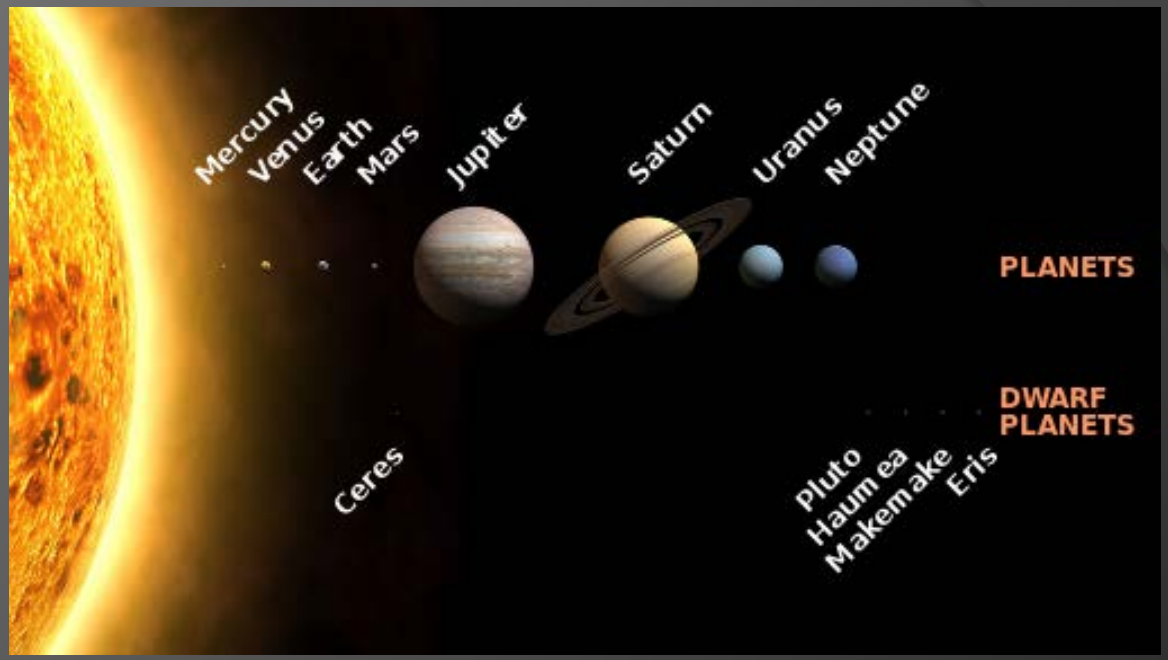
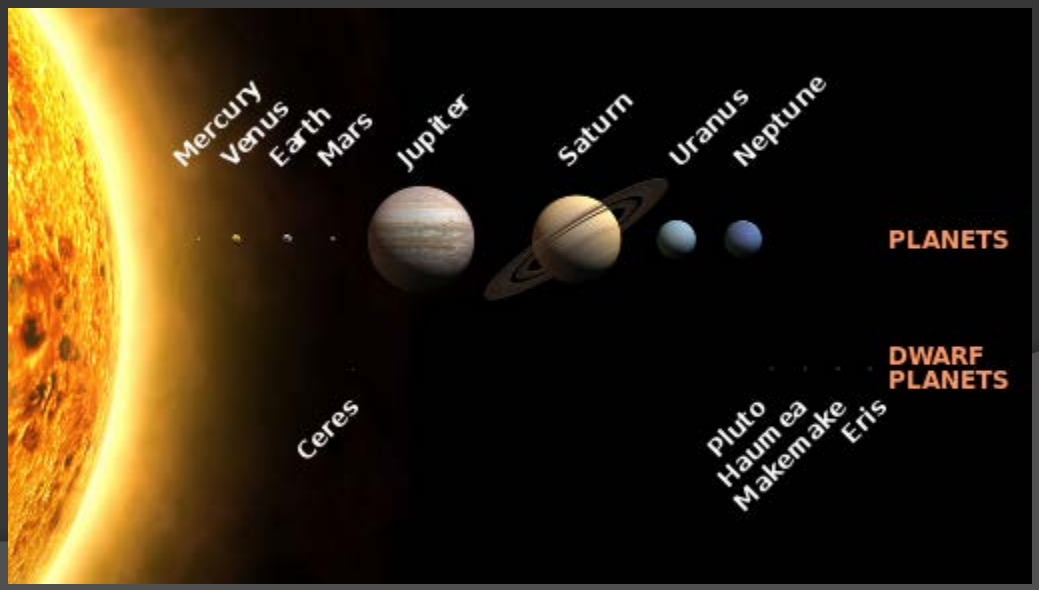


PLANETARY OBSERVING

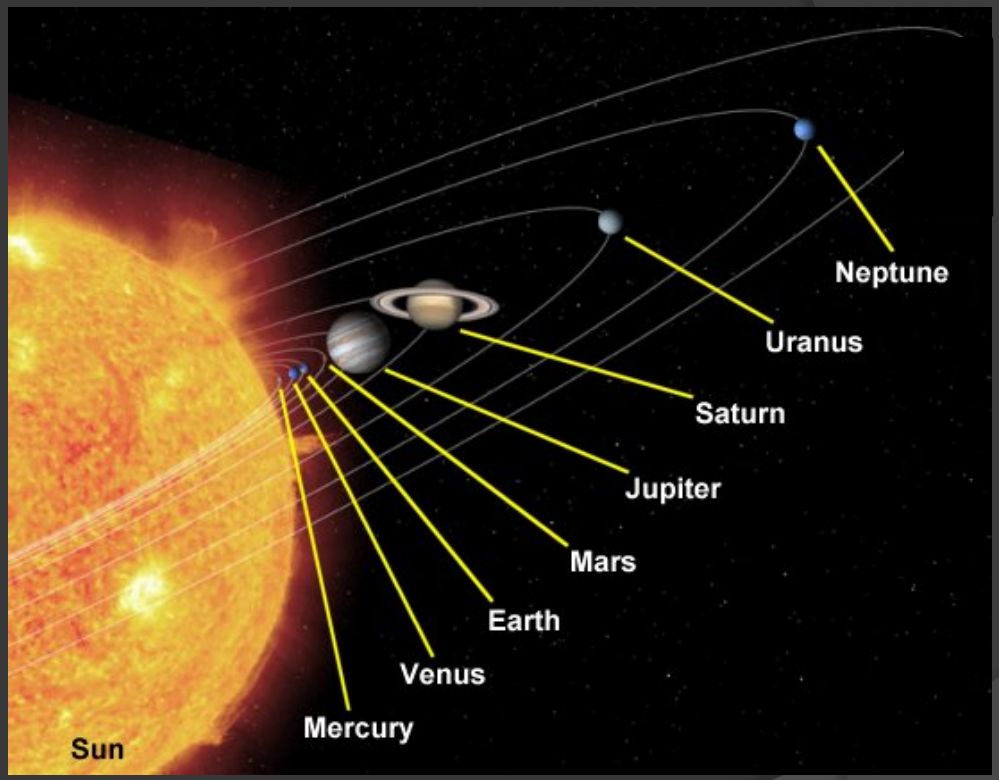
What is a Planet?

- A planet is an astronomical object orbiting a star or stellar remnant that is massive enough to be rounded by its own gravity, is not massive enough to cause thermonuclear fusion, and has cleared its neighboring region of planetesimals. In 2006, the International Astronomical Union (IAU) officially adopted a resolution defining planets within **the Solar System**. This definition has been both praised and criticized and remains disputed by some scientists because it excludes many objects of planetary mass based on where or what they orbit. While eight of the planetary bodies discovered before 1950 remain "planets" under the modern definition, some celestial bodies, such as Ceres, Pallas, Juno, Vesta and Pluto (the first-discovered trans-Neptunian object), that were once considered planets by the scientific community are no longer viewed as such.



What is a Planet?

- Planets are generally divided into two main types: large, low-density gas giants and smaller, rocky terrestrials. Under IAU definitions, there are eight planets in the Solar System. In order of increasing distance from the Sun, they are the four terrestrials, Mercury, Venus, Earth, and Mars, then the four gas giants, Jupiter, Saturn, Uranus, and Neptune. Six of the planets are orbited by one or more natural satellites.



Origin of planet names

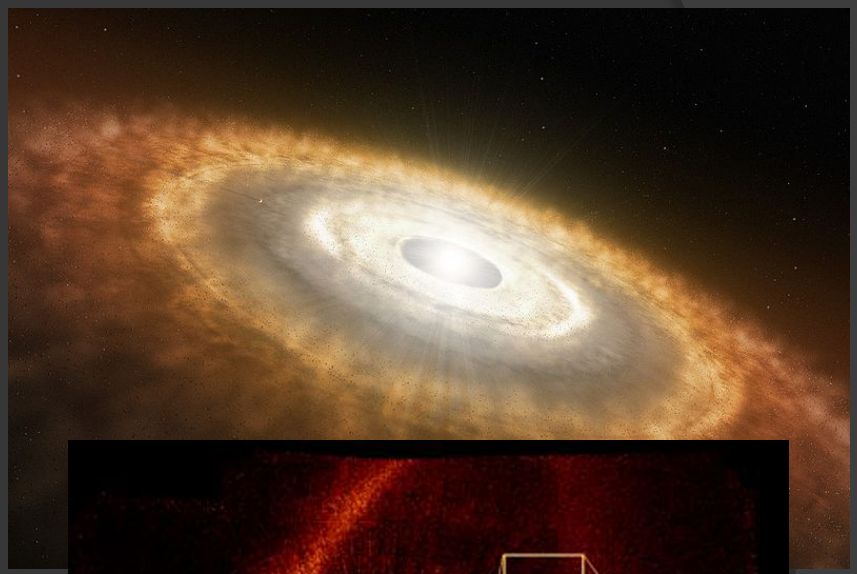
- The names for the planets in the Western world are derived from the naming practices of the Romans, which ultimately derive from those of the Greeks and the Babylonians. In ancient Greece, the two great luminaries the Sun and the Moon were called Helios and Selene; the farthest planet (Saturn) was called Phainon, the shiner; followed by Phaethon (Jupiter), "bright"; the red planet (Mars) was known as Pyroeis, the "fiery"; the brightest (Venus) was known as Phosphoros, the light bringer; and the fleeting final planet (Mercury) was called Stilbon, the gleamer. The Greeks also made each planet sacred to one among their pantheon of gods, the Olympians: Helios and Selene were the names of both planets and gods; Phainon was sacred to Cronus, the Titan who fathered the Olympians; Phaethon was sacred to Zeus, Cronus's son who deposed him as king; Pyroeis was given to Ares, son of Zeus and god of war; Phosphoros was ruled by Aphrodite, the goddess of love; and Hermes, messenger of the gods and god of learning and wit, ruled over Stilbon.

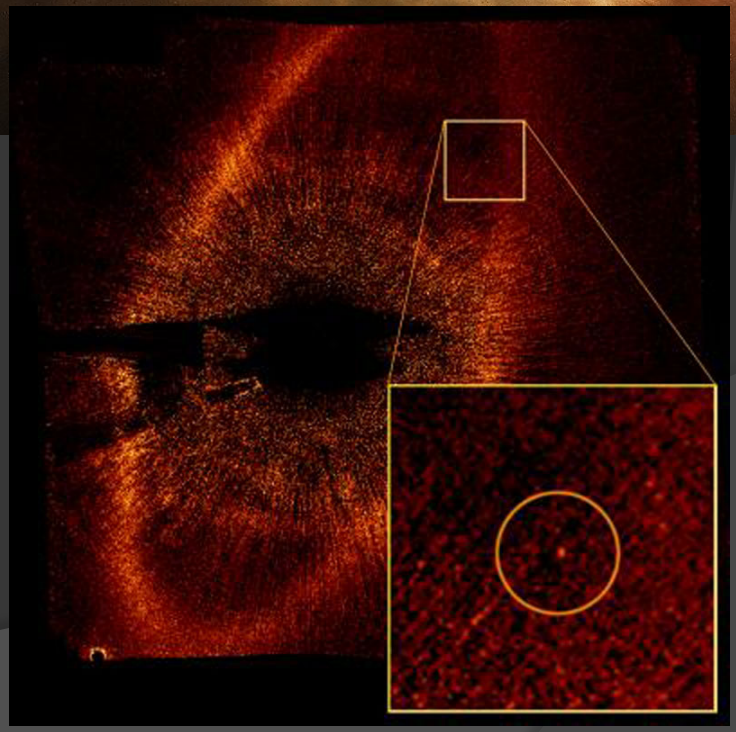
Origin of planet names

- While modern Greeks still use their ancient names for the planets, other European languages, because of the influence of the Roman Empire and, later, the Catholic Church, use the Roman (Latin) names rather than the Greek. The Romans, who, like the Greeks, were Indo-Europeans, shared with them a common pantheon under different names but lacked the rich narrative traditions that Greek poetic culture had given their gods. During the later period of the Roman Republic, Roman writers borrowed much of the Greek narratives and applied them to their own pantheon, to the point where they became virtually indistinguishable. When the Romans studied Greek astronomy, they gave the planets their own gods' names: *Mercurius* (for Hermes), *Venus* (Aphrodite), *Mars* (Ares), *Iuppiter* (Zeus) and *Saturnus* (Cronus). When subsequent planets were discovered in the 18th and 19th centuries, the naming practice was retained with *Neptūnus* (Poseidon). Uranus is unique in that it is named for a Greek deity rather than his Roman counterpart.

Planetary Formation

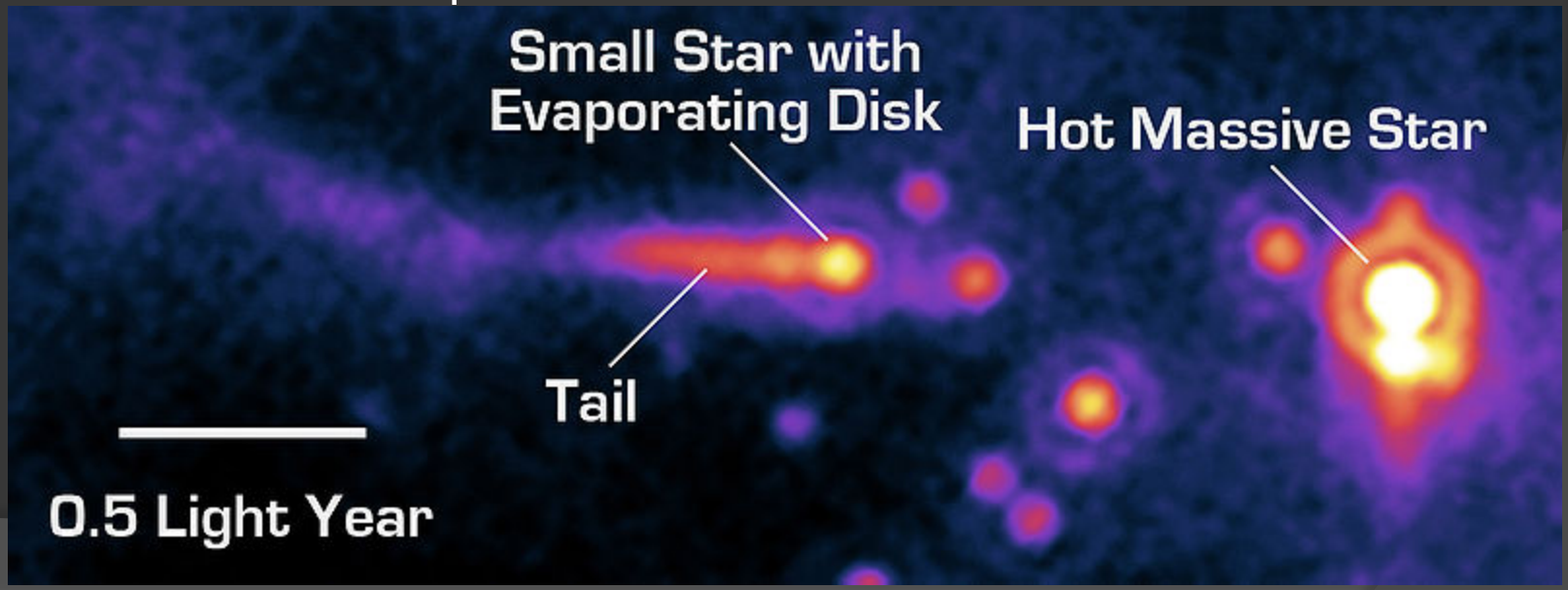
- Planets are formed during the collapse of a nebula into a thin disk of gas and dust. A protostar forms at the core, surrounded by a rotating protoplanetary disk. Through accretion (a process of sticky collision) dust particles in the disk steadily accumulate mass to form ever-larger bodies. Local concentrations of mass known as planetesimals form, and these accelerate the accretion process by drawing in additional material by their gravitational attraction. These concentrations become ever denser until they collapse inward under gravity to form protoplanets. After a planet reaches a diameter larger than the Earth's moon, it begins to accumulate an extended atmosphere, greatly increasing the capture rate of the planetesimals by means of atmospheric drag.





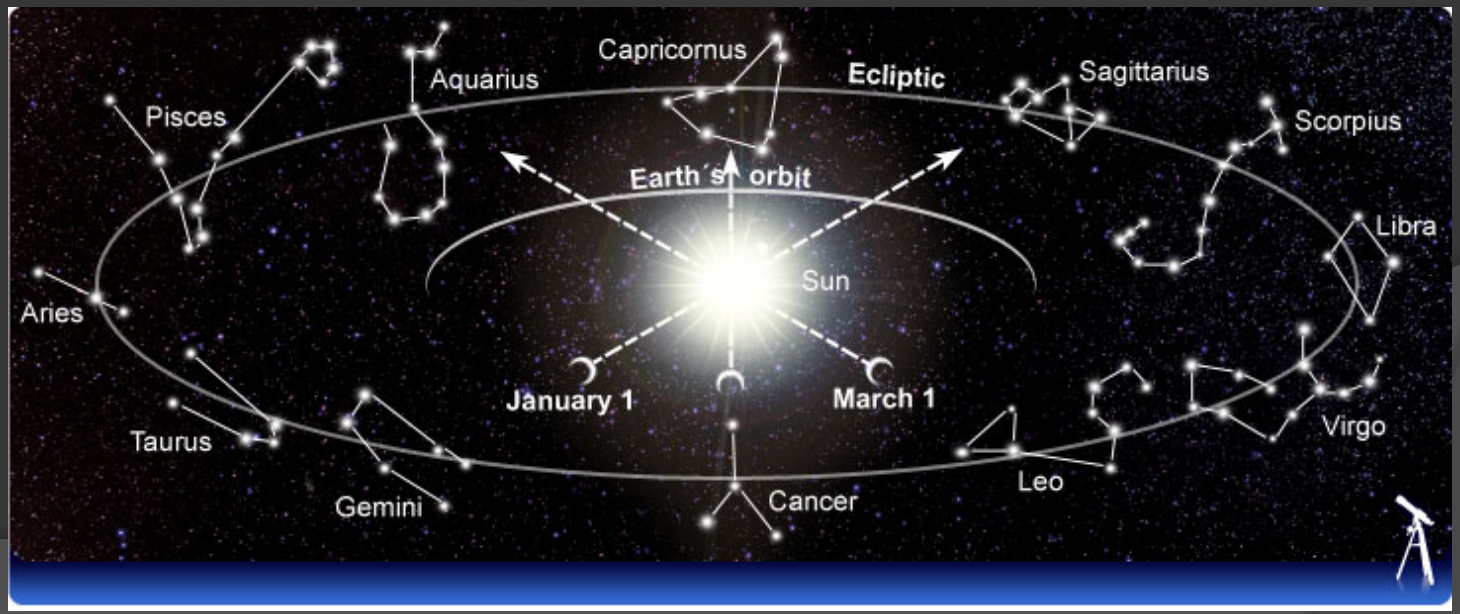
Planetary Formation

- When the protostar has grown such that it ignites to form a star, the surviving disk is removed from the inside outward by the solar wind. Thereafter there still may be many protoplanets orbiting the star or each other, but over time many will collide, either to form a single larger planet or release material for other larger protoplanets or planets to absorb. Those objects that have become massive enough will capture most matter in their orbital neighborhoods to become planets. Meanwhile, protoplanets that have avoided collisions may become natural satellites of planets through a process of gravitational capture, or remain in belts of other objects to become either dwarf planets or small bodies.



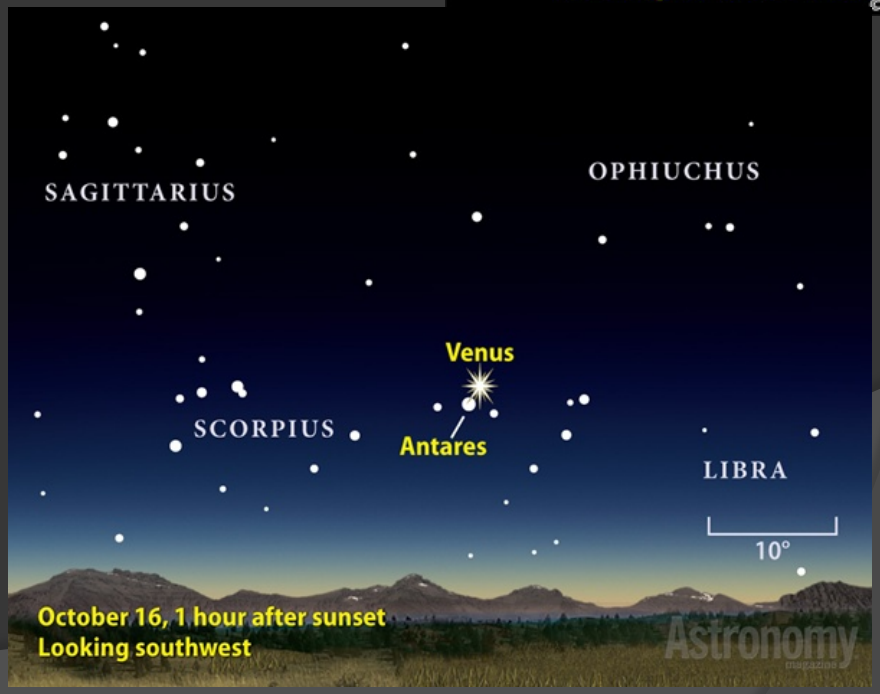
Observing the planets

- You don't need your own Voyager to see the solar system. You can see much of it from your own back yard. Of course, you don't see the fantastic close up views that NASA gets, but you can see it first-hand with your own eyes.
- Finding the planets: The planets lie on or near what is known as the plane of the ecliptic, the path the Sun follows through the sky. Knowing this path isn't enough, though, since the planets are moving targets. Astronomers use an ephemeris to locate the planets, but for the amateur it is probably easier to use software or an astronomy magazine to know where to look.



Observing the planets

- Sky and Tel website
- Astronomy Website

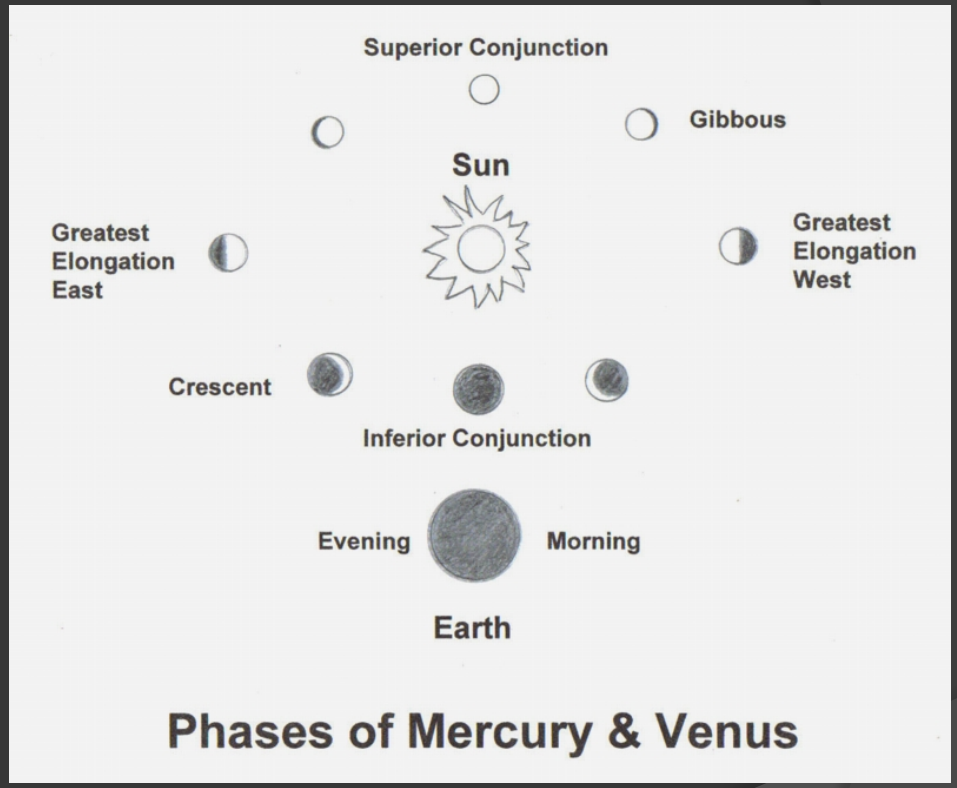


Mercury

- Mercury is considered one of the five bright ancient planets along with Venus, Mars, Jupiter, and Saturn because it has been followed since antiquity. It is visible to the unaided eye and is as bright as Saturn, but it is the most neglected of the five. The problem with Mercury is that even under the best conditions it can only be observed low in the twilight sky where atmospheric turbulence from the cooling evening causes blurring. Mercury provides a rewarding challenge for the patient observer especially since legend has it that Copernicus never saw Mercury.

Mercury

- Under the best conditions Mercury never appears more than 12 arcseconds in diameter, but can shine as bright as magnitude –2 which makes it easy to locate given a clear western horizon on a spring evening, or eastern horizon on an autumn morning. During those times of the year, the path the planets follow, the ecliptic, is nearly perpendicular to the horizon. This places Mercury higher above the horizon than at other times of the year. Half the fun is locating and following Mercury each evening. A small telescope will increase the fun by resolving the phases as Mercury goes from a small, nearly full disc to a larger, thin crescent in the evening and from a larger, thin crescent to a small, nearly full disc in the morning. Unfortunately, even the most experienced observers only give Mercury a quick glance, forgoing a chance to potentially observe surface detail.



Venus

- Venus can be the closest planet to Earth (25 million miles), but in spite of its closeness, Venus reveals very little detail because it is completely covered by thick carbon dioxide and sulfuric acid clouds. There is no hope of seeing the towering mountains, rolling plains, or majestic canyons. But there is still much to see and sketch!
- **The Phases:** Since Venus orbits the Sun closer than the Earth, it passes between the Sun and us. It can never appear very far from the Sun in our sky and therefore can never be seen all night. As Venus swings from the far side of the Sun towards us, it grows from a small disc to a large, but thin crescent. It can range in size from 10 to 64 arcseconds across and blaze at a magnitude of –4.7. The crescent becomes sliver thin as Venus drops out of the evening sky and passes between the Sun and us. It then appears in the morning sky shrinking in size as it goes from a thin crescent to a disc as it heads for the far side of the Sun again. The phases can be seen with a small telescope while the crescent can be seen with binoculars. In fact, a few people claim that the very large and thin crescent phase of Venus can be seen with the unaided eye! If you have 20/15 vision or better, give it a try! Otherwise, simply enjoy the changing phases through the telescope.

Venus

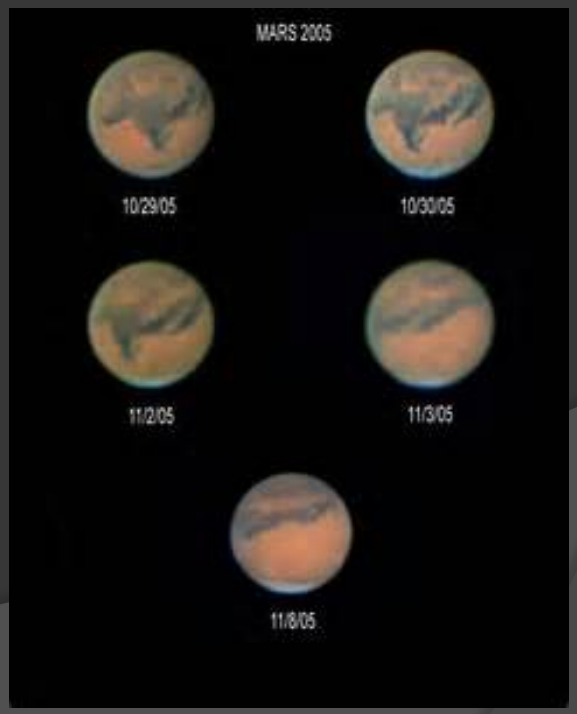
- **Cusp Caps:** This is where one of the crescent's horns appears unusually bright or blunted. Usually it is the southern horn. Often the cap is bordered by a dark (dusky) collar. This event can last for weeks and should be watched closely as it is most likely caused by the strong circulation patterns in the clouds of Venus.
- **Ashen Light:** When Venus is a large, thin crescent there may be a glow on the night side. The cause is not understood, but it is not Earthshine since the Earth is too far away. It may be caused by airglow, thunderstorms, or perhaps even the intense surface temperatures. Ashen light often appears reddish or violet.
- **Cusp Extensions:** Venus has a thick atmosphere and when the crescent becomes sliver thin, the horns can appear greatly prolonged like those on the Turkish Flag. Sometimes there can be tiny, detached points of light at the tips of the horns. Even more beautiful is when the horns unite to form a delicate ring of light around the night side. Try watching for all of these phenomena whenever Venus is near inferior conjunction, a time when Venus is nearly between the Earth and Sun and at its closest and largest
- **Terminator Deformations:** Frequently the terminator will display a serrated edge that can affect the curvature. Use a red (W23A or W25) filter and you will be surprised to see that the terminator has a soft contrast at times. There is a recurring notch near the southern cusp cap that can be dramatic along with a smaller notch in the north. A rich blue (W38A) filter also gives the terminator a soft hue and may enhance the dusky notches. This is also most likely caused by the strong circulation patterns in the clouds of Venus.

Mars

- Mars is the only object in the universe besides the Moon where detail can be seen on a solid surface. It is not an easy planet to observe because it is usually too small to see any detail. It is the next planet outwards from the Earth, but it is a small world at 4220 miles in diameter. Opposition is a time when a planet is closest to Earth and therefore at its largest, brightest, and up all night. Unfortunately the speed of both Mars and Earth around the Sun are not much different with Mars being the slower of the two, which means that oppositions occur roughly every 26 months. This is quite a long wait compared to the other outer planets. Even after the long wait, not all oppositions are decent due to Mars' highly elliptical orbit. The result is that Mars can come as close to Earth as 34.6 million miles and be as large as 25.2 arcseconds across, while at other times it is as much as 63.0 million miles and barely 13.8 arcseconds across. The rest of the time Mars is on the far side of the Sun, barely 4 arcseconds across, featureless, and no larger than Uranus through a telescope.

Mars

- Here are several techniques to help maximize each viewing session with Mars:
  - Observe Mars as much as possible at least one to two months before and one month after opposition. By viewing Mars enough times before opposition the eyes will become trained to see finer detail and it will also be possible to become familiar with the varying features on the different sides of the planet. This will make the observing sessions closest to opposition more pleasurable.
  - Do not be afraid to max out the telescope by using the highest power possible that seeing will allow. If it is too turbulent, then nothing much can be done, but on good nights a minimum magnification of 100x is suggested, but 200x to 300x is preferred. This will depend on the atmospheric conditions and the telescope, but the moments of steady seeing will be rewarding.
  - Observe Mars when it is highest in the sky. In order to minimize the blurring from atmospheric turbulence, it is best to observe through the least amount of atmosphere, therefore viewing near the horizon is less ideal since haze will wash out detail. It is best to allow Mars to climb higher for at least two hours after rising

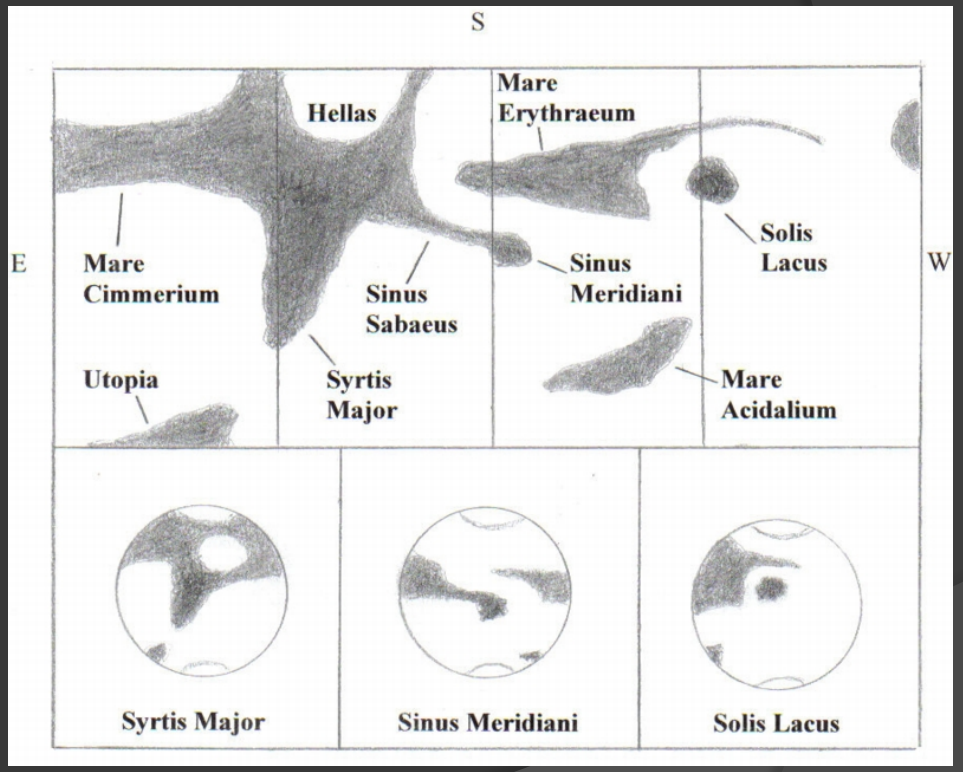


Mars

- These simple rules will assure a decent view of the Red Planet, but there is one more important technique that is often overlooked. A color filter is a vital accessory to an eyepiece, just as an eyepiece is a vital accessory to a telescope. A set of color filters should be considered mandatory for every telescopic observer. Features on a planet reflect sunlight in varying colors. A filter absorbs a specific color of reflected sunlight, such as red. Absorbing red light will reveal detail of a contrasting color such as green. The filters actually alter color in such a way as to increase contrast and enhance the details on a planet. The slight reduction of glare from a bright planet also reduces eyestrain, which helps in detecting finer detail. Planetary filters are labeled with the same Kodak Wratten number as in photography. With Mars revealing a solid surface of rock and desert, ice caps, dust storms, clouds, and hazes, filters of every color are capable of revealing something:
  - **Red (#25):** The dark surface features will be enhanced as a red filter cuts through the haze and steadies the Earth's turbulent atmosphere. This filter is dark and is best for larger telescopes at lower powers.
  - **Orange (#21):** This is the best all-around filter for Mars and for any planet. Since it is not as dark as a red filter the contrast will be dramatic between the dark areas and the brighter deserts as it subdues the brilliance of the reddish areas and reveals finer detail. An orange filter is considered the best to use in order to steady the Earth's turbulent atmosphere. It also darkens a bright background if viewing in twilight.
  - **Yellow (#15):** A yellow filter is generally used for penetrating the atmosphere and enhancing the fine particles associated with dust storms. If Mars is experiencing a dust storm, this filter will help define them. If the storms are unusually intense, it might be possible to see some texture in the dust clouds.
  - **Green (#58):** An excellent filter for increasing the contrast of the polar ice caps and for studying details within them. Green also enhances the dark band that is often seen surrounding the ice caps. This filter can also be used for detecting dust storms and other clouds as it makes brighter areas and white areas stand out more clearly against the reddish surface.
  - **Blue (#38A):** Water ice clouds in the upper atmosphere and hazes, particularly along the limb, will stand out better with this filter. A lighter blue filter (#80A) will have the same effect and may be better for smaller telescopes.
  - **Violet (#47):** This is a very dark filter best used for larger telescopes and is useful for detecting polar hazes and structure in the high altitude clouds. Surface detail is washed out with this filter, but it can suddenly become sharply visible on rare occasions. This unexplained phenomenon is known as "violet clearing".

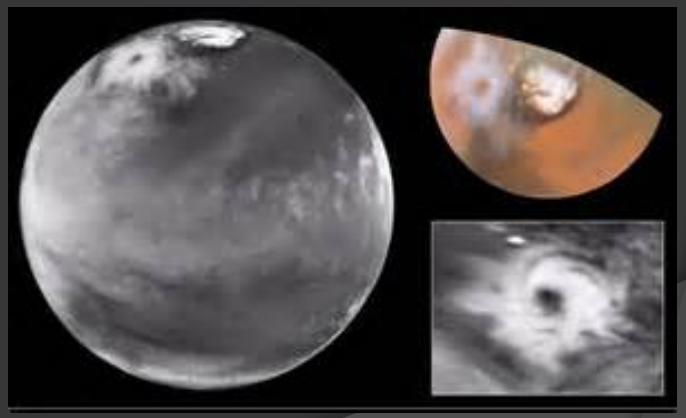
Mars

- Mars will give an impression of a world like Earth with dark patches appearing like continents among an ocean of pink deserts, polar ice caps, clouds, and dust storms. There is plenty to observe in telescopes as small as a 3-inch refractor.
- **Dusky Features:** The most obvious feature on Mars is the overall bright, peach-like hue that is actually a vast global desert. The ruddy hue is due to iron ores in the soil similar to red clays on Earth and causes Mars to appear as a reddish star in the night sky. The darker features on Mars are often referred to as maria, but are actually vast rocky outcrops that have been blown free of brighter dust. These areas appear tan or brownish, but may appear greenish due to the brighter, redder hues that dazzle the eye and create a greenish after-image on the retina. This trick on the eye was so convincing that generations of astronomers were convinced that the dark areas were actually covered with simple plant life such as lichen and moss.
- The darkest regions on Mars include a vast triangular area known as Syrtis Major and a pipe-shaped area complete with a bowl and stem called Sinus Meridiani and Sinus Sabaeus. The Solis Lacus region appears like a dark spot and is called the “Eye of Mars” since it resembles the pupil of an eye. This particular feature has been known to undergo dramatic changes; it can grow larger and darken, or shrink and fade. All of these dark regions should be watched carefully for any sudden change in shape or color. There is a seasonal wave of darkening as spring advances in either hemisphere, but this has never been fully understood and may be caused by local winds scouring the terrain clear of brighter dust. These dark features are visible during steady seeing in the smallest telescopes when Mars is closest to Earth. It is fascinating to follow them as Mars rotates during the course of a night reminding us how similar Mars is to Earth.



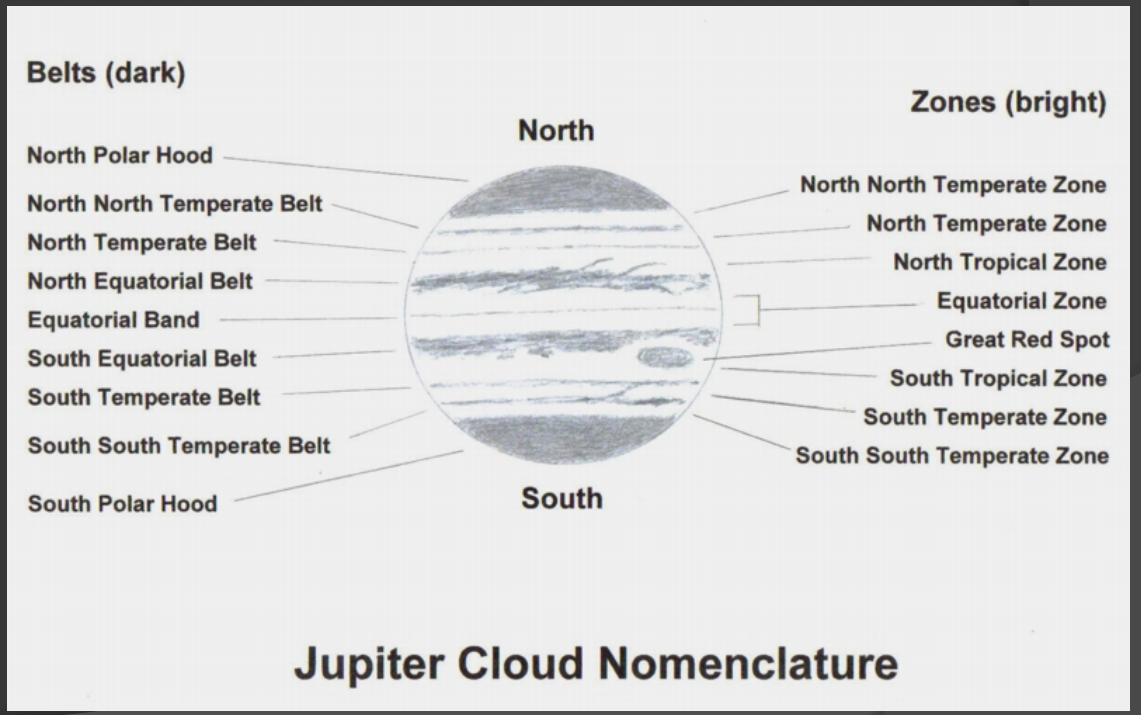
Mars

- **Polar Ice Caps:** These are the brightest features on Mars and it is interesting to follow the changes in size as the Martian year progresses. The north polar cap is made of water ice overlaid with carbon dioxide ice, also known as dry ice. The south polar cap is completely composed of dry ice. As spring advances, the ice cap will steadily shrink and is noticeable to the dedicated observer. The northern ice cap never completely vanishes, but the southern one does. This is because Mars is closer to the Sun during the southern summer and without oceans to moderate the temperature as on Earth, the southern hemisphere warms enough to melt the ice cap.
- **Atmospheric Phenomenon:** White clouds are seasonal, consist of water ice, and usually form during the warmer seasons. They become more numerous and cover a larger area of the poles as the ice caps melt or grow. These clouds occur close to the surface and are probably fogs. They are also seen along the morning terminator as a haze and dissipate after sunrise. White clouds also form near the largest volcanoes: Olympus Mons, Pavonis Mons, Ascraeus Mons, and Arsia Mons and appear as bright spots.



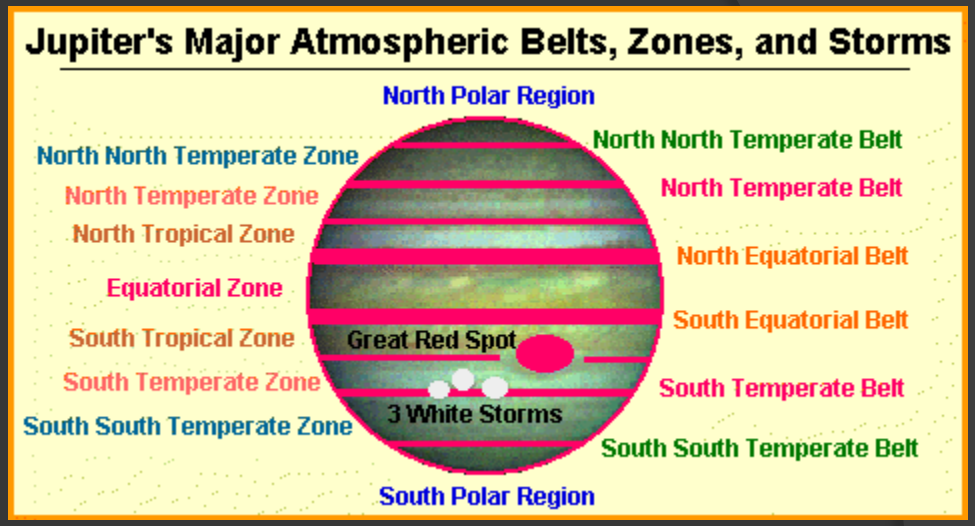
Jupiter

- Jupiter is the best planet to observe as it consistently displays a wealth of detail with even the smallest telescopes. Even when Jupiter is at its smallest, farthest from Earth, detail can still be seen because Jupiter is such a large planet. Since it rotates in just 9 hours and 55 minutes, the changing features provide an excellent opportunity to practice observing and sketching skills. Jupiter is a completely cloudy world with no visible solid surface so the only details visible are its distinct cloud features. Becoming familiar with these cloud features will provide better understanding of what is being seen and a deeper knowledge of Jupiter's weather.



Jupiter

- **Belts, Zones, and Hoods:** These are the most prominent features on Jupiter and even the smallest and cheapest telescopes can reveal them. The dark bands are called belts and run parallel across Jupiter due to its strong winds and rapid rotation. The belts are areas of cool sinking air that is warming up and drying out, revealing a clearing into the darker depths. The lower, yellowish-tan clouds are composed primarily of sulfur compounds and water droplets. The bright stripes are called zones and are areas of rising air that condense into billowing whitish clouds consisting primarily of ammonia ice. The dusky cloud caps at both poles are called hoods and are usually not as prominent as the equatorial belts. Slight clearing near both poles reveals some of the deeper, darker clouds below, similar to the belts, but are somewhat obscured by ammonia haze. The North and South Equatorial Belts, which are the darkest belts, are located on either side of the equator. Larger telescopes will reveal additional belts and zones.
- **Festoons, Garlands, and Rifts:** All of these are usually thin delicate extensions of the belts that finger out into the brighter zones. A festoon bridges the entire width of a zone by connecting two belts. A garland does not connect, but instead forms a hook and may curve all the way back to form a closed loop. Another feature, known as a rift, is a bright bridge of cloud spanning from one zone to another across a dark belt.



Jupiter

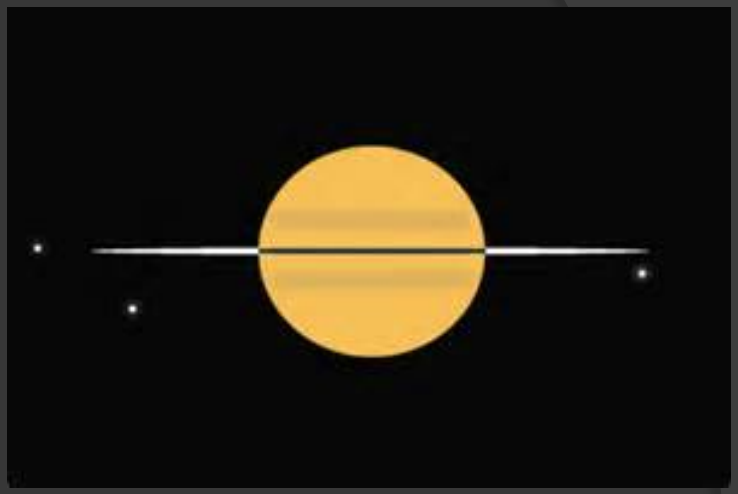
- **Ovals, Spots, and Knots:** Ovals are noncircular patches that are usually very bright and fairly large. Spots are rounder and more sharply defined, but small. Knots are thickenings or a darkening found in parts of the belts. The most famous spot of all is the Great Red Spot. It is a huge storm of towering clouds similar to a hurricane that is colored red possibly from phosphine being churned up from far below. The Great Red Spot is over twice the size of Earth and sometimes grows redder and at other times fades to a pale salmon hue. Sometimes the Great Red Spot becomes so faint that only a dent remains in the South Equatorial Belt, within which it resides. Filters are valuable when observing any planet as they can bring out fainter detail that would otherwise be invisible. The best filter for Jupiter is green (Wratten #58) as it enhances the cloud belts and especially the Great Red Spot. It also reveals the limb shadow along the edge of the planet more readily and will make it easier to see a moon passing in front of the darker clouds.
- **The Moons:** Four large moons can easily be seen orbiting Jupiter, but all the other roughly sixty moons are too small and too faint. These four large moons known as the Galilean Moons: Callisto, Ganymede, Europa, and Io, were named after the famous astronomer who discovered them, Galileo Galilei. It is fun to watch them change positions from night to night. It is possible to determine how long it takes each to orbit once around Jupiter by plotting their positions nightly. Other interesting activities include watching the moons disappear and reappear from behind Jupiter or its shadow, watching them cross in front of Jupiter, and watching their tiny shadows cross the face of the planet. It is possible on nights of excellent seeing to be able to distinguish the varying sizes of each moon. During nights of superb seeing with a larger telescope it might even be possible to detect faint detail on Ganymede, although it will be a challenge. If a moon can be seen in front of Jupiter, it might be possible to detect some color. Callisto is the darkest moon and will appear ruddy. Ganymede may appear dusky gray. Europa is an icy world and probably will appear white. Io is a sulfur-stained volcanic world and may have a yellowish tint. These colors will all be subtle, so try to observe them against Jupiter in order to cut down their contrasting glare against the blackness of space.

Saturn

- The most beautiful sight in a telescope has to be Saturn. The golden globe surrounded by the razor sharp, icy white rings set against the blackness of space is a sight to behold and is a satisfying sight in itself. Dedicated observers scrutinize Saturn closely in order to see detail on the globe and rings. There is actually much more to be seen than is apparent.

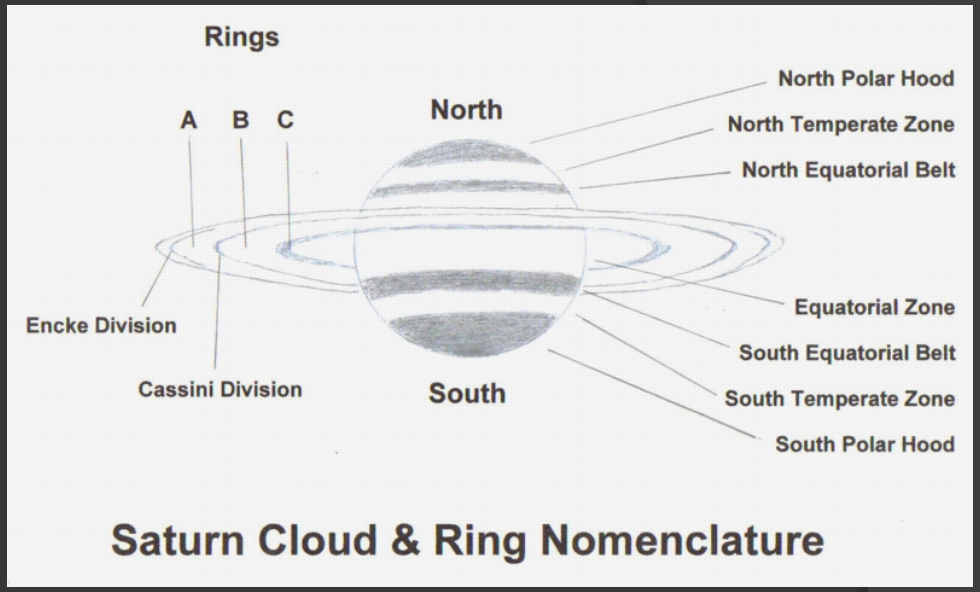
Saturn

- Saturn's globe is noticeably oblate and can be easily observed when the rings are edge-on. Saturn is a completely cloudy world with no visible solid surface and the only details visible are subtle cloud features. The most prominent features are the Equatorial Zone, Equatorial Belts, and the Polar Hoods. The nomenclature for the cloud features is similar to Jupiter, but most of the features are not visible all at once and are very subtle, so a good telescope with steady seeing are essential. The belts are areas of cool sinking air that is warming up and drying out, revealing a clearing into the darker depths. The darker yellow and yellow-tan clouds are composed primarily of sulfur compounds and water droplets.
- The Equatorial Zone is a wide, bright whitish band that wraps around the equator and is usually partially obstructed from view by the rings, but fully visible when the rings are edge-on. The Equatorial Belts are the darkest features and usually appear tan against the golden globe.



Saturn

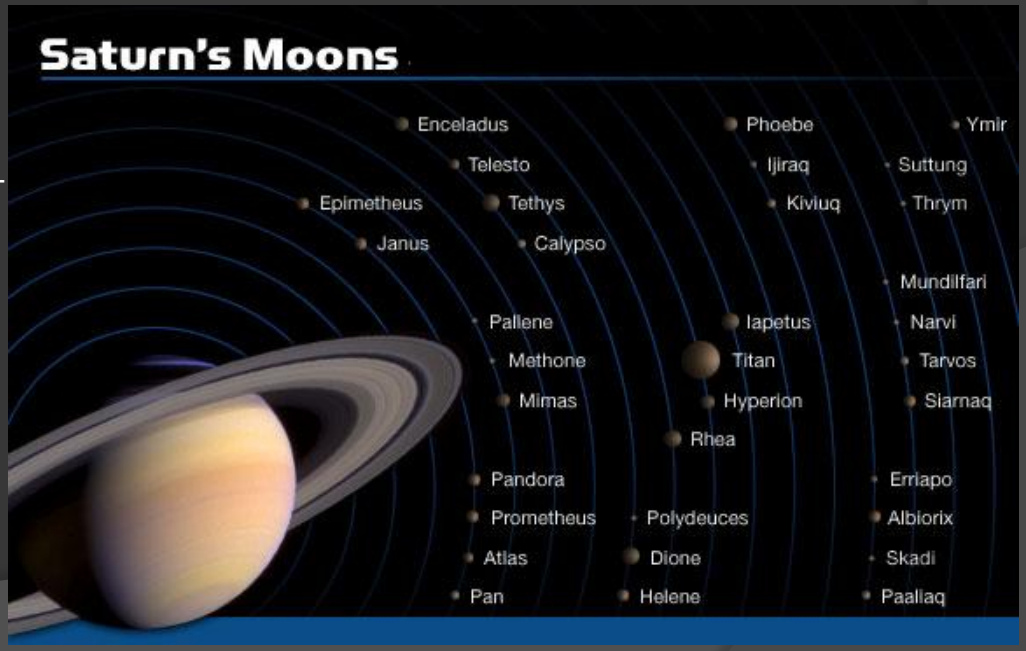
- The rings are the showcase features of Saturn and the most beautiful planetary feature in the Solar System. They are large, but thin and there is plenty to see. When the rings are wide open, look for the dark Cassini Division; it will look like a thin, dark line within the rings. It is hard to believe that this gap is as wide as the Atlantic Ocean! The outer, A ring is not as bright as the inner, B ring and it is important to take note if there are any variations in brightness within the rings. The innermost ring, the C ring or Crepe Ring, is dark and nearly transparent, but may be glimpsed when the rings are widest open as a narrow, dusky band across Saturn's globe. There is a very thin gap known as the Enke Division located near the outer edge of the A ring and is a challenge to see even in larger telescopes. The famous spokes that the Voyager and Cassini spacecraft have seen are worth looking for as amateur equipment becomes more advanced. Take notice that at certain times when the rings are sufficiently open it is possible to see the shadow of the globe on the rings and the shadow of the rings on the globe.
- The edge-on rings are also interesting to observe and great care should be taken to note if the rings reveal any brighter clumps when nearly edge-on. It is also interesting to note the dark line that crosses Saturn when the rings appear to be missing. Try to determine if the line is smooth or clumpy, but do not confuse any of the moons for a clump. With the rings nearly gone it will be easier to see the fainter inner moons. It is also the time to observe the transits, eclipses, occultations, and shadow transits of the moons.



Saturn Cloud & Ring Nomenclature

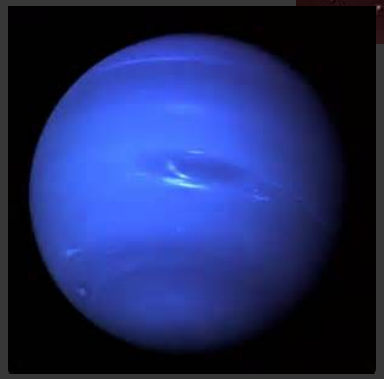
Saturn

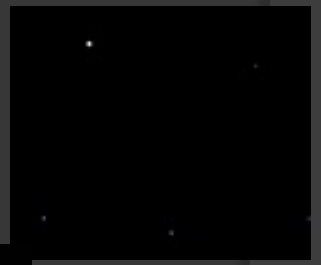
- Up to eight moons can be seen orbiting Saturn: Mimas, Enceladus, Tethys, Dione, Rhea, Titan, Hyperion, and Iapetus, but Mimas and Hyperion will require a large telescope as both are very dim. The easiest moon to see is Titan as it is the brightest at about magnitude +8.3. If it can be seen transiting Saturn, it might be possible to detect an orange color that is due to its smoggy, organic atmosphere. Iapetus is the odd, two-toned world that has one side bright as snow and the other as dark as coal. This makes it easier to see when it is on one side of Saturn than the other as its magnitude ranges from +10 to +12. Rhea is closer in than Titan, but rather easy to see at 10th magnitude. Still closer to Saturn is Dione followed by Tethys and both are a little dimmer than Rhea. Enceladus is a little closer to Saturn than Tethys, but at a dimmer magnitude of about +11 it is a challenge. It can be seen with a high-quality 4” refracting telescope. Mimas is the closest and very dim at magnitude +13 while Hyperion orbits just a little beyond Titan and is very faint at magnitude +14. Observing these two moons is regarded as a major accomplishment.



Uranus and Neptune

- Uranus and Neptune are often overlooked because they are dim and considered too remote to seriously observe; however, under clear, moonless nights away from city lights, and with good finder charts it is surprisingly easy to find and track these nearly forgotten worlds.
- Uranus and Neptune are dim because they orbit the Sun at a distance of 1.8 and 2.7 billion miles, respectively. In the dim depths of the outer Solar System, daytime sunlight is no brighter than a clear evening sky on Earth shortly after sunset. Both planets are about four times larger than Earth, slightly over 30,000 miles in diameter, and have thick atmospheres that are completely cloudy. The small amount of methane (2%) in Uranus' atmosphere absorbs the red component of sunlight and scatters the blue creating a turquoise hue. Neptune appears even bluer since it is not as hazy and has more methane (3%). These colors are dramatic whenever they are near stars of contrasting colors.
- Given a night of steady seeing, a small telescope should be capable of resolving the discs and revealing the colors of these remote worlds; however, both planets are too far away to observe cloud detail or moons unless the telescope has an aperture of at least 16 inches. Uranus is generally 3.7 arcseconds across and shines around magnitude +5.7 and Neptune is generally 2.3 arcseconds across and shines around magnitude +7.8. The planets appear distinctly different with Uranus having a rich turquoise hue while Neptune is a chilly, icy-blue disc.





Astro League Solar System Program

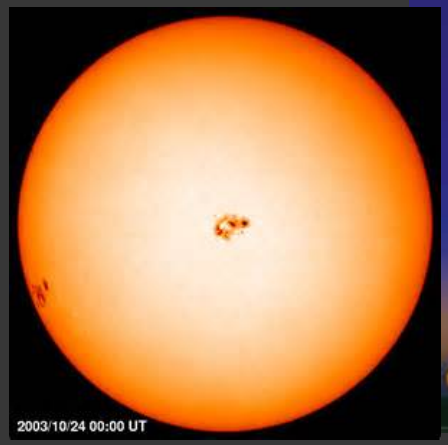
- The Solar System Observers Program is a list of thirty-four selected projects designed to introduce you to the pleasures of planetary observing. Observing skills come only with experience. An eye trained by observing will see more, regardless of what type of optical aid is used. Good observing skills reinforce the desire to observe. Observing trains the eye to see. It is a cycle that has to be willed to happen. Given the time and effort it WILL happen. Once it happens, astronomy will become a joyful lifelong experience.

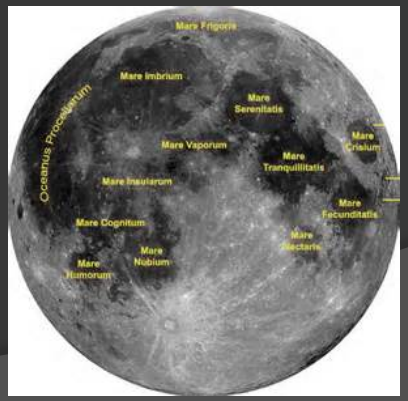
Astro League Solar System Program

- To qualify for the A.L.'s Solar System Observers Program Certificate and pin, you need only be a member of the Astronomical League, either through an affiliated club or as a Member-at-Large, and complete twenty-five of the suggested projects. Record your observations on copies of the included log. Some observations may require sketches, but don't panic; artistic prowess is not required. Make as many copies of the log sheet as you will need. Fill in information appropriate to that project.

Astro League Solar System Program

- **The Projects for the Sun and Moon**
- SUN: Sunrise, Sunset Azimuth Positions
- SUN: Solar Eclipse
- SUN: Sunspots
- MOON: Maria
- MOON: Highlands
- MOON: Crater Ages
- MOON: Scarps
- MOON: Occultations
- Moon: Lunar Eclipse





Astro League Solar System Program

- **The Projects for the Inner Solar System**
- MERCURY
- VENUS: Low Power Crescent
- VENUS: Daytime Observation
- VENUS: Phases
- MARS: Albedo Features
- MARS: Retrograde Motion
- CERES: Locating
- ASTEROIDS: Course Plotting
- ASTEROIDS: Measuring their Movement
- COMET: Observing

Astro League Solar System Program

- **The Projects for the Outer Solar System**
- JUPITER: The Great Red Spot
- JUPITER: The Galilean Satellites
- JUPITER: The Cloud Belts
- JUPITER: Satellite Discovery
- JUPITER: Satellite Shadow Transits
- JUPITER: Satellite Transits
- JUPITER: Satellite Eclipses
- JUPITER: Satellite Occultations
- SATURN: The Rings
- SATURN: The Cassini Division
- SATURN: Disk Markings
- SATURN: The Satellites
- URANUS: Locating
- NEPTUNE: Locating
- PLUTO: Locating

Try it you will be glad you did!

- Most planetary observations can be done from home.
- Observing the planets will make you a better observer.
- Get out under the night sky and follow in the footsteps of our ancestors.