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J S U N I L T U T O R I A L

P U N J A B I C O L O N Y G A L I 0 1

Definition of Astronomy Terms

The terminology used in astronomy can sometimes be a little intimidating or confusing at first. Have no fear! This is a list of basic definitions for some common astronomy terms that are used throughout this web site.

Absolute Magnitude: Measures the brightness of a star as it would appear if it was located at the standard distance of 10 parsecs (32.6 light years). This provides an easy way to compare the brightnesses of stars that lay at different distances from Earth. Our own sun has an absolute magnitude of +4.8. Compare with magnitude.

Apparition: Describes the length of time during which a celestial object can be observed. This term is often used in reference to Mercury or Venus as they change between being visible in the morning or evening sky. For example, the several month long period of time when Venus is visible in the morning sky is called the "morning apparition of Venus". When the planet moves into the evening sky, it's called the "evening apparition". Apparition is also used in reference to a comet's entire period of visibility.

Asterism: A conspicuous pattern of stars that happen to be arranged in a familiar shape is sometimes given a proper name but does not make up an official constellation. *The Teapot* in Sagittarius and *The Big Dipper* in Ursa Major are good examples of asterisms.

Astronomical Unit (AU): A unit of distance equal to the mean radius of the Earth's orbit around the Sun. It's helpful for visualizing huge distances by giving a comprehendable reference scale! 1 AU = 93 million miles

Binary Stars: Two stars which are gravitationally bound to one another. Each star moves in an elliptical orbit around the other, just as the planets of our solar system orbit the Sun. These stars usually appear very close to one another in space, and generally a telescope is required to see each star individually. In reality, the stars are tens to hundreds of AUs apart.

Celestial Equator: The plane of the Earth's equator projected into space, resulting in an imaginary line across the sky which separates the northern hemisphere sky from the southern hemisphere sky. The celestial equator is the zero point for declination, which is the celestial coordinate system's equivalent of latitude. Since we are in the northern hemisphere, we can see all of the northern hemisphere sky. Just how much of the southern hemisphere sky you can see will depend on your latitude on earth. If you lived at the north pole, you would only see the northern sky. As you travel south from there, more of the southern hemisphere's sky tilts into view.

Circumpolar: Describes a celestial object which never sets below the horizon as seen from a particular latitude.

Conjunction: In general, conjunction is an alignment of two (or more!) celestial bodies along the same line of sight as viewed from Earth, so that they appear to occupy the same location in the sky. See also Inferior Conjunction and Superior Conjunction.

Dark Nebula: An interstellar cloud of gas and dust that cannot be seen because there are no nearby stars to light it. The gas and dust are thick enough to hide the stars behind it, causing dark nebula to look like a conspicuously empty, black patch of sky if it happens to exist in front of a brighter background such as a star field.

Eclipsing Binary Star System: In a binary star system, an eclipsing binary occurs when the orbit of the pair of stars appears at or close to edge-on as viewed from Earth. As a result, the combined apparent brightness, or magnitude, of the pair will vary on a regular cycle, reaching minimum brightness as one star passes in front of the other.

Ecliptic: The ecliptic is the plane of the Earth's orbit around the Sun projected onto the sky. The effect of Earth's orbit is to make the Sun appear (from our perspective) to orbit the Earth once per year. Thus, as the year progresses, the sun appears to move through the different constellations of the zodiac. The line traced by the Sun's apparent motion projected onto the celestial sphere represents the ecliptic. You will often see this line drawn on star maps. Since the orbits of all the other planets are only slightly inclined to the plane of Earth's orbit, you will always find the other planets close to the line of the ecliptic. (*Important!* Do not confuse this with the path that the sun travels across the sky during the course of the **day**!)

Elongation: The angular distance between the sun and an object in orbit as measured from a viewpoint on Earth. In other words, elongation is the measure of how far from the sun an object in our sky appears. The term "greatest elongation" is often used in reference to the appearance of the planets Venus and Mercury. Since these two never stray very far from the sun, greatest elongation represents the peak time for observing because their largest distance from the sun often translates into greater altitude above the horizon and a darker sky. How much altitude is obtained at greatest elongation is highly dependant upon the angle that the ecliptic makes with the horizon. This angle changes with the time of day and the seasons. If the ecliptic forms a shallow angle with the horizon (as in the morning during spring or the evening during fall), greatest elongation does little to improve the planet's altitude above the horizon since most of the distance from the sun is concentrated horizontally. But if the ecliptic forms a steep angle with the horizon (like in the evening during spring or in the morning during fall), nearly all of the planet's distance from the sun is translated into altitude, and greatest elongation during these times can send Mercury or Venus high into the sky!

Emission Nebula: An interstellar cloud of gas, located around or near hot, energetic stars. The ultraviolet radiation from these stars ionizes the hydrogen within the nebula causing it to glow with its own light. This type of nebula is easily recognized in astrophotos due to the characteristic red color of ionized hydrogen. The Rosette Nebula (NGC 2237) is a example of an emission Nebula.

Globular Cluster: A densely concentrated, spherical object containing hundreds of thousands of stars which are part of, but not in, our galaxy. Globular clusters are in orbit around our galaxy in the galactic halo. These clusters are generally tens to hundreds of light-years in diameter with about one star per cubic light-year. The stars in a globular cluster are very old, and may be as old as the universe itself: 15 billion years! Small telescopes often show globular clusters as circular puffs of gray light with perhaps some graininess suggesting the myriad unresolved stars it contains. Larger scopes are usually need to begin resolving individual stars. There are about 140 globular clusters known to surround our galaxy.

Inferior Conjunction: This type of conjunction occurs when a planet passes between the in front of the Sun as seen from Earth and therefore occupies the same spot in the sky. Venus and Mercury are the only two planets that can come to inferior conjunction (they are the only two planets with orbits inside of Earth's!). The planets become unviewable when close to inferior conjunction because of the Sun's extreme brightness. The Moon also comes to inferior conjunction, but we commonly call this event New Moon...or sometimes a solar eclipse! Compare with Superior Conjunction.

Light-Year: The distance traveled by light through the vacuum of space in one year, used to help express the mind-bogglingly large distances between celestial objects. A light-year is equal to 5.88×10^{12} miles (yes, that's 5 *trillion*, 880 *billion* miles!), or 9.46×10^{12} kilometers. *Important!* Remember, this term is a measure of distance, **not** time, despite the word "year" in its name! See also light speed.

Light Speed: Light travels so fast that it's easy to forget that it does have a measureable speed! Light travels at the constant speed of 186,282.4 miles every second (299,792.5 km per second). The light from our sun actually takes 8.32 minutes to reach our eyes, while light from the Andromeda Galaxy takes *2 million years* to reach our eyes.

Luminosity: *Intrinsic* or *actual* luminosity is the measure of the energy output of a celestial object that emits light (usually a star) per unit of time. *Apparent* luminosity is measured as viewed by an observer on Earth, and therefore depends upon the distance to the star as well as energy output. If the intrinsic luminosity of an object is known and the apparent luminosity can be measured, then the distance to the object can be found. This is the principle which makes Cepheid variables useful for distance measurements.

Magnitude: A number designating the relative brightness of a star or other celestial object. A bright object receives a lower magnitude number, and negative magnitudes are possible. For example, the full moon is magnitude -12 and Sirius (the brightest star) is magnitude -1.5, while Polaris (the North Star) is magnitude +2.1. Naked eye visibility limit is considered to be about magnitude +6. The small telescope limit is about +12 depending on aperture. A drop of one full magnitude means an object is

2.512 times brighter, and a drop of 5.0 means an object is 100 times brighter. For example, a magnitude +1.0 star is 100 times brighter than a magnitude +6.0 star. Compare with absolute magnitude.

Messier Catalogue: A listing of over a hundred bright galaxies, star clusters, and nebulae compiled in the late 1700s by French astronomer Charles Messier. Each member of the Messier Catalogue is designated by a number preceded by the letter "M" (for example: M42 or M101). Originally intended as a inventory of objects that could be confused with comets (Messier's true interest was studying comets), the catalogue contains some of *the best* objects for small telescopes. Although even a cursory glance at most Messier objects through a modern small telescope will reveal their true non-comet nature, remember that Messier's 18th century instruments were not nearly so refined as those available to today's beginner!

Nebula: The general term used for interstellar gas and dust from the Latin word for "cloud". Nebulae are mostly made up of hydrogen gas, and there are several different types. Emission nebula, reflection nebula and dark nebula are all essentially the same except for how they are lit. A planetary nebula is different in that they mark the death of a certain class of star. See Emission Nebula, Reflection Nebula, Dark Nebula, and Planetary Nebula.

North Celestial Pole: In the northern hemisphere, the point in the sky around which all the stars appear to rotate due to the spin of the Earth. The position of the North Celestial Pole (NCP) represents the spot in space toward which the axis of Earth's rotation is pointing. Because the Earth slowly wobbles as it rotates, much like a spinning top sometimes wobbles as it spins, the position of the North Celestial Pole among the stars changes very gradually over time, tracing a 47º diameter circle around the sky every 25,780 years. Currently, Polaris is our North Star, but in 12,000 years the bright star Vega will be the closest bright star to the NCP.

Occultation: When an astronomical object appears to pass over and cover another astronomical object as seen from a particular observing site. Often used in reference to the Moon obscuring a planet or star from view.

Open Cluster: A loose collection of stars having no well defined shape and often full of relatively young stars. Sometimes referred to as galactic clusters, they are found within the plane of our galaxy. They can contain anywhere from a few tens to hundreds of stars in an area that typically spans around a hundred light-years or less, and can be beautiful sights in small telescopes. The member stars of an open cluster generally formed from the same cloud of interstellar gas, and sometimes hints of nebulosity can still be seen surrounding the stars in photographs and larger telescopes. Remember that through the telescope, the hazy gray light of unresolved stars can look a lot like the hazy gray of nebulosity! The Pleiades (M45) in Taurus and the Beehive (M44) in Cancer are excellent examples of open star clusters.

Opposition: A geometric configuration in which the Earth lies on a straight line in between the sun and a planet. During opposition, a planet rises at sunset and sets at sunrise, which means the planet is visible all night long. Also, when at opposition a planet is generally at its closest and brightest for the year.

Penumbra: The region of partial shadow during an eclipse. For example, during a lunar eclipse, the moon first enters the penumbral shadow as the Earth begins to move between the Moon and the Sun. If you could observe this event on the Moon from a region within the penumbral shadow, the Earth would appear to only partially cover the sun. The penumbral shadow is paler and less defined than an umbral shadow. Compare with umbra

Perihelion: The closest point to the sun reached by an object during its orbit.

Planetary Nebula: Despite the name, this type of nebula actually has nothing to do planets. Sir William Hershel gave these objects their confusing name in 1782 because through his telescope they resembled planetary disks. In reality, planetary nebula result when an aging star like the Sun ejects its outter layers of gas. The discarded gas becomes an expanding shell surrounding the central star, now an exposed core. The star then begins to collapse and becomes a very hot white dwarf star. The expanding shell of gas is illuminated by the central white dwarf star through ionization exactly like an emission nebula. Planetary nebula are relatively short-lived objects, because as the expanding shell gradually dissipates into space the nebula disappears.

Position Angle: The angle specifying the orientation of two celestial objects (usually double stars) with respect to north on a scale from 0º to 360º. North = 0º or 360º, east = 90º, south = 180º, and west = 270º. How do you know which way is north through the eyepiece? Well, the easiest way is to let whatever object you are viewing drift out of the eyepiece field of view. That direction is

west, or position angle 270º. From there, finding north depends on your telescope. Through a newtonian reflector, north is 90º counter-clockwise from west. Through a refractor or cassegrain telescope, north is 90º clockwise from west because the image created by these scopes are usually mirror-reversed.

Proper Motion: The apparent motion of a star across the sky caused by both the star's true motion through space and the solar system's relative motion. This motion is generally *very* slow, taking many years to detect at minimum.

Quadrature: Describes the moment when the angle between the Sun and a superior planet (one with an orbit outside of Earth's orbit) is exactly 90º as viewed from Earth. Eastern quadrature means the planet is 90º east of the Sun, while western quadrature describes a planet west of the Sun. Ordinarily, superior planets do not display any phase other than full or very nearly full. But the quadrature position allows observers on Earth to notice a slight phase effect on the target planet, because we are viewing the planet from the most oblique angle possible compared to the direction of the Sun's illumination. The phase effect is most noticeable on Mars when it reaches quadrature, while Saturn at quadrature rewards observers as the planet's globe casts the longest shadow across the rings. For Jupiter at quadrature, an observer can more easily observe the Galilean satellites as they move in and out of Jupiter's shadow.

Quasars: Star-like objects believed to be the highly active centers of very distant galaxies. In fact, are among the most distant objects known. These unusual objects each emit as much energy as hundreds of normal galaxies, which enables these objects to be seen despite their great distance.

Reflection Nebula: An interstellar cloud of gas and dust that can be seen because it reflects light from nearby stars. This type of nebula has a characteristic blue color in astrophotos. The blue nebulosity seen surrounding the stars of the Pleiades (M44) in some astrophotos is a good example of a reflection nebula.

Setting Circles: A set of circular dials mounted on each rotational axis of an equatorially mounted telescope which allow a polar-aligned telescope to be pointed at specific coordinates in the sky. The setting circle on the polar axis indicates the hours and minutes of right ascension, while the circle on the declination axis measures degrees and minutes of declination. Setting circles are often used to find dim deep sky objects or for day-time observing of planets.

Superior Conjunction: This type of conjunction occurs when a planet passes behind the sun as seen from the Earth. All of the planets are capable of coming to Superior Conjunction, but you won't be able to see them when they're close to conjunction because of the Sun's glare. Compare with Inferior Conjunction.

Terminator: The boundary between the lit and unlit portion of a planet or moon, especially the Earth's Moon.

Umbra: The region of deep or total shadow during an eclipse. For example, during a lunar eclipse, the Earth moves between the Moon and the Sun. If you could observe this event on the Moon from a region within the umbral shadow, the Earth would appear to completely block the sun. The umbral shadow is darker and sharp-edged compared to the penumbral shadow. Compare with penumbra

Zenith: The point in the sky that appears directly overhead of your observing site.

Zodiac: The twelve constellations through which the Sun appears travel during the course of a year. As the Earth orbits the Sun, our perspective causes the Sun to appear as if it is moving through the constellations in the background. The official zodiac constellations are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpius, Sagittarius, Capricornus, Aquarius, and Pisces. Thanks to precession and changed constellation boundaries, the Sun also travels through part of Ophiuchus, technically making a thirteenth zodiac constellation!