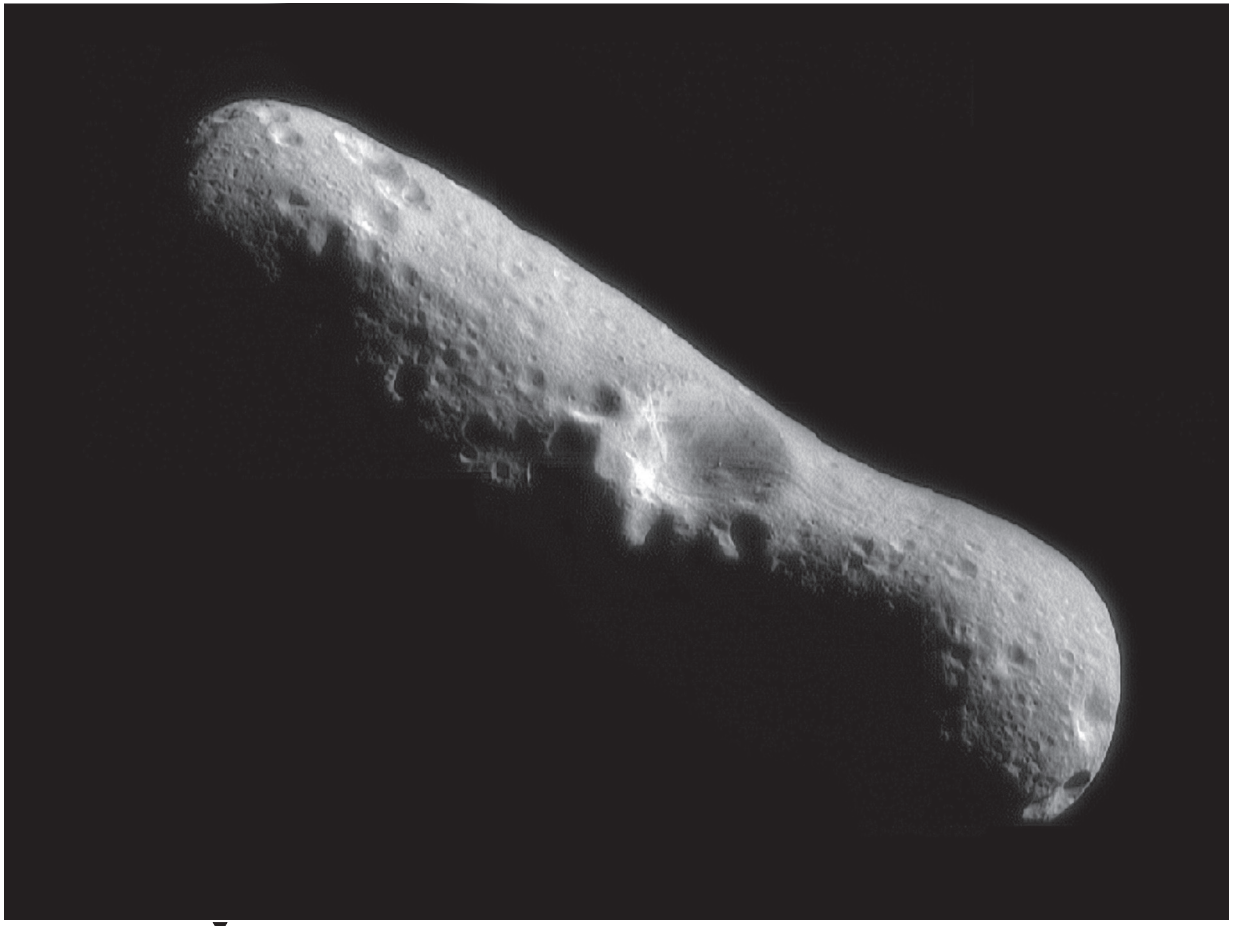

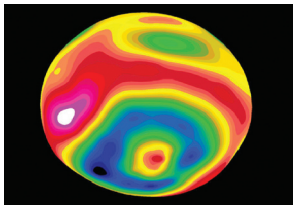

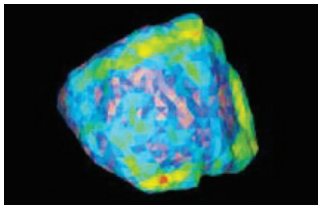

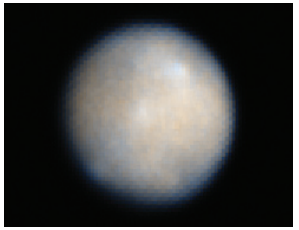

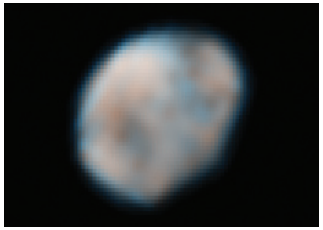

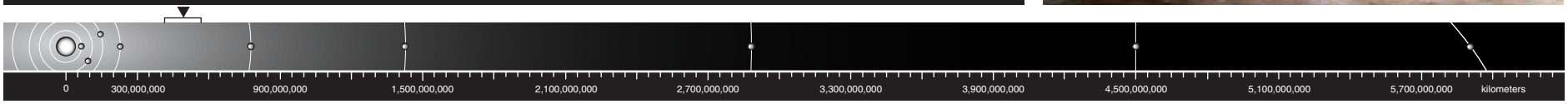
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Asteroids

Asteroids, sometimes called minor planets, are small, rocky fragments left over from the formation of the solar system about 4.6 billion years ago. Most of this ancient space rubble can be found orbiting the Sun between Mars and Jupiter. Asteroids range in size from Ceres, about 952 kilometers (592 miles) in diameter, to bodies that are less than 1 kilometer (0.6 mile) across. The total mass of all the asteroids is less than that of the Moon.

Early in the history of the solar system, the formation of Jupiter brought an end to the formation of planetary bodies in the gap between Mars and Jupiter and caused the small bodies that occupied this region to collide with one another, fragmenting them into the asteroids we observe today. This region, called the asteroid belt or simply the main belt, may contain millions of asteroids. Because asteroids have remained mostly unchanged for billions of years, studies of them could tell us a great deal about the early solar system.

Nearly all asteroids are irregularly shaped, though a few are nearly spherical, and are often pitted or cratered. As they revolve around the Sun in elliptical orbits, the asteroids also rotate, sometimes quite erratically, tumbling as they go. More than 150 asteroids are known to have a small companion moon (some have two moons). There are also binary (double) asteroids, in which two rocky bodies of roughly equal size orbit each other, as well as triple asteroid systems.

The three broad composition classes of asteroids are C-, S-, and M-types. The C-type asteroids are most common, probably consist of clay and silicate rocks, and are dark in appearance. They are among the most ancient objects in the solar system. The S-types ("stony") are made up of silicate materials and nickel–iron. The M-types are metallic (nickel–iron). The asteroids' compositional differences are related to how far from the Sun they formed. Some experienced high temperatures after they formed and partly melted, with iron sinking to the center and forcing basaltic (volcanic) lava to the surface. One such asteroid, Vesta, survives to this day.

Jupiter's massive gravity and occasional close encounters with Mars or another object change the asteroids' orbits, knocking them out of the main belt and hurling them into space in both directions across the orbits of the planets. Stray asteroids and asteroid fragments slammed into Earth and the other planets in the past, playing a major role in altering the geological history of the planets and in the evolution of life on Earth. Scientists continuously monitor Earth-crossing asteroids, whose paths intersect Earth's orbit, including near-Earth asteroids that may pose an impact danger. Radar is a valuable tool in detecting and monitoring potential impact hazards. By bouncing transmitted signals off objects, images and information can be derived from the echoes. Scientists can learn a great deal about an asteroid's orbit, rotation, size, shape, and metal concentration. The U.S. is the only country that has an operating survey and detection program for discovering near-Earth objects.

NASA space missions have flown by and observed asteroids. The Galileo spacecraft flew by asteroids Gaspra in 1991 and Ida in 1993; the Near-Earth Asteroid Rendezvous (NEAR) mission studied asteroids Mathilde and Eros; and Deep Space 1 and Stardust both had close encounters with asteroids.

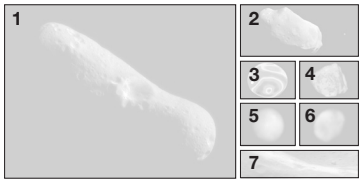
In 2005, the Japanese spacecraft Hayabusa landed on the near-Earth asteroid Itokawa and attempted to collect samples. When Hayabusa returns to Earth in June 2010, we will find out if it was successful.

NASA's Dawn mission, launched in September 2007 on a 3-billion-kilometer (1.7-billion-mile) journey to the asteroid belt, is planned to orbit the asteroids Vesta (August 2011) and Ceres (February 2015). Vesta and Ceres are sometimes called "baby planets" — their growth was interrupted by the formation of Jupiter, and they followed different evolutionary paths. Scientists hope to characterize the conditions and processes of the solar system's earliest epoch by studying these two very different large asteroids.

SIGNIFICANT DATES

1801 — Giuseppe Piazzi discovers the first and largest asteroid, Ceres, orbiting between Mars and Jupiter.
1898 — Gustav Witt discovers Eros, one of the largest near-Earth asteroids.
1991–1994 — The Galileo spacecraft takes the first close-up images of an asteroid (Gaspra) and discovers the first moon (later named Dactyl) orbiting an asteroid (Ida).
1997–2000 — The NEAR Shoemaker spacecraft flies by Mathilde and orbits and lands on Eros.
1998 — NASA establishes the Near-Earth Program Office to detect, track, and characterize potentially hazardous asteroids and comets that could approach Earth.
2006 — Ceres attains a new classification, "dwarf planet," but retains its distinction as the largest known asteroid.
2007 — The Dawn spacecraft is launched on its journey to the asteroid belt to study Vesta and Ceres.
2008 — The European spacecraft Rosetta, on its way to study a comet in 2014, flies by and photographs asteroid Steins, a rare type of asteroid composed of silicates and basalts.

ABOUT THE IMAGES



1 A mosaic of asteroid Eros by the NEAR spacecraft.

2 A Galileo image of asteroid Ida and its moon Dactyl.

3 Elevation mapping using imagery from the Hubble Space Telescope reveals a giant crater (the blue ring) on asteroid Vesta.

4 A computer-generated model (color indicates degree of slope) of asteroid Golevka was created from radar data.

5 The Hubble Space Telescope provides our best view of Ceres until Dawn encounters it in 2015.

6 The Hubble Space Telescope provides our best view of Vesta until Dawn encounters it in 2011.

7 A false-color view of a large crater on Eros.

FOR MORE INFORMATION

solarsystem.nasa.gov/asteroids

FAST FACTS	433 Eros	951 Gaspra	4 Vesta	1 Ceres	243 Ida
Mean Distance from the Sun (AU*)	1.46	2.21	2.36	2.77	2.86
Orbit Period (years)	1.76	3.29	3.63	4.60	4.84
Orbit Eccentricity (Circular = 0)	0.22	0.17	0.09	0.08	0.05
Orbit Inclination to Ecliptic (deg)	10.83	4.10	7.13	10.58	1.14
Rotation Period	5 hr, 16 min	7 hr, 2 min	5 hr, 20 min	9 hr, 4 min	4 hr, 38 min
Dimensions (km)	34 × 11 × 11	20 × 12 × 11	578 × 560 × 458	960 × 932	60 × 25 × 19
Dimensions (mi)	21 × 7 × 7	12 × 7 × 7	359 × 348 × 285	597 × 579	37 × 15 × 12

*AU = astronomical unit, the mean distance from Earth to the Sun: 149.60 million km or 92.96 million mi.

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