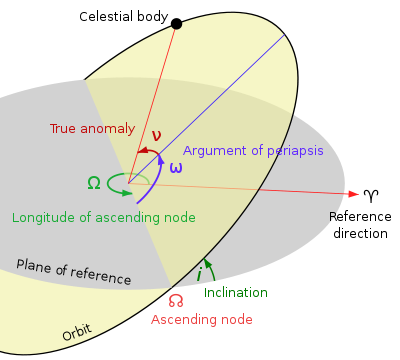
**Keplerian elements**

[](http://en.wikipedia.org/wiki/File:Orbit1.svg)

[http://bits.wikimedia.org/skins-1.5/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Orbit1.svg)

In this diagram, the [orbital plane](http://en.wikipedia.org/wiki/Orbital_plane_(astronomy)) (yellow) intersects a reference plane (gray). For earth-orbiting satellites, the reference plane is usually the Earth's equatorial plane, and for satellites in solar orbits it is the [ecliptic plane](http://en.wikipedia.org/wiki/Plane_of_the_ecliptic). The intersection is called the [line of nodes](http://en.wikipedia.org/wiki/Orbital_node), as it connects the center of mass with the ascending and descending nodes. This plane, together with the [Vernal Point](http://en.wikipedia.org/wiki/Equinox), (♈) establishes a reference frame.

The traditional orbital elements are the six **Keplerian elements**, after [Johannes Kepler](http://en.wikipedia.org/wiki/Johannes_Kepler) and his [laws of planetary motion](http://en.wikipedia.org/wiki/Kepler%27s_laws).  
When viewed from an inertial frame, two orbiting bodies trace out distinct trajectories. Each of these trajectories has it's focus at the common center of mass. When viewed from the non-inertial frame of one body only the trajectory of the opposite body is apparent; Keplerian elements describe these non-inertial trajectories. An orbit has two sets of Keplerian elements depending on which body used as the point of reference. The reference body is called the [primary](http://en.wikipedia.org/wiki/Primary), the other body is called the [secondary](http://en.wikipedia.org/wiki/Secondary). The primary is not necessarily more massive than the secondary, even when the bodies are of equal mass, the orbital elements depend on the choice of the primary.

The main two elements that define the shape and size of the ellipse:

* [Eccentricity](http://en.wikipedia.org/wiki/Eccentricity_(orbit)) (e\,\!) - shape of the ellipse, describing how flattened it is compared with a circle. (not marked in diagram)
* [Semimajor axis](http://en.wikipedia.org/wiki/Semimajor_axis) (a\,\!) - the sum of the [periapsis and apoapsis distances](http://en.wikipedia.org/wiki/Apsis) divided by two. For circular orbits the semimajor axis is the distance between the bodies, not the distance of the bodies to the center of mass.

Two elements define the orientation of the [orbital plane](http://en.wikipedia.org/wiki/Orbital_plane_(astronomy)) in which the ellipse is embedded:

* [Inclination](http://en.wikipedia.org/wiki/Inclination) - vertical tilt of the ellipse with respect to the reference plane, measured at the [ascending node](http://en.wikipedia.org/wiki/Ascending_node) (where the orbit passes upward through the reference plane) (green angle *i* in diagram).
* [Longitude of the ascending node](http://en.wikipedia.org/wiki/Longitude_of_the_ascending_node) - horizontally orients the [ascending node](http://en.wikipedia.org/wiki/Ascending_node) of the ellipse (where the orbit passes upward through the reference plane) with respect to the reference frame's [vernal point](http://en.wikipedia.org/wiki/Vernal_point) (green angle Ω in diagram).

And finally:

* [Argument of periapsis](http://en.wikipedia.org/wiki/Argument_of_periapsis) defines the orientation of the ellipse (in which direction it is flattened compared to a circle) in the orbital plane, as an angle measured from the ascending node to the semimajor axis. (violet angle \omega\,\!in diagram)
* [Mean anomaly](http://en.wikipedia.org/wiki/Mean_anomaly) at [epoch](http://en.wikipedia.org/wiki/Epoch_(astronomy)) (M_o\,\!) defines the position of the orbiting body along the ellipse at a specific time (the "epoch").

The mean anomaly is a mathematically convenient "angle" which varies linearly with time, but which does not correspond to a real geometric angle. It can be converted into the [true anomaly](http://en.wikipedia.org/wiki/True_anomaly) \nu\,\!, which does represent the real geometric angle in the plane of the ellipse, between [periapsis](http://en.wikipedia.org/wiki/Periapsis) (closest approach to the central body) and the position of the orbiting object at any given time. Thus, the true anomaly is shown as the red angle \nu\,\!in the diagram, and the mean anomaly is not shown.

The angles of inclination, longitude of the ascending node, and argument of periapsis can also be described as the [Euler angles](http://en.wikipedia.org/wiki/Euler_angles) defining the orientation of the orbit relative to the reference coordinate system.

Note that non-elliptic orbits also exist; If the eccentricity is greater than one, the orbit is a [hyperbola](http://en.wikipedia.org/wiki/Hyperbola). If the eccentricity is equal to one and the angular momentum is zero, the orbit is [radial](http://en.wikipedia.org/wiki/Radial_trajectory). If the eccentricity is one and there is angular momentum, the orbit is a [parabola](http://en.wikipedia.org/wiki/Parabola).