Definition: **asteroid (minor planet)** from *The Penguin Dictionary of Science*

A small rocky or metallic body orbiting the Sun. Most are in the **asteroid belt** between Mars and Jupiter. About 20,000 asteroids have been observed, the largest of which has a radius of only 457 km. There may be a million larger than 1 km, below which they extend in size down to dust particles. The asteroids are believed to be the remnants of planetesimals, the precursors of the planets of the Solar System, that failed to accrete into a planet.

Summary Article: **asteroid**

from *The Columbia Encyclopedia*

planetoid, or minor planet, small body orbiting the sun. More than 300,000 asteroids have been identified and cataloged; more than a million are believed to exist in the main belt between Mars and Jupiter, with many more in the Kuiper belt beyond Neptune. Most asteroids are irregularly shaped, unlike the spherically shaped major planets. The largest asteroids, Quaoar (diameter c.800 mi/1,300 km) and Ixion and Varuna (both c.750 mi/1,200 km), reside in the Kuiper belt (see comet) and are about half the size of Pluto. The largest main-belt asteroid, Ceres, has a diameter of c.630 mi (1,000 km) and is considered a dwarf planet; the three next largest in size are Pallas, Vesta, and Juno. Only Vesta can be seen with the naked eye. Many known asteroids are no larger than a few kilometers; in 1991, an asteroid only 33 ft (10 m) in diameter was found. Many asteroids are so small that their sizes cannot be measured directly; in many cases, their sizes have been estimated from their brightness and distances. The average orbital distance of the main-belt asteroids from the sun is about 2.9 astronomical units (AU).

The orbits of most main-belt asteroids lie partially between the orbits of Mars and Jupiter. These asteroids, also known as cisjovian asteroids, are divided into subgroups named for the main asteroid in the grouping: Hungarias, Floras, Phocaea, Koronis, Eos, Themis, Cybeles, and Hildas. The near-earth asteroids, which closely approach the earth, are classed as Atens (with orbits between the earth and the sun), Apollos (with orbits similar to that of the earth), and Amors (with orbits between the earth and Mars). Asteroids that share a planet's orbit are known as Trojan asteroids. First found in Jupiter's orbit, Trojan asteroids have also been found in the orbits of Mars, Neptune, and earth. Centaurs are asteroids with orbits in the outer solar system.

Asteroids are also classified by composition and albedo, most being one of three types. The majority (C-type) are similar to carbon-chondrite meteorites with approximately the same composition as the sun (excluding hydrogen) and are relatively dark. Those with a composition of nickel iron mixed with silicates of iron and magnesium (S-type) are relatively bright. The M-type are composed of nickel iron and are bright. Some of the Trojan asteroids appear to be captured comets, composed of ice and dirt, rather than rocky asteroids.

Toward the end of the 18th cent. astronomers were searching for a planet whose orbit should, according to Bode's law, have an average distance from the sun of 2.8 AU. On Jan. 1, 1801, G. Piazzi discovered Ceres while studying the sky in the constellation Taurus; Ceres was later found to have an orbit very near that predicted by Bode's law. Ceres and the asteroids Juno, Pallas, and Vesta, which were discovered soon (1802–7) after Ceres, were initially regarded as planets by many astronomers, a
view that was not overturned until additional asteroids were identified in the 1840s and 50s. By 1890 more than 300 asteroids had been discovered by visual means. In 1891, Max Wolf introduced the method of identifying an asteroid by the record of its path on an exposed photographic plate; it appears as a short line in a time exposure, rather than as the sharp point of a star. Brucia was the first asteroid discovered by this method. A more modern approach uses two photographs taken less than an hour apart and examined through a stereomicroscope that allows the asteroid to appear suspended above the background of stars. Still more modern techniques were employed in the discoveries of Ixion, found in 2001 using virtual telescope techniques, and of Quaoar, found in 2002 using photographs taken with the Hubble Space Telescope.

Roughly 1,500 asteroids 330 ft (100 m) or larger in diameter have been identified that regularly intersect the orbit of the earth at a distance of 0.5 AU or less (half the distance to the sun). Over geologic time, similarly sized asteroids in similar orbits have struck the earth, and it is estimated that some 4,700 of these asteroids exist. NASA has estimated that a so-called potentially hazardous asteroid (or comet) might cause a global disaster once in several hundred thousand years, and a local disaster once every 10,000 years. Hermes, discovered in 1937 and subsequently lost until 2003 when it was identified as a pair of asteroids, comes within 378,000 mi (608,000 km), and Eros comes within 14 million mi (22 million km). More recently, a small asteroid provisionally designated 2002 MN, 150–360 ft (45–110 m) in diameter, passed within 75,000 mi (121,000 km) of the earth—in 2002. In 2009 an apparent asteroid impact was observed on Jupiter; estimated to be 0.3 mi (.5 km) wide, the object would have caused widespread devastation had it struck the earth.

Even smaller asteroids, between 100 ft and 330 ft (30 m and 100 m) in diameter, are capable of causing significant damage should they strike near a population center, and astronomers have observed about several hundred small asteroids, most measuring less than 55 yd (50 m) across, in near-earth orbits that are spread thinly between the earth and Mars. Many of these small asteroids have orbits that intersect the earth's. In 2013 one such asteroid, 2012 DA14, 150 ft (45 m) in diameter, passed by the earth only 17,200 mi (27,700 km) away. A stony asteroid of roughly similar size may have been responsible the widespread destruction that occurred in 1908 in the isolated Tunguska Basin. A study of data collected by the Comprehensive Nuclear Test Ban Treaty Organization from 2000 to 2013, in which 26 asteroid explosions, largely in the atmosphere and over the oceans, were recorded, has led researchers associated with the B612 Foundation to conclude that an asteroid capable of destroying a city strikes the earth about once every 100 years.

Asteroids have been implicated in several mass extinctions of large numbers of animal and plant species in the past. From evidence found in sediments, Luis Walter Alvarez and others hypothesized that the great mass extinction of the dinosaurs and other species 65 million years ago, at the end of the Cretaceous period, was caused by the atmospheric and climatic effects of an asteroid impact; a possible crater exists in the Yucatán region of Mexico. In 1992, scientists reported that the appearance of patterns of shattered quartz crystals imbedded in Triassic shale and other fossil evidence suggest that another major mass extinction, about 200 million years ago, was caused by three closely spaced asteroid impacts.

The origin of asteroids is unclear; one theory claims that they were formed from material that could not condense into a single planet because of perturbation effects involving Jupiter. Some asteroids are actually nuclei of comets that are no longer active.
The space probe Galileo, which passed near and photographed Gaspra (1991) and Ida (1993), provided the first close images of an asteroid. The pictures revealed that Ida has a natural satellite, Dactyl. Ida, in the main asteroid belt between Mars and Jupiter, is about 35 mi (56 km) long and 15 mi (24 km) in diameter. Its tiny moon is about a mile (1.6 km) in diameter and orbits about 60 mi (97 km) above Ida. Since then several other asteroids have been found to have companions, leading astronomers to believe that it may not be uncommon. The probe NEAR-Shoemaker examined Mathilde (1997) on its way to rendezvous (1999) and orbit (2000) Eros. After providing the most information ever obtained about an asteroid (measurements of size, shape, mass, and gravitational field; elemental and mineral composition of the surface; topographic mapping; and measurement of the magnetic field and its interaction with the solar wind), NEAR-Shoemaker made an originally unplanned landing on Eros in 2001, returning close-up images as it descended and data about surface composition. In 1999 the probe Deep Space 1 accomplished the then closest-ever flyby of an asteroid, coming within 16 mi (26 km) of the surface of Braille; spectroscopic data suggests that Braille broke off from Vesta millions of years ago. Other probes have since studied asteroids, including Rosetta, Hayabusa, which returned with samples of the asteroid Itokawa in 2010, and Dawn, which studied Vesta in 2011–12 and then orbited Ceres beginning in 2015.


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