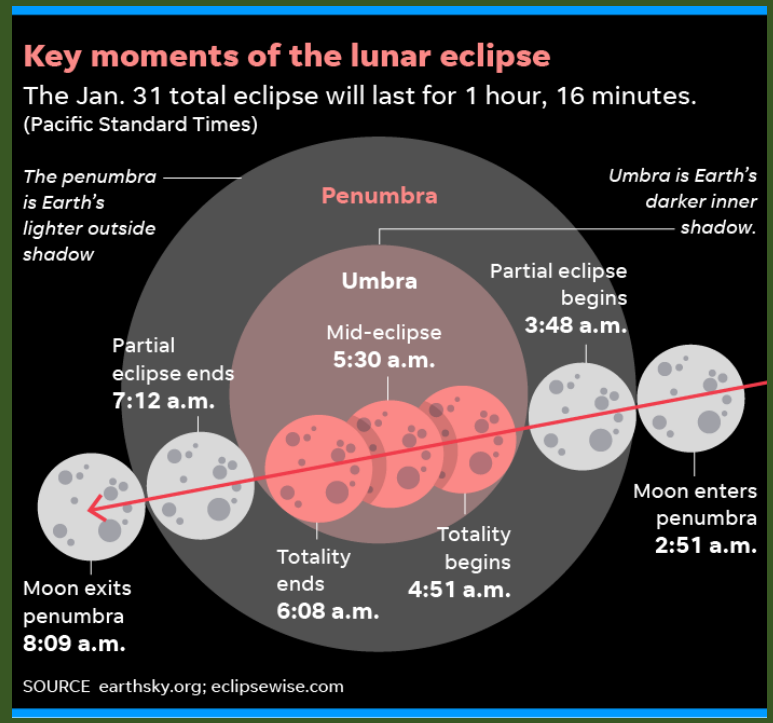
The Moon

- The moon's orbit around Earth is elliptical
  - Orbit ranges from 225,623M to 252,088M
  - Average distance of 238,855 miles
  - “Supermoon” is Full Moon at perigee
- Moon phases and the moon's orbit are unique
  - The moon always shows us the same side
  - Periods of rotation and revolution both 27.3 days
  - How much of it we see depends on the moon's position in relation to Earth and the sun



Lunar Eclipse

- Lunar eclipses occur when Earth's shadow blocks the sun's light, which otherwise reflects off the moon
- There are three types — total, partial and penumbral — with the most dramatic being a total lunar eclipse, in which Earth's shadow completely covers the Moon
- The Moon turns red “Blood Moon” because of the way the moon is illuminated by sunlight
  - has been filtered and refracted by the earth’s atmosphere
- Next lunar eclipse visible in NA:
  - January 19, 2019: Total eclipse. Visible from North and South America, Europe, Africa



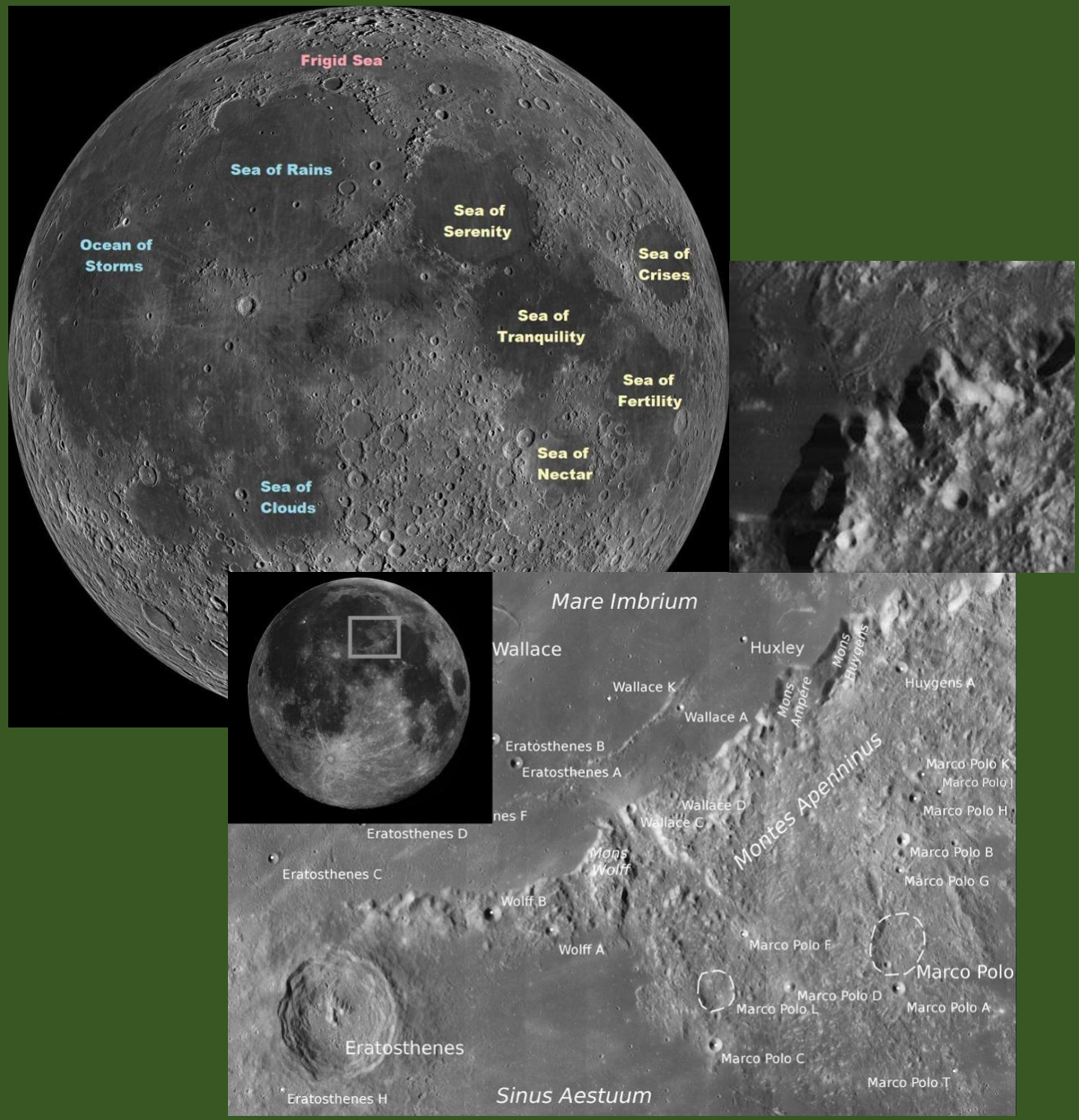
Moon’s Origins

- Leading explanation is that a giant impact knocked the raw ingredients for the Moon off the primitive molten Earth and into orbit
  - Impactor was roughly 10 percent the mass of Earth or about the size of Mars
  - Because Earth and the moon are so similar in composition have concluded that the impact must have occurred about 95 million years after the formation of the solar system, give or take 32 million years
  - New studies in 2015 gave further weight to this theory, based on simulations of planetary orbits in the early solar system

- Although the large impact theory dominates the scientific community's discussion, there are several other ideas for the moon's formation, these include:
  - Earth captured the moon
  - The moon fissioned out of the Earth
  - Earth may even have stolen the moon from Venus

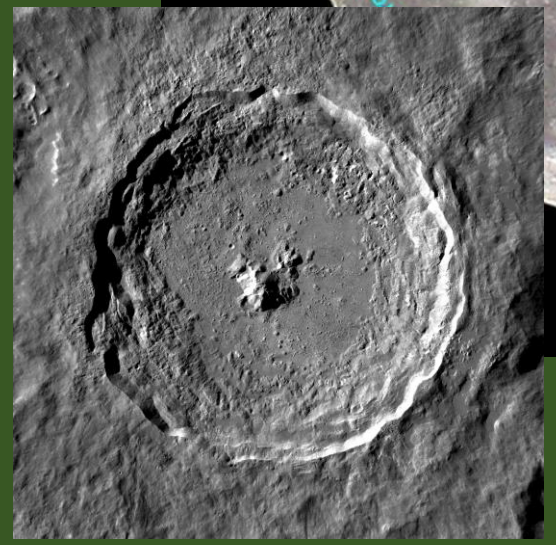
Surface Features -I

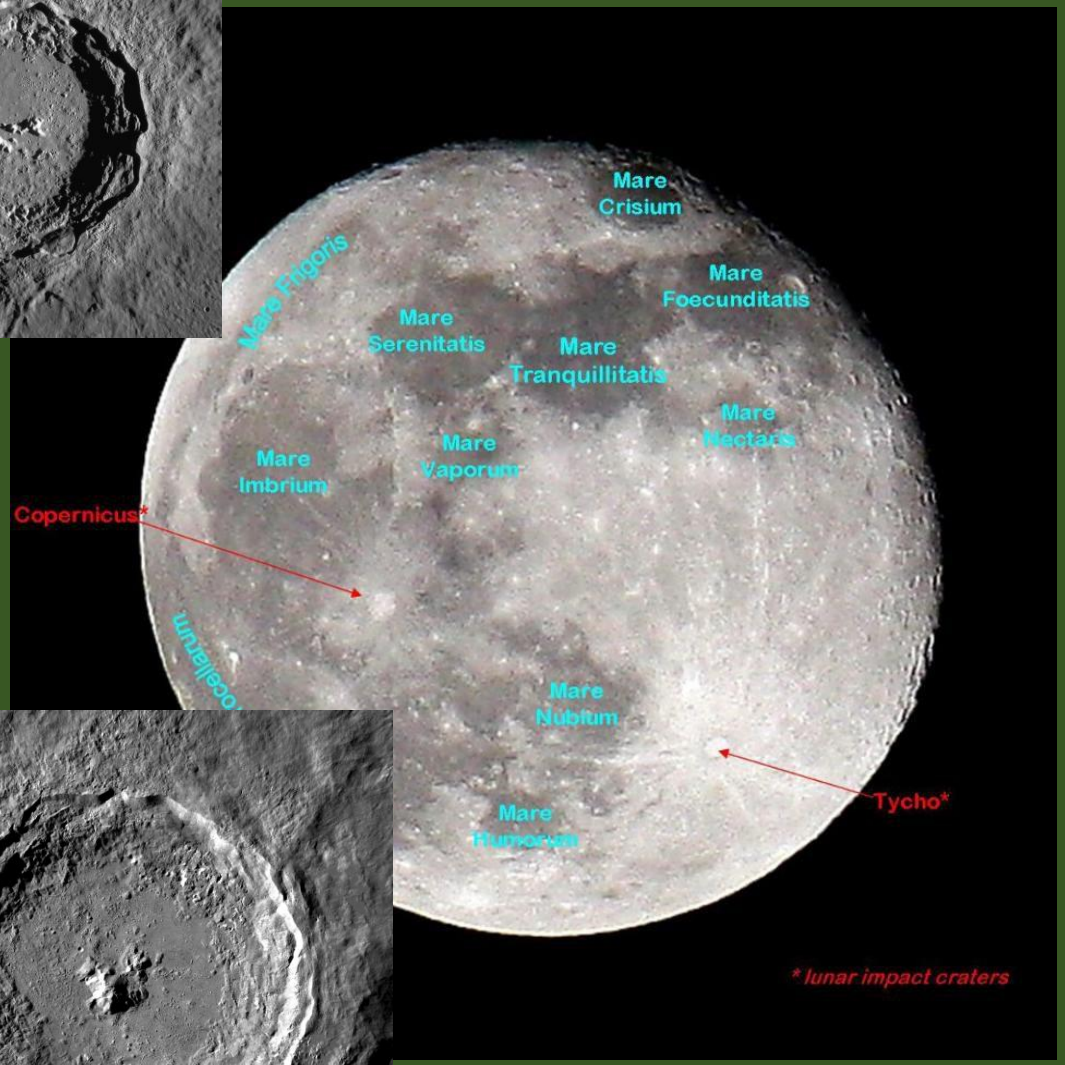
- The Lunar Mare:
  - These dark regions -- Latin for "seas" -- are solidified lava flows from between 3-3.5 billion years ago: a billion years younger than the majority of the lunar surface
- Montes Apenninus:
  - The Moon's highest mountain range outlines Mare Imbrium, extending for over 400 km
  - Contains Mons Huygens, the Moon's tallest mountain, and the Hadley–Apennine valley, where Apollo 15 landed



Surface Features - II

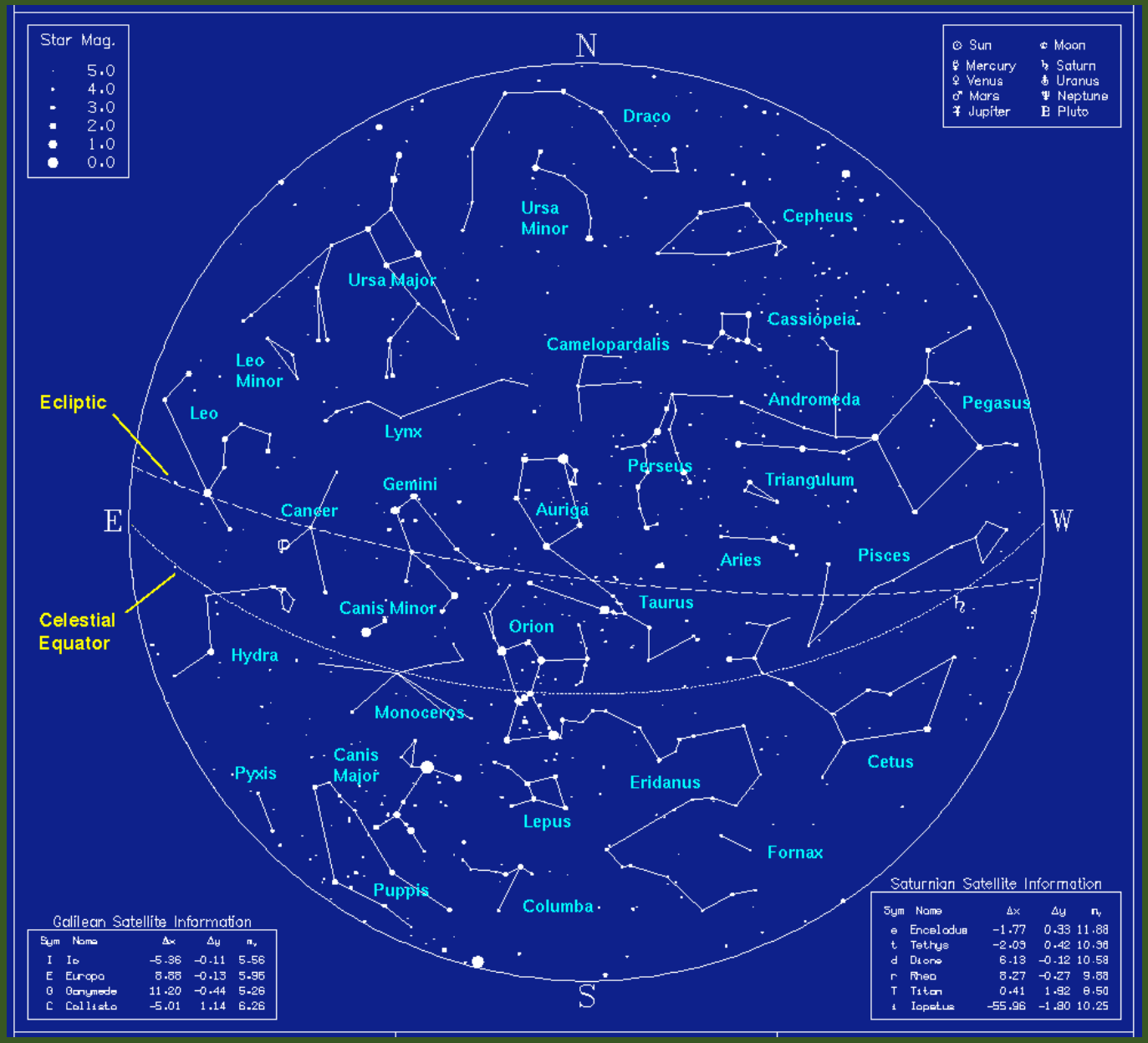
- Copernicus crater:
  - Visible as the bright spot amidst the dark Mare
  - Copernicus, at 107 km in diameter, offers the greatest visual contrast of any lunar crater to human eyes
- Tycho crater:
  - A highly-reflective impact crater over 100 km in diameter in the southern lunar highlands
  - Prominent rays emanate from the impact site
  - Samples collected by Apollo 16 determined Tycho's young age: 108 million years





Constellations

- Will explore three this evening
  - Monoceros, The Unicorn
  - Canis Major, The Big Dog
  - Puppis, The Stern

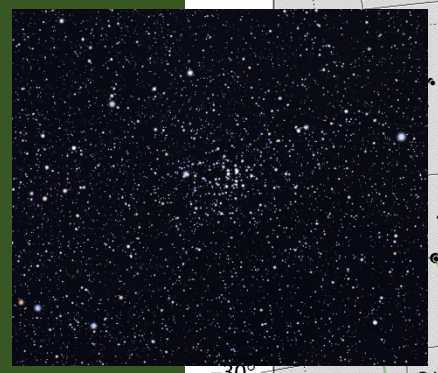


Monoceros - The Unicorn

- The constellation was created to fill the area between Orion and Hydra, where there weren't any constellations introduced in Greek times
  - No particular myth associated with it
- Beta Mon is a triple star system
- Messier 50 is an open cluster
  - Distinct for its heart-shaped figure
- The Rosette Nebula is a large emission nebula
- NGC 2264 is a New General Catalogue designation for two deep sky objects
  - Christmas Tree Cluster
  - Cone Nebula

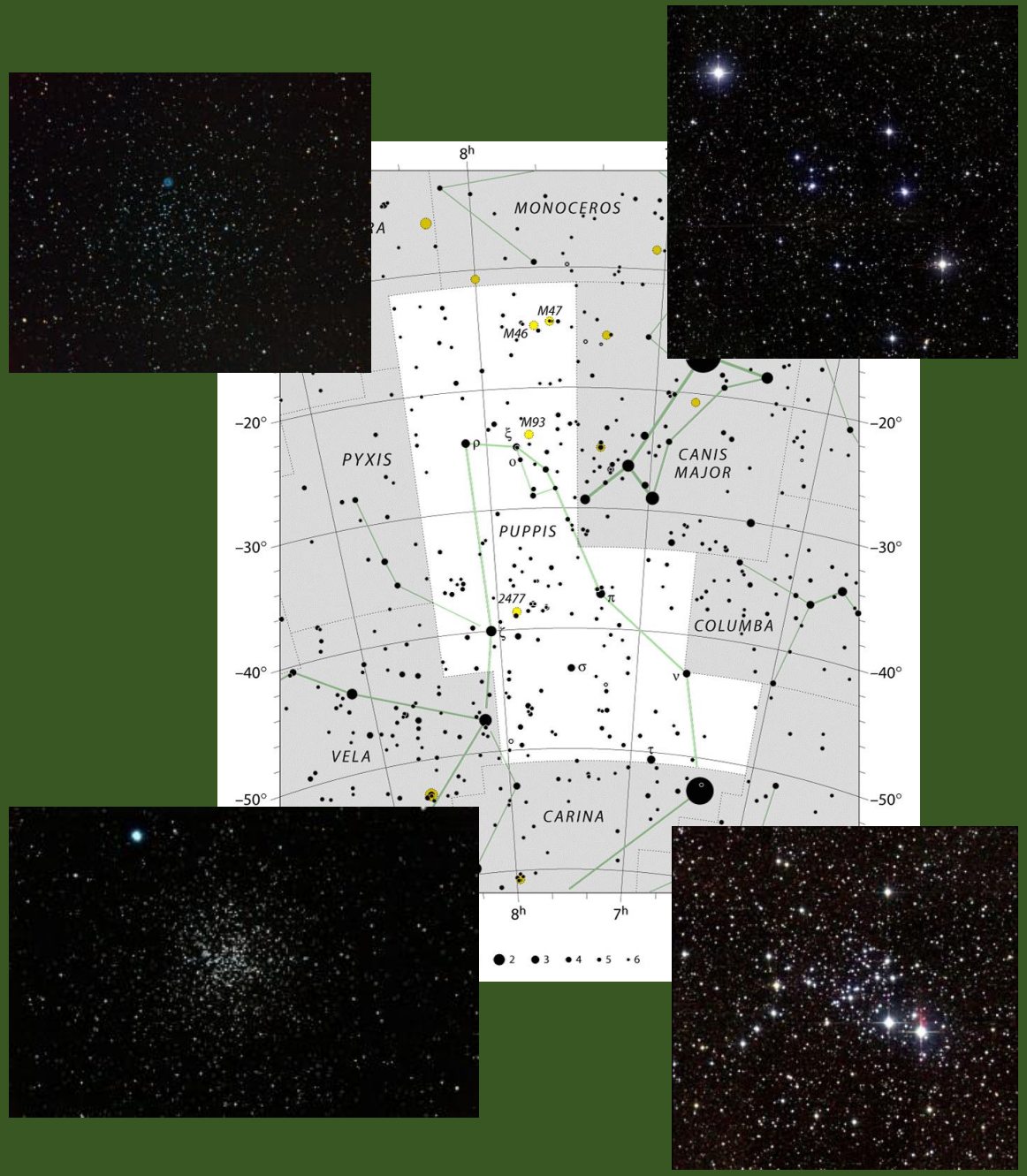
Canis Major – The Big Dog

- Larger of the the two hunting dogs used by Orion; chasing the Hare
- Within the constellation can be found Sirius, the brightest star in the night sky
  - Known as the "Dog Star“
  - Derived from the Greek word seirios which means "scorcher“
  - Sirius – Difficult Binary (50 yr period)
- Open Star Clusters
  - M41, NGC’s 2360, 2362
- Thor’s Helmet (NGC 2359)
  - Emission Nebula - 30LY Wide; 15K LY Distant
  - Formed of ionized gases that emit light of various colors
  - Source of ionization is high-energy photons emitted from a Wolf-Rayet star named HD 56925



Puppis – “The Stern”

- Represents the stern of a ship; used to be part of the much larger constellation which represented the ship on which Jason and the Argonauts sailed to get the Golden Fleece
- Deep Sky Objects:
  - Messier 46: Open Cluster with an apparent magnitude of 6.1; 5.5K LY distant; nice Planetary Nebulae in FOV
  - Messier 47: Open Cluster about a degree west of Messier 46; contains about 50 stars, the brightest of which is of magnitude 5.7
  - Messier 93: Open Cluster with apparent magnitude of 6.0; 3.6K LY distant
  - NGC 2477: Open Cluster with an apparent magnitude of 5.8; 3.6K LY distant; contains about 300 stars; about 700 million years old



Meteor Showers

- Some of the best are listed below along with dates when the most meteors are visible
  - Quadrantids, January 3-4 (Comet 2003 EH1)
  - Lyrids, April 22-23 (Comet Thatcher)
  - Perseids, August 12-13 (Comet Swift-Tuttle)
  - Orionids, October 20-21 (Halley's Comet)
  - Leonids, November 17-18 (Comet Tempel-Tuttle)
  - Geminids, December 13-14 (Asteroid 3200 Phaethon)
  - Ursids, December 23-24 (Comet 8P/Tuttle)
- The name of each shower refers to the constellation to which the meteors trace their apparent paths

Upcoming Events

- Next Meeting: March 19, 2018*
  - Primary Topic: The Sun