

# Keywords

**Absolute dating** – Absolute dating refers to the process of assigning absolute ages to physical samples (such as rocks) or to geologic events. These ages are usually based on radioactive decay rates.

**Altitude** – The altitude of an object in the sky is the number of degrees which it lies above the horizon. At local noon the Sun could have an altitude of 90 degrees (lying directly overhead), and as it sets the altitude falls to a value of zero.

**Amazonian Period** – The last of three major periods in Martian history, lasting from 1.8 billion years to the present. This era is named for Amazonis Planitia, a low plain in the northern hemisphere. Amazonian surfaces exhibit a varied morphology, but contain relatively few impact craters. The bulk of the historical record of cratering on these surfaces has been erased by lava flows, glacial activity, and even occasional liquid water flows. Much of the northern hemisphere is thought to have been resurfaced during the Amazonian Period.

**Aperture** – A circle, or ellipse, with an open center. Astronomers often place an aperture around a single star or galaxy, and then add up all the light contained within this region in order to determine how bright the object is.

**Arcminute** – An arcminute is a unit of angular size, equal to 1/60 of a degree (recall that there are 90 degrees in a right angle). There are 60 arcseconds in an arcminute (see below).

**Arcsecond** – An arcsecond is a unit of angular size, equal to 1/60 of an arcminute or 1/3600 of a degree (recall that there are 90 degrees in a right angle). Astronomers often measure the angular separation between neighboring objects on the sky in units of arcseconds.

**Astronomical unit** – The average distance between the Earth and the Sun, equal to  $1.5 \times 10^8$  kilometers.

**Asymmetry Index (AI)** - The percentage variation in the difference between the flux emitted at one position within a galaxy and at a corresponding position located  $180^\circ$  around the galaxy center-point. This index tends to be quite low for elliptical galaxies because they have smooth, symmetric light profiles, higher for spiral galaxies due to the spiral arm structure in the disks, and higher still for interacting galaxies, which can appear quite distorted.

**BCG** – The brightest cluster galaxy (BCG) is the brightest galaxy within a cluster of galaxies. It typically resides in the core of the cluster. BCGs are known for having moderately uniform properties (such as linear size and luminosity).

**Big Dipper** – The Big Dipper is made up of the seven brightest stars in the northern hemisphere constellation Ursae Majoris (the Great Bear). It is both large and bright, and so forms a useful landmark in the northern sky. The two stars which form the outer lip of the “dipper” (bowl) shape lie along a line which points toward the North Star.

Billion – Ten raised to the ninth power, or 1,000,000,000.

Blue supergiants – Rare hot, blue stars with very high mass and luminosity that are ten to fifty times the Sun’s size. In the H-R diagram, they occupy a region above the Main Sequence and on the left.

Caldera – A caldera is a circular crater, the relic of a volcanic explosion or the collapse of a volcanic cone. Caldera is also the Spanish word for cauldron, in reference to the basin-shape of the depression.

Cassiopeia – Cassiopeia is a northern hemisphere constellation which looks like a letter “W”, making it easy to identify. It is located opposite to the Big Dipper (on the other side of the North Star).

Celestial equator – The celestial equator is the equatorial band of the celestial sphere (see below). It lies in the same plane as the Earth’s equator.

Celestial sphere – The celestial sphere is an imaginary construct designed to aid in visualizing the positions and movements of objects through the sky. It comprises a spherical surface with an arbitrarily large radius, which is centered at the center of the Earth. It has a celestial equator which lies in the same plane as the Earth’s equator, and celestial north and south poles which extend along the Earth’s rotational axis above and below the Earth’s North and South Poles. Objects in the sky can be projected onto the celestial sphere, and their motions understood in the context of the Earth’s motions around the Sun.

Central peak – A central mountain peak is produced when molten excavated material from an impact blast flows back towards the center of the excavation and creates an uplift. This typically occurs at the center of large craters, those which are 40 kilometers or more in diameter.

Central vent volcano – A volcano with a central vent is constructed as debris and lava are ejected from an upthrust, cylindrical vent, forming a symmetrical structure around it.

Color index – A number used to gauge a star’s color, or relative intensity, at two wavelengths. Often based on the difference between how bright a star appears in two different filters, e.g. B–V for the blue and visual filters.

Concentration Index (CI) – The ratio of the amount of flux emitted by the inner 30% of a galaxy and by the total galaxy. Because elliptical galaxies are centrally concentrated they have higher CI values than spiral galaxies, which generally have more slowly decaying, exponential light profiles across their disks.

Correlation coefficient – The correlation coefficient  $R$  is a measure of the strength of the relationship between two variables  $x$  and  $y$ . It ranges from -1 to 1, where +1 indicates the strongest possible positive correlation (as  $x$  increases, so does  $y$ ), zero indicates no predictive relationship between quantities, and -1 indicates the strongest possible negative correlation

(as  $x$  increases,  $y$  decreases). Correlation coefficients are well-suited for determining zero-point offsets in periodic relationships (such as syncing sine waves to remove phase offsets).

Cosmology – Cosmology is the study of the structure and the evolution of the entire Universe.

Crater – A crater is a generally circular surface depression, caused by an impact or an explosion, a volcano, or a geyser.

Crystalline rock – Crystalline, or igneous, rock forms as molten rock cools and crystallizes. It is generally harder and denser than sedimentary rock. Granite is an example of crystalline rock.

Culmination – See transit.

Data set – A data set is a collection of measurements made within an experiment.

Declination – The declination of an astronomical body is its height (in degrees) above the plane defined by the Earth's Equator. It runs from  $90^\circ$  (due north) to  $-90^\circ$  (due south).

Degree – A unit used to measure angles. There are 90 degrees in a right angle, and 360 degrees in a full circle.

$\Delta\lambda$  – The shift in wavelength for an absorption or emission feature in a spectrum between its observed ( $\lambda_{obs}$ ) and its rest-frame ( $\lambda_{rest}$ ) wavelengths.

Density – The density of a three-dimensional object is equal to its mass divided by its volume (or the mass per unit volume), and is typically measured in units of grams per cubic centimeter, or kilograms per cubic meter. The density of water is one  $\text{g cm}^{-3}$ , while rock is roughly three times more dense, and steel has a density of eight  $\text{g cm}^{-3}$ . One could also refer to the surface density of features found on a planetary surface, for example, with units of counts (the number of features) per unit area.

Distance Scale – The distance scale, or the cosmic distance ladder, is the combination of various techniques used to determine distances to cosmological objects such as stars and galaxies.

Ecliptic plane – The plane in which the Earth orbits about the Sun (inclined by  $23^\circ$  to the plane containing the Earth's equator).

Ejecta – Ejecta refers to a blanket of material surrounding a crater that was excavated during an impact event. The ejecta will become thinner at increasing distances from a crater.

Equator – The Equator is the area on the surface of the Earth within the plane which is perpendicular to the rotation axis (running through the North and South Poles).

Error bar – An error bar is a symbol attached to a point on a plot, which shows the associated error (how much the point have might shifted in position due the way in which it was

measured). It often resembles a small bar (or line) placed on one side or another of the point value.

Flux - The flux from a celestial object is the amount of emitted light that is observed, by eye or through a telescope, at a certain distance.

Galaxy – A galaxy is a gravitationally bound set of stars, gas, and dust, spanning up to hundreds of kiloparsecs in size and containing thousands to billions of stars. Our galaxy is called the Milky Way.

Galaxy Cluster – A galaxy cluster contains hundreds or thousands of galaxies, all bound together by their combined gravitational attraction.

Gibbous – A moon or planet in the gibbous phase appears more than half, but less than fully, illuminated.

Hertzsprung-Russell Diagram (H-R Diagram) – A plot of intrinsic brightness (luminosity or absolute magnitude) versus color index (or the analogous surface temperature or spectral class) for stars, used to study stellar evolution for stars of various types and for clusters of stars.

Hesperian Period – The second of three major periods in Martian history, lasting from 3.5 till 1.8 billion years ago. This era is named for Hesperia Planum, an elevated plain in the southern hemisphere. The largest volcano on Mars, Olympus Mons, was active during this time. Surfaces dating back to the Hesperian lack the pattern of large, densely packed craters characteristic of the older Noachian era, as many were erased by intense volcanic activity. Large bodies of water, and catastrophic releases of water, were also thought to be common, and carved channels in regions like the Chryse Palitia basin. The southern hemisphere contains many regions thought to date back to the Hesperian Period.

Histogram – A histogram is a plot which shows the number of measurements of a particular quantity which fall within bins defined to extend over the range of measured values. The bin size should be selected so that the bins with the largest number of measurements within them hold a statistically meaningful number of measurements, and should also not be smaller than the precision (the resolution) of the measurements.

Horizon – The horizon is the boundary observed between the Earth and the sky. It extends in all directions (north, south, east, and west) around an observer.

Hubble constant – The Hubble constant,  $H_0$ , is the slope of the relationship between recessional velocity  $v$  and distance  $d$  observed for nearby galaxies (those within 400 megaparsecs of the Milky Way galaxy). The current accepted value for  $H_0$  is  $72 \text{ km sec}^{-1}$  per megaparsec.

Hubble diagram – A Hubble diagram is a plot of recessional velocity  $v$  versus distance  $d$  for nearby galaxies.

Hubble's Law – Hubble's Law is the relationship  $v = H_0 d$ , observed between recessional velocity  $v$  and distance  $d$  for nearby galaxies.

Impact crater – An impact crater is one produced by the collision of an object with a planetary body's surface.

Intrinsic – Inherent, or natural. Astronomers distinguish between the intrinsic brightness of a star, or how much energy it radiates, and the apparent brightness, or how bright it appears when observed from Earth. Intrinsic properties of stars are absolute, while apparent properties change depending on how far away the stars are from us.

Inverse square law for light – The observed intensity of light emitted by an object varies inversely with the square of the distance from an observer ( $f \propto 1/d^2$ ). A star or galaxy placed twice as far away from us would thus appear one-fourth as bright.

JPG format – Images are often stored on computer disks in JPG-format files, a format which allows the files to be stored and transferred from computer to computer without loss of information. A JPG-format file should have a file name which ends with the extension “.jpg,” so that the image analysis and display packages can recognize its contents.

Kelvin (K) – A temperature unit, similar to degree Fahrenheit (commonly used in the United States) or Celsius. Astronomers use the Kelvin scale to describe how hot or cool stars are. Stars cooler than 4000 kelvin appear reddish, and those hotter than 7500 kelvin appear bluish. The Sun lies in between these extremes, with a temperature of 5800 kelvin.

Kinetic energy – Kinetic energy is commonly referred to as energy of motion, and is equal to one-half of an object's mass times the square of its velocity.

$\lambda_{obs}$  - The wavelength of an absorption or emission feature in a spectrum at which it is observed to occur within a celestial object moving at some velocity with respect to the observer.

$\lambda_{rest}$  - The wavelength of an absorption or emission feature in a spectrum at which it is observed to occur within a celestial object at rest with respect to the observer.

Latitude – The latitude of a location on Earth is the number of degrees which it lies above the plane of the Equator. It takes on values between  $90^\circ$  (North Pole) to  $-90^\circ$  (South Pole).

Lava – Lava flows are streams of liquid rock, or magma, which reach the surface of a terrestrial body through volcanic eruption.

Law of Cross-Cutting Relations – The law of cross-cutting relations states that any geological feature that cuts across another geological feature must be younger (must have formed later) than the feature it disturbed.

Light curve – A light curve is a plot of the observed brightness of a star (plotted on the vertical  $y$ -axis) as a function of time (plotted on the horizontal  $x$ -axis).

Light year – A unit of distance (not time), equal to the distance which light travels in a year. One light year is equal to 0.307 parsecs.

Linear size – The linear size of an object is its length, in units of length such as centimeters (small) or miles (large).

Little Dipper – The Little Dipper is made up of some of the brightest stars in the northern hemisphere constellation Ursae Minoris (the Little Bear). The North Star, Polaris, located almost due north, is the brightest star in the Little Dipper. It can be found at the end of the handle.

Logarithm – The word logarithm comes from the Greek words for *proportion* and *number*, and means “a number that indicates a ratio.” In the expression  $x = 10^e$ , the exponent  $e$  is the base 10 logarithm of the number  $x$ . When we plot numbers on a logarithmic scale, we can compare data over wide ranges on a single plot. As ones moves along a logarithmic axis by set amounts, one multiplies by a certain factor (rather than adding a certain amount, as is done along a linear axis).

Luminosity – A measure of intrinsic brightness defined by how much energy a star (or other object) radiates into space per second.

Main Sequence – A narrow region running across the H-R diagram, where hydrogen-burning stars are found. As stars grow old and run out of fuel, they evolve away from the Main Sequence.

Magnitude, absolute – The brightness of an object on the logarithmic magnitude scale, as observed from a distance of ten parsecs. This provides a measure of intrinsic brightness.

Magnitude, apparent – The brightness of an object based on the logarithmic magnitude scale, as observed from Earth. Two equivalent stars (with the same absolute magnitude) will have different apparent magnitudes if one lies closer to Earth than the other does.

Magnitude scale – A logarithmic scale for gauging the brightness of astronomical objects. It is based on historical measurements done by eye in which first magnitude stars were the brightest and sixth the faintest, so brighter objects have smaller magnitude values.

Major axis – The major axis of an ellipse is its longest side, the longest line segment which can be placed within it (passing from one side through the center to the other side). It is perpendicular to the minor axis.

Maria – The lunar maria are the dark, smooth regions thought to represent ancient lava flows. They are generally younger than the heavily cratered highlands. They were immortalized in Bernstein and Sondheim’s 1956 West Side Story.

Mean value – The mean value  $\mu$  of a set of  $N$  repeated measurements  $m_i$  is defined to be

the unweighted average, or

$$\mu = \frac{1}{N} (m_1 + m_2 + m_3 + \dots + m_N) = \frac{1}{N} \sum_{i=1}^N m_i.$$

Measurement error – Measurement error refers to the precision with which a set of measurements were made (to how many decimal places the measured values were recorded).

Mercator projection – A Mercator projection is a cylindrical map of a spherical surface, such as the surface of a planet. By convention, west and east run from left to right, with north at the top and south at the bottom. Because lines of constant latitude are spread out across the entire plot, the regions near to the poles are greatly extended in width relative to those at the equator. (This is why Greenland, Iceland, and Antarctica, for example, appear so huge on Mercator projections of the Earth’s surface.)

Meridian – A meridian is an arc which projects from the North Pole to the South Pole and passes directly overhead for an observer. All observers located along a given meridian share a common longitude (the distance they lie east of the Royal Greenwich Observatory in England), but have unique longitudes corresponding to how far north or south of the Earth’s equator they lie.

Meteor – The term meteor is used to refer to a particle of debris (space dust) which has entered the atmosphere of a planet or satellite. It also refers to the visible path left by such an object.

Meteoroid – A meteoroid is a particle of rocky or metallic debris found in space. If a meteoroid enters the Earth’s atmosphere it becomes a meteor, and upon landing any surviving remnant is called a meteorite.

Million – Ten raised to the sixth power, or 1,000,000.

Milky Way – The Milky Way is the name of our own galaxy, a barred intermediate-type spiral.

Minor axis – The minor axis of an ellipse is its shortest side, the shortest line segment which can be placed within it (passing from one side through the center to the other side). It is perpendicular to the major axis.

Model – A model fit is a mathematical expression which attempts to reproduce the relationship between two or more variables.

Morphology – Shape, or form.

Mu – The Greek letter “m” ( $\mu$ ), often associated with the average value of a set of measurements.

Natural variation – Natural variation refers to the intrinsic width of a distribution of a

measured property.

Network valley – A network valley is one of a set of branching valleys found on Mars, with a resemblance to terrestrial river drainage basins. They are usually less than five kilometers wide, though they may extend for thousands of kilometers in length.

Noachian Period – The first of three major periods in Martian history, dating from formation epoch 4.5 billion years ago to 3.5 billion years ago. This era is named for Noachis Terra, a large southern hemisphere highland. Surfaces dating back to the Noachian are covered with many craters, and exhibit the largest impact craters, but widespread evidence for water erosion suggests that the planetary surface was warm and wet during this time. They are found predominantly in the southern hemisphere.

North Celestial Pole – The North Celestial Pole (NCP) is the projection of the Earth's North Pole upon the celestial sphere. One can think of it as the extension of the Earth's rotational axis arbitrarily high above the North Pole. The North Star, Polaris, lies very close to the NCP on the sky.

North Star – The North Star, or Polaris (the pole star), is a star which currently happens to lie almost due north of our planet, above the North Pole and along the Earth's rotational axis. Because of its location it is always above the horizon for observers in the northern hemisphere (and never above the horizon for those in the south). The northern night sky appears to revolve around this star, moving counter-clockwise in a full circle once every 24 hours. Because the earth's rotation axis wobbles, over tens of thousands of years it points slightly away from, and then back toward, the North Star. In ten thousand years, the title of North Star will be given to another, neighboring star in the vicinity.

Outflow channel – An outflow channel is a particular type of surface feature found on Mars. Outflow channels are wide and long, and contain streamlined remnants of ancient features which have been sculpted by the passage of fluids (such as lava or water flows). They can extend over hundreds of kilometers in length, and can be up to a few hundred kilometers wide as well. Kasei Vallis is a prominent example of such.

Parallax – A technique for estimating the distances to objects, by measuring their apparent angular shifts on the sky relative to distant objects when they are observed from two separated locations.

Parsec – A unit of distance defined as the distance at which an object exhibits a parallax shift of one arcsecond. As the Earth rotates around the Sun and shifts by a length of one astronomical unit, a star which lies one parsec away from Earth will appear to shift by one arcsecond across the sky. One parsec is equal to 3.26 light years or 206,265 astronomical units.

Perturbation – A perturbation is a disturbance (in the force, or elsewhere). When the orbit of an astronomical body varies slightly (wobbling, or shifting back and forth), we often describe the variation as a perturbation.



Phase – For a periodic function, such as sine or cosine, the word phase is often used to define the shift of the function away from the default zero point by a fraction of a full period. For the Moon, we generally describe its appearance as it shifts from shadow into full illumination and back over the course of a lunar month in terms of the new, quarter, gibbous, and full phases.

Plate tectonics – Plate tectonics defines a theory of planetary surface dynamics in which a planet’s outer skin (the lithosphere) is broken into plates. These plates are driven by internal heat, and shift and interact in various ways (including collisions).

PNG format – Images are often stored on computer disks in PNG-format files, a format which allows the files to be stored and transferred from computer to computer without loss of information. A PNG-format file should have a file name which ends with the extension “.png,” so that the image analysis and display packages can recognize its contents.

Polaris – see North Star.

Precision – The precision of a measurement is defined as the smallest change in its value which can be observed with a given experimental technique. A ruler with markings every millimeter (mm), for example, could carry a precision of  $\pm 0.5$  mm.

Projectile – A projectile is an object that is launched or dropped into space, or into an atmosphere. It is sometimes called an impactor, once it has struck a surface.

Proto-planetoid – This word is a combination of “proto”, meaning first or earliest, and “planetoid,” meaning minor planet. The proto-planetoids in the early solar system were the largest of the building blocks which combined (through collisions) to form the major planets which we know, and love, today.

Radial – Extending outward from a common center. When a child draws the Sun as a little dot with arrows going out in all directions to show the sunlight escaping, they are drawing radial lines. To plot the radial distribution of light within an aperture centered on an image of a star, imagine placing a series of thin rings around the star. Average the brightness of the light contained within the left half and the right half of each ring, and plot these values from left to right according to how far each ring lies from the center of the star.

Radian – A unit used to measure angles. There are  $\pi/2$  degrees in a right angle, and  $2\pi$  radians in a full circle.

Radioactive – An radioactive isotope of a particular element is unstable, and will decay into other elements and isotopes over time. We define the “half-life” of a radioactive sample as the amount of time in which half of its atoms will decay into another state. By comparing the relative amounts of various isotopes of key radioactive elements, we can often determine absolute ages for samples of various materials.

Rays – Rays are bright linear streaks extending radially outward from certain craters, most

notably young ones like Tycho and Copernicus on the Moon. They indicate the presence of thin deposits of lighter material.

Red dwarfs – Cool, red, low luminosity stars with less mass and smaller sizes than the Sun. In the H-R diagram, they are Main Sequence objects, located to the lower right of the Sun’s position. Because red dwarfs are such low-mass stars, they spend much more time on the Main Sequence than solar-mass or more massive counterparts.

Red giants – Cool, red, high-luminosity stars that are hundreds of times the Sun’s size. In the H-R diagram, they occupy a region well off the Main Sequence to the upper right. The progenitors of red giants are Main Sequence stars, which burn through their hydrogen reserves and then move into the giant phase.

Redshift – The redshift  $z$  of a galaxy is defined as  $\Delta\lambda/\lambda_{rest}$ , the ratio of the shift in wavelength  $\Delta\lambda$  observed for a spectra feature of rest-frame wavelength  $\lambda_{rest}$ .

Relative dating – Relative dating refers to the process of placing an event along a time line relative to other events (before them or after them), without defining a specific time for any event.

Rille – The word rille (also rill) is used to denote long trenches, or brooks or streams, and was often used in describing lunar features seen through the first telescopes.

River delta – A river delta is land formed from sediment (silt) that builds up at the mouth of a river, where it flows into an ocean or other large body of water.

RMS (root mean square) deviation – The rms deviation is the square-root of the average square of the offsets in  $y$  between a set of  $N$  data points and a fit function. For a linear fit, where  $y = mx + b$ ,

$$\text{rms} = \sqrt{\frac{1}{N} \sum_{i=1}^N [y_i - (mx_i + b)]^2}.$$

Scablands – Scablands are erosive features, composed of flat, elevated land characterized by poor soil and little or no vegetation, marked by dry channels which formed through the action of glaciers. The Channeled Scablands of the state of Washington were created by the Missoula Floods during the Pleistocene era, and are the most well-known of such features.

Scatter plot – See  $xy$  plot.

Sedimentary rock – Sedimentary rock, such as limestone or sandstone, is rock that was originally laid down as horizontal sediment (deposited by water, air, or ice). Contrast it with igneous rock, which is formed by the cooling of molten rock.

Semi-major axis – The semi-major axis of an ellipse is half the length of the major axis.

Semi-minor axis – The semi-minor axis of an ellipse is half the length of the minor axis.

Sextant – A mechanical device used to calculate the angle on the sky between two objects, or the altitude of an object (its distance above the horizon).

Shield volcano – A shield volcano is one that has built up from fluid lava flows. The name comes from the distinctive large, extended size and low height (low profile), giving rise to a shape that resembles the shield of a warrior.

Sigma – The Greek letter “s” ( $\sigma$ ), often associated with a measurement of a standard deviation.

Slope – The slope  $m$  of a line is the change in  $y$  divided by the change in  $x$ , or for two points along the line with coordinates  $(x_1, y_1)$  and  $(x_2, y_2)$ ,

$$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}.$$

Small angle approximation – For small angles (less than 10 degrees, or  $\pi/18$  radians), the tangent of the angle is roughly equal to the angle itself, measured in radians.

South Celestial Pole – The South Celestial Pole (SCP) is the projection of the Earth’s South Pole upon the celestial sphere. One can think of it as the extension of the Earth’s rotational axis arbitrarily high above the South Pole.

Spectral class – A classification based on the appearance of a stellar spectrum, analogous to the temperature sequence, with blue O class stars being hottest, yellow G stars like the Sun being intermediate, and red M stars being cooler.

Standard candle – A class of objects assumed to be of uniform brightness. Any variation in observed brightness for a set of standard candles can be attributed to the distance to each object.

Standard deviation – The standard deviation  $\sigma$ , also called the spread, of a set of  $N$  repeated measurements  $m_i$  with an mean (average) value  $\mu$  is defined as

$$\sigma = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (m_i - \mu)^2}.$$

Star – A hot, glowing, spherical mass of gas, dominated by hydrogen. Stars are typically found in stable configurations in which the inward-directed force of gravity is balanced by the outward radiation pressure due to nuclear fusion reactions in the cores.

Star cluster – A group of hundreds or thousands of stars bound together by gravity, which formed at a single epoch from a giant cloud of interstellar gas and dust.

Stefan-Boltzmann Law – A mathematical relationship describing the behavior of spherical, idealized radiators (a.k.a. stars), connecting luminosity  $L$ , temperature  $T$ , and radius  $R$ :  $L = (4\pi\sigma)T^4R^2$ , where  $\sigma$  is the Stefan-Boltzmann constant.

Stellar – Relating to a star or to stars.

Stellar evolution – The process by which a star changes in size, luminosity, temperature, and appearance, as it ages and consumes its fuel. The speed of these changes is driven primarily by stellar mass. The most massive stars may shine for only a few million years, while the least massive could last hundreds of billions of years.

Systematic error – A systematic error is one which biases all of a set of measurements in the same fashion (as opposed to making some smaller and some larger).

Terraces – Terraces are stair-like levels in the sloped walls of craters.

Terrestrial – The term “terrestrial” means Earth-like or pertaining to the Earth’s surface. Planets with rocky surfaces are sometimes called Terrestrial planets, in contrast to the Jovian gas giants.

Topography – A topographical representation of a region involves a detailed physical description, including the relative positions and elevations of features.

Transit – An astronomical object transits when it passes across the observer’s meridian, an arc of constant longitude (the east/west coordinate) along the surface of the Earth connecting the North and South Poles and the observer’s location. An object which is transiting lies either to the north, to the south, or directly overhead of an observer. An object can be transiting for one observer, but appear far to the east or west in the sky for an observer at another location.

Trench – A trench is a long ditch, or a long steep-sided valley.

Tributary – A tributary is a stream that flows into a larger body of water.

Turn-off point – The point on the H-R diagram for a particular star cluster where its stars are evolving off of the Main Sequence and becoming red giants. The location, usually specified by the corresponding color index, depends on the cluster’s age.

Ursae Majoris – A large, bright constellation in the northern hemisphere, named “the Great Bear.” The well-known Big Dipper is a part of Ursae Majoris.

Ursae Minoris – A constellation in the northern hemisphere, named “the Little Bear.” The well-known Little Dipper is a part of Ursae Minoris, as is Polaris, the North Star.

Variable star – A star which varies periodically in luminosity over time.

Velocity – The velocity of an object is its speed in a particular direction. It has units of distance traveled per unit time, such as miles per hour, or centimeters per second.

Velocity of recession – The velocity of an object which appears to be moving away from us. For galaxies, recessional velocities can be measured from spectral redshifts.

Watershed – A watershed is an elevated ridge of land which divides two regions which drain into separate rivers, or a single region which drains into a river or other body of water.

White dwarfs – Hot, low-luminosity stars that are much smaller than the Sun (they are Earth sized!) These old, dying stars are gradually cooling, and growing fainter with time. They are the end-states for intermediate- and low-mass Main Sequence stars which have passed through the giant phase.

$xy$  plot – A plot which shows the relationship between two variables by plotting one along an  $x$ -axis and the other along a  $y$ -axis is commonly called an  $xy$ , or scatter, plot.

$y$ -intercept – The  $y$ -intercept  $b$  of a line is the  $y$  coordinate of the point on the line for which  $x = 0$ , or for two points along the line with slope  $m$  and coordinates  $(x_1, y_1)$  and  $(x_2, y_2)$ ,

$$b = y_1 - mx_1 = y_1 - \left( \frac{y_2 - y_1}{x_2 - x_1} \right) x_1.$$

Zenith – The zenith is the direction pointing directly overhead for an observer.

Zenith distance – The zenith distance is measured in degrees, and is equal to the angle on the sky between an observer's zenith and an object. The sum of the zenith distance and the altitude is always equal to  $90^\circ$ , for an object.