

# Asteroids



Picture: one of the biggest asteroids, Vesta, located inside the asteroid belt

Autor: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

[https://de.wikipedia.org/wiki/\(4\)\\_Vesta#/media/Datei:Vesta\\_Full-Frame.jpg](https://de.wikipedia.org/wiki/(4)_Vesta#/media/Datei:Vesta_Full-Frame.jpg)

Asteroids include medium-sized objects that can be found almost throughout the solar system. They are smaller than planets and dwarf planets, but larger than meteoroids. Their diameters range from a few hundred meters to a few hundred kilometres. The most important distinguishing feature from dwarf planets is that asteroids are not in hydrostatic equilibrium and cannot assume a round shape. They have too small a mass (less than  $10^{20}$ kg) to form this equilibrium. However, they have a Keplerian orbit around the sun, similar to planets and dwarf planets. They differ from comets in that they do not form a tail and are constant in shape. They have a great variety of shapes, ranging from nearly spherical to ellipsoidal to very irregular. Asteroids are remnants from planet formation. The name asteroid comes from ancient Greek and means star-like. Asteroids are also called planetoids or minor planets.



Picture: Irregularly shaped asteroid Ida (60×25km) with its small moon Dactyl

Autor: Kevin Gill from Nashua, NH, United States

[https://en.wikipedia.org/wiki/Asteroid#/media/File:243\\_I da -  
August 1993 \(16366655925\).jpg](https://en.wikipedia.org/wiki/Asteroid#/media/File:243_Ida_-_August_1993_(16366655925).jpg)

The first asteroid discovered was Ceres, which was elevated to dwarf planet status because of its size when this classification of celestial bodies was introduced. Currently, well over a million asteroids are known, but probably several million of them exist. Most of them were discovered only in this century. Thus the asteroids are numerically the largest group of celestial bodies. The asteroids are classified according to their orbits.

Near Earth asteroids are located between the Earth and Mars orbits. They are among those celestial bodies that are potential candidates for collision with Earth and are therefore constantly monitored. Among them, there are asteroids that cross the Earth's orbit and those that move outside or inside the Earth's orbit:

- Aten asteroids: Their perihelion is smaller than Earth's and their aphelion is larger than 0.983 AU (1 astronomical unit 150 million km). They cross the Earth's orbit.
- Cupid asteroids: Their perihelion is less than 1.382 and greater than 1.017 AU.
- Apollo asteroids: Their major axis is larger than Earth's, their perihelion is smaller than 1.017 AU, and they cross Earth's orbit.
- Atira (Apohele) asteroids move only within the Earth's orbit.

About 90% of the known asteroids are located in the so-called asteroid belt, which is located between Jupiter and Mars. They thus fill the gap in the Titius-Bode series, according to which one can determine the approximate distance to the Sun:  $\text{Distance} = (0.4 + 0.3 \cdot 2^n)$  AU. According to this rule of thumb  $n=3$  is valid for the asteroid belt. They have an orbital inclination below  $20^\circ$  and have eccentricities smaller than 0,25. They are probably formed by a collision of larger asteroids in this zone and therefore form groups with similar chemical composition. Their orbits are bounded by the so-called Kirkwood gaps, which are formed by orbital resonances with Jupiter. Thus the main belt can be divided into three zones:

- Inner Main Belt: This zone is bounded by the 4:1 and 3:1 resonance, lies between about 2.06 and 2.5 AU, and contains mostly silicate-rich V- and S-class asteroids.
- Middle Main Belt: Objects in this group have orbital semi-axes between 2.5 and 2.8 AU. C-type asteroids dominate there. The dwarf planet Ceres also moves in this zone, which lies between the 3:1 resonance (Hestia gap) and the 5:2 resonance.
- Outer Main Belt: This region is bounded outward by the Hecuba Gap (2:1 resonance) at about 3.3 AU. D- and P-class objects often appear in this region.

Outside the orbit of Jupiter, two main groups of asteroids are distinguished:

- The centaurs are located between the planets Jupiter and Neptune and move on eccentric orbits. The first discovered representative was (2060) Chiron.
- The Damocloids are a group of objects named after the asteroid (5335) Damocles. They have their aphelion mostly beyond the orbit of Uranus, but a perihelion in the inner solar system. Their comet-like orbits are very eccentric and strongly inclined against the ecliptic. Their orbit is retrograde in some cases.

The physical composition and the material composition of the asteroids show a wide range of properties. In total, the asteroids are divided into 14 classes (A asteroids, B asteroids, C asteroids, D asteroids, E asteroids, F asteroids, G asteroids, M asteroids, P asteroids, R asteroids, S asteroids, T asteroids, V asteroids, X asteroids).

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