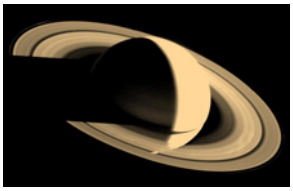
Glossary of Basic Astronomical Terms



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A

Andromeda Galaxy The closest major galaxy to our own, located about 2.5 million light years away in the constellation of Andromeda. Also known by its catalog number M31, it is the only other large galaxy in the Local Group of galaxies.

Aperture The size (diameter) of the light-collecting lens or mirror in a telescope.

Apparent Magnitude How bright a star or other object in the sky *looks* from Earth, expressed in the old-fashioned magnitude system. The brighter the star looks, the smaller the magnitude number. The brightest star in the sky, Sirius, has a magnitude of –1.42, the star Vega has a magnitude of zero, while dim Barnard's Star, with a magnitude of 9.5, is too faint to be seen with the naked eye. (Bear in mind that how bright a star *looks* to us depends on both how bright it really is — its luminosity — and how far away it is.)

Asteroid A relatively small rocky object orbiting the Sun. Most asteroids are found between Mars and Jupiter in a region called the asteroid belt, although some asteroids have orbits that cross the orbits of inner planets (like Earth). Those are the ones we worry about.

Astronomical Unit The average distance between the Earth and the Sun, about 150 million km or 93 million miles. Astronomers use this unit to express distances within the solar system.

Axis An imaginary line drawn through the center of a body, around which it spins.

B

Big Bang The high-energy, very dense beginning of the universe; the start of its expansion. The Big Bang Theory is the popular name for a whole set of ideas for the origin and early evolution of the universe.

Black Hole The collapsed remnant of a star whose gravity is so great that nothing, not even light, can escape it. More technically, a region where gravity has warped space-time so much that straight lines have become circles.

Brown Dwarf A failed star; a star that cannot (for any significant length of time) sustain itself by producing energy in its core through nuclear reactions (fusion).

C

CCD (charge-coupled device) An electronic detector of electromagnetic radiation (including light). In photography, CCD's are light-sensitive arrays that record the amount of light coming in and read them out as numbers (digits). They made digital photography possible, replacing film as the collector of light.

Comet A relatively small body made of ice and dust that orbits the Sun. Most comets remain far away and frozen solid, but when a comet approaches the Sun, its ice can evaporate and its dust can be freed, producing a large cloud of material around the frozen core, and making it much easier to spot. Light and energy from the Sun can push some of this cloud into a direction away from the Sun, producing the comet's *tail.*

Constellation In the old days, a constellation was any recognizable pattern of bright stars in the sky. Today, astronomers have given the word a more precise meaning: it is one of 88 sectors into which astronomers divide the sky (much like the territory of the U.S. is divided into sectors called states.) Each constellation "box" is named after a pattern of bright stars in it. For example, in the old system, Orion (the Hunter) is a pattern of bright stars easily recognized in the winter sky. In the new system, the "box" in the sky that includes the hunter pattern is called Orion, and it includes all the stars and galaxies in the sky that lie in the box.

Cosmology The branch of astronomy that deals with the properties of the universe as a whole — as a single system. Topics that cosmologists think about include the organization, origin, and ultimate fate of the universe.

D

Dark Energy The energy that is causing the expansion of the universe to accelerate (speed up). Astronomers have discovered this acceleration by using distant supernovae (exploding stars) as distance markers and noting that space has not been stretching at a constant rate over cosmic time. The nature of this energy is unknown at present.

Dark Matter Material which we cannot detect (by observing light or other radiation from it) but whose existence we know about from seeing its gravity affect the material in the universe that we *can* see. It appears that there is more of this mysterious dark matter in the universe than the regular matter which we see as stars and galaxies. What dark matter is made of is currently unknown.

Day In astronomy, the time a planet takes to spin (turn on its axis) once.

Declination A system of measuring the position of objects in the sky that is similar to the latitude system we use on Earth. Declination is measured in degrees north and south of the celestial equator (the circle in the sky that you would see if you extended the Earth's equator out into the sky.)

Degree A measure of angle equal to one 360th of a full circle. The dome of the sky from a point on the horizon to the opposite point measures 180 degrees.

Density The amount of mass per unit volume in a body. A cubic centimeter of lead is a lot more dense than a cubic centimeter of Jell-O.

Detector A device that registers (detects) light or other radiation. The human eye and a solar panel are both examples of detectors; telescopes by themselves are not.

Doppler shift The change in the wavelength (color) of light — or other electromagnetic radiation — caused by motion of its source toward us or away from us.

Dwarf planet An object orbiting the Sun which is large enough for gravity to make it round, but one that shares its general orbit with a number of other objects. Ceres, Pluto, and Eris are examples of dwarf planets.

E

Eclipse When one body gets into the shadow of another in space. For example, we get an eclipse of the Moon when the Earth gets right between the Sun and the Moon and casts its shadow on the Moon.

Electric charge The property of some particles of matter that causes them to attract or repel other charged particles. Examples of particles with electric charge are the electron and the proton.

Electromagnetic radiation Waves of energy generated by electric and magnetic changes in matter; these waves travel at the speed of light. Examples include radio waves, infrared waves, visible light, ultraviolet waves, x-rays, and gamma rays.

Expansion of the Universe (Expanding Universe) The observation that the groups of galaxies are all moving away from one another — we now know that this is because space itself has been "stretching" since the big bang. Recent observations indicate that this expansion is speeding up (accelerating).

Extra-solar planet A planet orbiting a star other than the Sun.

Eyepiece A magnifying lens used to view the image produced by a telescope.

F

Frequency The number of cycles (repetitions) per second in a wave, such as light. The higher the frequency, the more energy a wave carries.

Fusion A process by which light atomic nuclei come together under tremendously hot conditions to produce energy; fusion is what allows the stars to shine. When fusion occurs, some mass turns into energy.

G

Galaxy A great island of millions to hundreds of billions of stars (plus "raw material" in the form of gas and dust), separated from other galaxies by large gulfs of space. We live in one such group called the Milky Way Galaxy. (Astronomers generally write "Galaxy"

when referring to ours and "galaxy" — lower case — when referring to others.)

Galaxy Cluster a group of galaxies containing dozens to thousands of members

Gamma Ray A form of electro-magnetic radiation, consisting of waves with the highest energy.

Gamma-ray Burst Brief event which generates a huge amount of gamma-ray energy, lasting from a fraction of a second to a few minutes. Such bursts are now known to come from rare, extremely violent events in other galaxies.

General Theory of Relativity (or General Relativity) An overarching theory, developed by Albert Einstein, which relates gravity and the nature of space and time in the universe. Astronomers use the general theory of relativity as the basis of modern cosmology. Its ideas also help to explain the strange properties of black holes.

Globular Cluster A crowded group of 100,000 or more stars all traveling together, as part of a galaxy. These clusters are spherical in shape, hence their name. The Milky Way Galaxy has more than 150 such globular clusters.

Gravity The pull of all matter on all other matter in the universe. Gravity is one of the fundamental forces in the cosmos, and is responsible for pulling structures like stars together. (A more "sophisticated" or overarching theory of gravity is given by the General Theory of Relativity.)

H

Hubble's Law In an expanding universe, the farther away a galaxy is from an observer, the faster its speed of moving away. This principle was first noted in a systematic way by the American astronomer Edwin Hubble (in the 1920s). In the general theory of relativity, this behavior is expected from the fact that space-time itself is stretching. The more space there is between galaxies (or groups of galaxies, to be precise), the more space there is to stretch, and the faster the galaxies get "carried away" from each other by that stretching.

Hypernova The explosion, at the end of its life, of a very massive star, whose core collapses to be a super-compressed, spinning black hole, stirring and energize the wreckage around it. Such hypernovae are thought to be the explanation for one kind of gamma-ray burst.

I

Infrared light A type of electro-magnetic radiation with a longer wavelength than visible light. Infrared light, discovered by William Herschel, is the type of wave that human beings and chairs give off. (They also *reflect* visible light when it is shining on them, but this is not *their* radiation; it comes from another source.) Infrared is a way for astronomers to detect cooler objects, such as stars that are in the process of forming.

L

Light Year The distance that light travels in one year; roughly 9.5 trillion kilometers or 6 trillion miles. The nearest star is a little over 4 light years away.

Local Group The group of several dozen galaxies to which our Milky Way Galaxy belongs. Most of the members of the group are galaxies smaller than the Milky Way.

Luminosity The total energy output of a star or other celestial object; a measure of the total of all the visible light and other electromagnetic radiation an object gives off.

Lunar Eclipse An eclipse of the Moon; it happens when the Moon moves directly between the Earth and the Sun, and thus into the Earth's shadow.

M

Magnitude see apparent magnitude

Mass The total amount of material in a body.

Messier Catalog A catalog of "fuzzy" celestial objects compiled by Charles Messier in the 18th century. He compiled the catalog so he would not mistake the objects in it for comets (which were his passion). But the catalog turned out to be a pioneering list of the most noticeable nebulae, star clusters, and galaxies, and is still used today. Astronomers often call objects by their number in this catalog: the Andromeda Galaxy is M31, the Crab Nebula is M1.

Meteor A bit of solid debris from space, which vaporizes during its passage through the Earth's atmosphere.

Its high-speed interaction the air with air causes a brief flash of light (which is sometimes called a "shooting star" — although it has nothing to do with stars.)

Meteorite A rock from space which has survived passage through the Earth's atmosphere.

Milky Way Galaxy The galaxy of stars in which the Sun and the Earth are located; one of the two large spiral galaxies in the Local Group.

Molecule A combination of two or more atoms chemically bound together. A water molecule, for example, consists of two atoms of hydrogen and one atom of oxygen.

Moon Any object that orbits a planet (sometimes also called a satellite.) When astronomers write about the Earth's satellite, they call it the Moon, but other planets' satellites are written as moons (lower case m).

N

Nebula A cloud of glowing gas and dust among the stars. A nebula can often be observed in regions where new stars have recently been born and around stars that are dying or have died. Before galaxies were understood, they were also classified as nebulae (as in the term "spiral nebula") but we don't use the term that way any more. The plural is *nebulae.*

Neutron Star The remains of a massive star that has exploded at the end of its life as a *supernova*. These remnants are very dense, because the violence of the star's death has compressed them until electrons and protons have merged to become neutrons. Typically, neutron stars can contain more than twice the mass of our Sun in a ball about 10–20 km across. Magnetic, spinning neutron stars can sometimes be seen as *pulsars.*

O

Observatory A place where telescopes and other astronomical instruments are housed and used. Observatories that have visible-light detecting telescopes are now built on remote mountain tops, to escape the lights of civilization.

Open Cluster A group of stars within the main disk of a galaxy, containing a few dozen to a few thousand member stars, all of whom were born in roughly the same place at roughly the same time. Another name used for such a group is *galactic cluster.*

Optical Telescope A telescope that is designed to collect *visible* light (as opposed to other forms of electromagnetic radiation, such as radio waves, that are not visible to the human eye.)

Orbit The path that an object takes as it revolves around another object due to their mutual gravity. For example, the Earth has an orbit around the Sun, and the Moon and the Hubble Space Telescope both have orbits around the Earth.

Ozone Layer A region of the Earth's atmosphere (roughly 10 to 20 miles above the surface) which has a higher concentration of ozone (a molecule of oxygen with three oxygen atoms in it). This ozone absorbs harmful ultraviolet radiation coming from the Sun, contributing to the conditions that make life on the Earth's surface possible.

P

Parsec A unit of distance equal to 3.26 light years (or 206,265 astronomical units.) This unit is still used by astronomers, but is not so often heard when astronomers talk to the public.

Phases of the Moon The changing appearance of the Moon as it revolves around the Earth, caused by the differing amounts of sunlight we can see reflected from the Moon from our vantage point. (More generally, phases are the different appearances of a planet or moon as it moves around its orbit.)

Planet An object of significant size that orbits a star, but is not itself a star. According to the new definition of a planet adopted by the International Astronomical Union, planets must have enough mass to be spherical and must have their own independent orbits around the Sun — as opposed to sharing orbits with a number of other bodies. The Sun has eight planets according to this definition. (Pluto is part of the Kuiper Belt and Ceres is part of the Asteroid Belt, making them *dwarf planets*.)

Planetary Nebula A shell or shells of gas ejected by a relatively low-mass star that is in the process of dying, and becoming a white dwarf. The name is very misleading — this "last gasp" material from a star at the end of its life has nothing to do with planets.

Prominence An eruption of hot gas from the surface of the Sun. Seen against the darkness of space, it can look like a giant arcing flame.

Pulsar Originally, short for "pulsating radio star". These objects, now known to be compact, rotating, magnetic neutron stars, signal their presence to us by giving off extremely regular pulses of electromagnetic radiation.

Q

Quasar Originally, short for "quasi-stellar object" — things that first looked like a dim blue stars, but turned out to be the bright centers of a distant galaxies. These central regions shine with so much energy that they are much more easily detected than the full galaxy that surrounds them. Today, we know that their brilliance is connected with the energy produced by enormous black holes in the crowded center of each galaxy.

R

Radial Outward from the center, like the radius of a circle, or the spokes of a bicycle wheel. Astronomers often talk about "radial velocity" — the speed of something in the cosmos in the direction outward from us.

Radiation Waves of energy that move away (radiate) from their source at the speed of light. By far the most common form is electro-magnetic radiation, of which light is the best-known example.

Radio Waves A type of electro-magnetic radiation consisting of waves of long wavelength and low energy. Radio waves on Earth travel from the transmitting tower of a radio station to the antenna in your car, for example. Objects in the universe give off natural radio waves (which would sound like "static" if we were to translate them into sound.)

Red Giant A stage in the life of every star, when it runs out of its initial fuel for fusion, and, as part of its readjustment, expands to become much larger than its original size. As the hot gas of the star expands, it cools down and becomes reddish in color. A well-known red giant is Betelgeuse, in the constellation figure of Orion, the hunter.

Redshift The change in the colors of an astronomical object caused by its motion away from us. Christian Doppler discovered in the 19th century that the motion of a source of light (or other radiation) away from us or toward us changes its colors in a subtle but measurable way. The faster an object moves away, the greater its redshift is. By spreading out the light of a star or galaxy into a spectrum, astronomers can thus measure the shift of its colors and thus its speed toward or away from us (objects moving toward us show a blueshift). Galaxies beyond our immediate group of neighbors ALL show a redshift, since they are participating in the expansion of the universe.

Reflecting Telescope A telescope in which the light is collected (and reflected) by a mirror.

Refracting Telescope A telescope in which the light is collected (and refracted or bent) by a lens.

Resolution The ability of a telescope to make out fine details in an astronomical object or to separate the image of two objects that are close to each other on the sky. (Resolution in astronomy is measured in units of angle on the sky: degrees, minutes of arc, or seconds of arc.)

Right Ascension A system of measuring the position of objects in the sky that is similar to the longitude system we use on Earth. Right Ascension is measured in hours and minutes around the celestial equator (a circle in the sky that would result if we pushed the Earth's equator out into the sky.)

S

Second of Arc A very small measure of angle, often used in astronomy; equal to 1/3600th of a degree. A U.S. dime, seen from about two miles away, takes up one second of arc.

SETI The Search for Extra-Terrestrial Intelligence. The branch of astronomy devoted to finding evidence of intelligent life among the stars.

Solar Eclipse An eclipse of the Sun by the Moon; when the Moon moves in front of the Sun as seen from Earth.

Solar System The Sun and its family of planets, moons, and assorted smaller chunks of material. Strictly speaking, this term refers only to the Sun and not to the other stars; but astronomers often talk about "other solar systems", when they refer to families of planets around other stars.

Spectrum The array of wavelength or colors in a beam of light (which can be studied when the white light is spread out in a spectroscope), or a photograph of this array of colors. More generally, the array of wavelengths

found in any beam of electro-magnetic radiation.

Spectroscope A device that allows scientists to observe the spectrum of radiation from some source. Using a spectroscope, for example, astronomers spread the light of the Sun out into its component colors and can learn about the Sun's temperature, composition, and motion.

Star A sphere of hot gas that shines under its own power. The energy that allows a star to shine comes from the process of nuclear fusion. The Sun is our closest example of a star.

Sunspot A cooler region of the Sun's surface, which looks dark in comparison to the hotter material around it.

Supercluster (of galaxies) A grouping of galaxy clusters. Such superclusters may contain as much material as 10,000 or more Milky Way Galaxies and stretch over hundreds of millions of light years.

Supernova An enormous explosion that causes the "death" of a massive star. Typically, such an explosion leaves behind a neutron star, or a black hole. Another type of supernova is an explosion that occurs because a white dwarf in a double star system has re-ignited after a companion star has dumped a lot of fresh material on it. (It is this second kind of supernova, which always flares up to be roughly the same luminosity, that has allowed astronomers to measure that the expansion of the universe is speeding up.)

T

Telescope An instrument that gathers light (or another type of electromagnetic radiation) and brings it to a focus. Telescopes allow astronomers to see or photograph objects that are too dim to be seen with the naked eye.

Transit When a smaller object passes in front of a larger one in space; for example, a planet may transit a star.

U-Z

Universe The sum total of all matter, radiation, and space; everything that is accessible or can become accessible to our observations.

Variable Star A star whose *luminosity* (output of energy) changes with time — some change regularly, others at random intervals. Many amateur astronomers contribute to astronomy by monitoring such stars carefully over long periods of time. (One class of variable stars, called *Cepheids,* has special properties that allow them to be used to determine distances.)

White Dwarf The collapsed, hot remnant of a low-mass star at the end of its life. When the Sun becomes a white dwarf, it is expected to be about as small as two Earths across. White dwarf are extremely dense objects, shining only by radiating away their heat energy. Ultimately, white dwarfs fade away into black dwarfs — too cool to be seen with visible light.

Year The time it takes a planet to revolve once around its star. The Earth's year is 365 ¼ days long, but the years of other planets are different.

A Few Astronomical Glossaries on the Web

NASA Imagine the Universe Site Dictionary (for younger readers):
http://imagine.gsfc.nasa.gov/docs/dictionary.html

Amazing Space Glossary from the Space Telescope Science Institute:
http://amazing-space.stsci.edu/glossary/def.php.s=topic_astronomy

Case Western Reserve University, brief definitions of astronomical terms:
http://burro.astr.cwru.edu/stu/extras_glossary.html

Glossary from the PBS Program *Seeing in the Dark:*
http://www.pbs.org/seeinginthedark/resources-links/glossary.html

Catalog of the Cosmos from the PBS Nova Program *Death Star:*
http://www.pbs.org/wgbh/nova/gamma/cosm_nf.html

NASA/IPAC Extragalactic Database Glossary (a bit technical, but extremely thorough):
http://nedwww.ipac.caltech.edu/level5/Glossary/frames.html