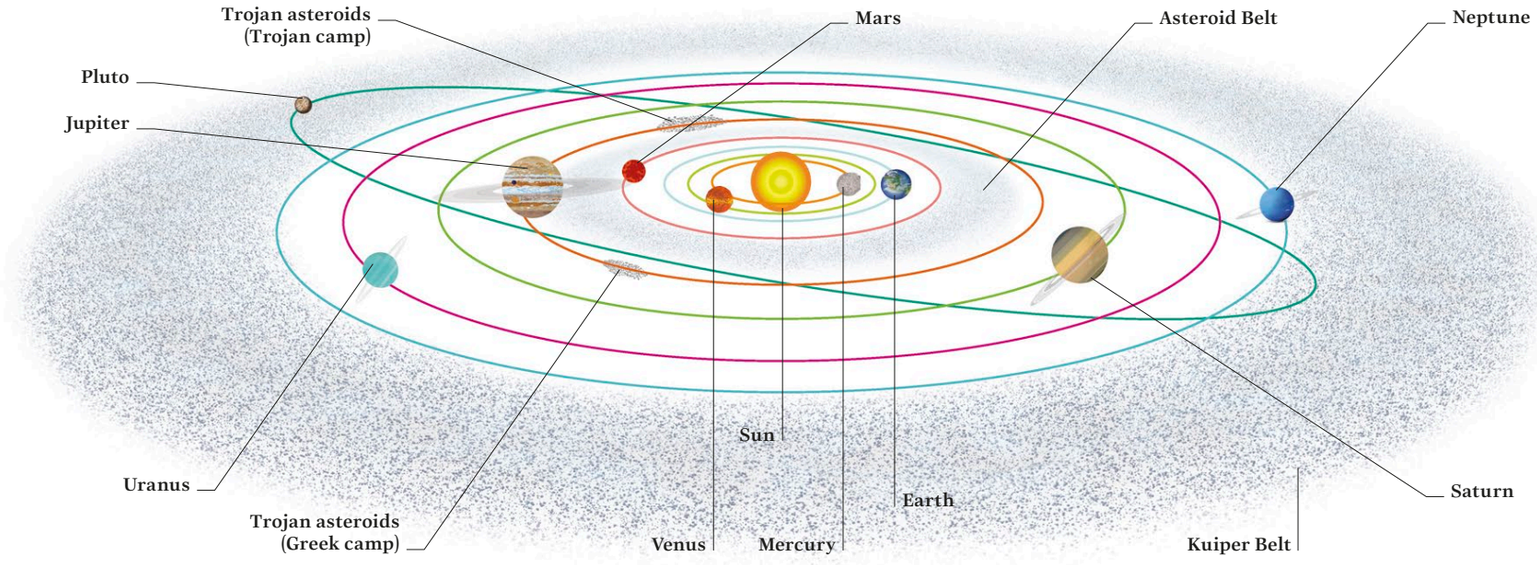
Small worlds

Between and beyond the major planets are countless rocky and icy objects that vary in size from boulders to dwarf planets. Most of these asteroids, ice dwarfs, and comets follow roughly circular orbits in areas well away from the major planets' gravity; those with more elliptical orbits risk destruction or exile from the Solar System during close encounters with larger worlds.

Belts of bodies

Most objects are in the rocky belt between Mars and Jupiter; the icy Kuiper Belt beyond Neptune; or the remote Oort Cloud (see opposite).



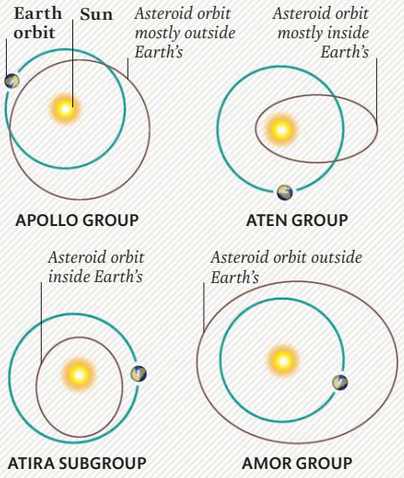
Asteroids

Asteroids are small rocky bodies that originally formed across the inner Solar System, but were prevented from growing into larger bodies by the gravitational influence of their planetary neighbours. Today, they are mostly confined to a belt between the orbits of Mars and Jupiter, but they frequently collide, so their structure and orbits evolve over time. A number of so-called Trojan asteroids – split into two "camps" inspired by Homer's *Iliad* – circle the Sun in gravitational neutral zones aligned with Jupiter's own orbit.

Estimates suggest that the **main asteroid belt** between Mars and Jupiter contains **1.1–1.9 million asteroids**

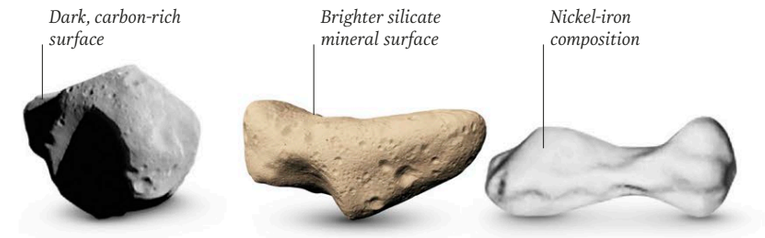
NEAR-EARTH ASTEROIDS

Collisions and close encounters can push asteroids onto paths that bring them closer to the Sun, and – given enough time – eventually destroy or eject them from the Solar System. These near-Earth asteroids can be grouped according to their orbit.



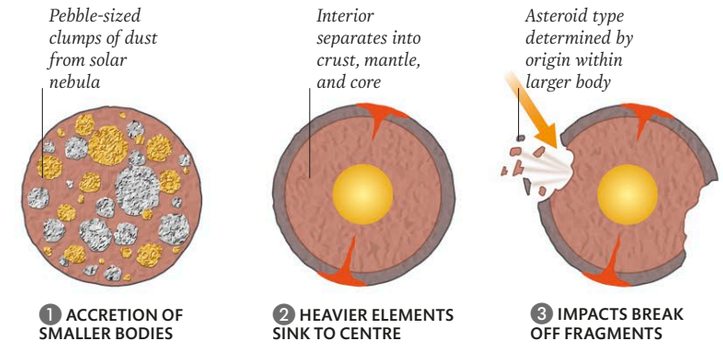
Types of asteroid

Asteroids vary in size and composition. Some, with dark, carbon-rich surfaces, have changed little since their formation, but others show signs of high metal content or past geological activity. Our knowledge is improved by meteorites that fall to Earth.



Asteroid evolution

Collisions may play a key role in the formation and compositon of different types of asteroid. A small body is not hot enough for its interior to melt and differentiate. A large one is – but impacts chip off fragments that may then become new asteroids with varied amounts of core and mantle material.



◂ see also The Cosmos pp.12–13 ◂ Rocky planets pp.14–15 ◂ Giant planets pp.16–17

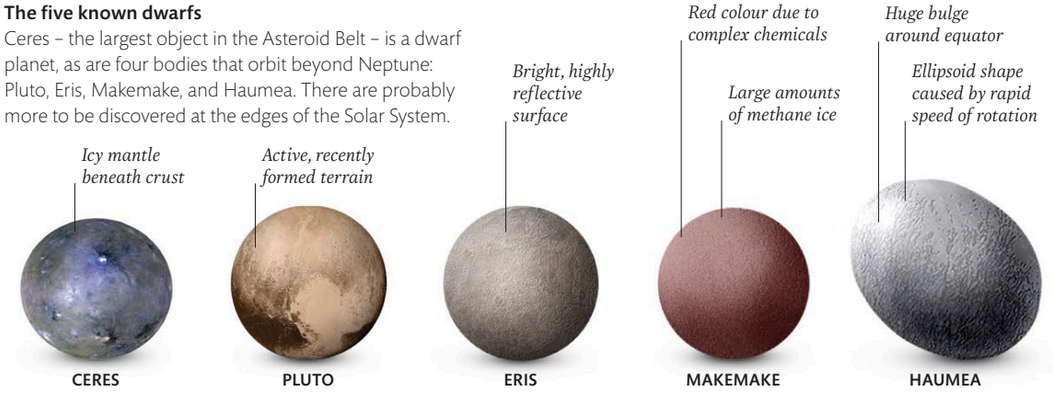
The remote object **Sedna** takes around **10,700 years** to complete an orbit of the Sun

Dwarf planets

These sizeable objects – which circle the Sun, and are not moons or satellites – would be considered major planets if it were not for the fact that they share their orbits with large numbers of smaller bodies. Classed officially as dwarf planets, these are objects with gravity that is powerful enough to pull them into a spherical shape – heating their interiors and driving geological activity on their surfaces – but too weak to clear their orbits of smaller objects; this distinguishes them from the rocky planets and gas giants found elsewhere in our Solar System.

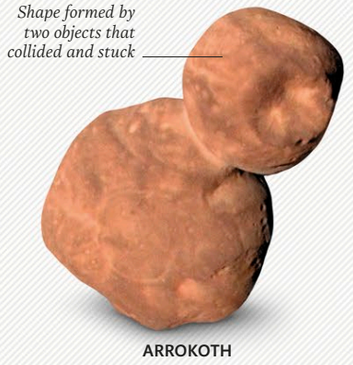
The five known dwarfs

Ceres – the largest object in the Asteroid Belt – is a dwarf planet, as are four bodies that orbit beyond Neptune: Pluto, Eris, Makemake, and Haumea. There are probably more to be discovered at the edges of the Solar System.



THE KUIPER BELT

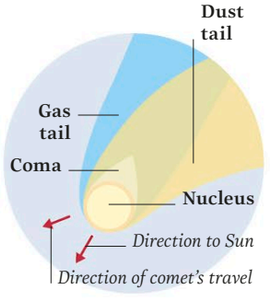
Set in the outer reaches of our Solar System, the Kuiper Belt probably contains more than 100,000 objects with a diameter of 100 km (62 miles) or more. Many of these icy worlds formed in the zone beyond the giant planets, but had their orbits altered as Uranus and Neptune moved outwards early in their history. Aside from Pluto, the 36 km (22 miles) snowman-shaped Arrokoth is the only Kuiper Belt object to have been studied up close.



For **75 years** – from 1930 to 2006 – **Pluto** was classed as the **9th major planet** in our Solar System

Comets

Comets are small icy bodies, usually a few kilometres across. They become visible when they approach the Sun from the outer Solar System, because they warm up and develop an extensive atmosphere and a tail of escaping ice. Some 1 trillion comets lurk unseen at the edge of the Solar System.



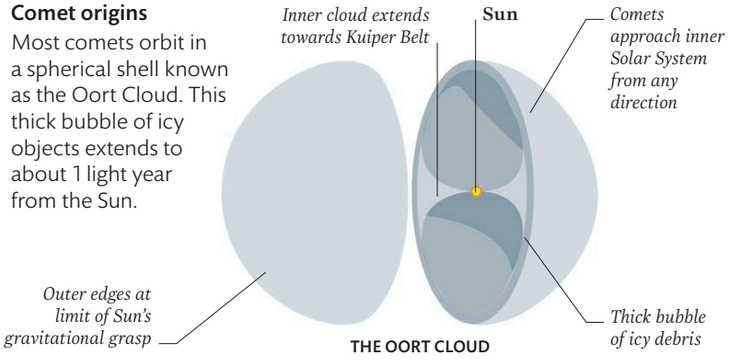
COMET ANATOMY

Comet structure

An active comet consists of a small, solid nucleus, which is surrounded by a planet-sized coma of tenuous gas, and one or more extensive tails.

Comet origins

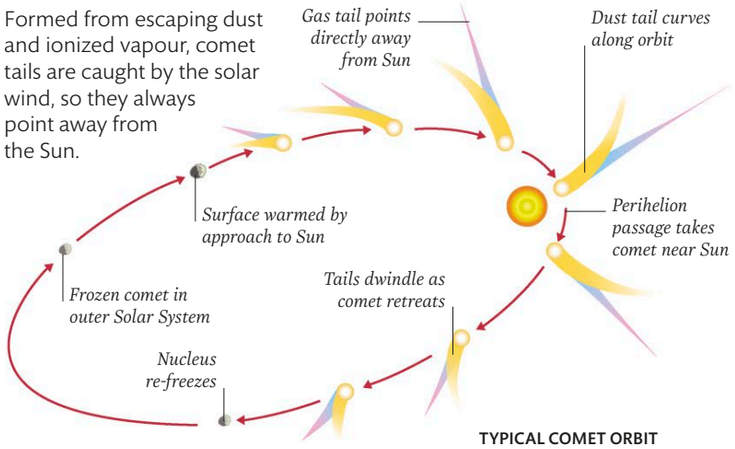
Most comets orbit in a spherical shell known as the Oort Cloud. This thick bubble of icy objects extends to about 1 light year from the Sun.



THE OORT CLOUD

Comet tails

Formed from escaping dust and ionized vapour, comet tails are caught by the solar wind, so they always point away from the Sun.



TYPICAL COMET ORBIT

Types of comet

Visiting comets are classified according to how often they return to the inner Solar System. Their orbits have all been disrupted – initially by encounters in the Oort Cloud, and later by one or more giant planets.

COMET HALLEY

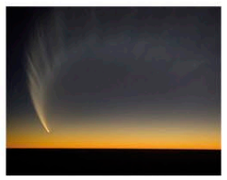
Short period

These comets return to the Solar System within 200 years. Multiple episodes of rapid heating remove their ice, which may diminish the display.

COMET HYAKUTAKE

Long period

The rarer visits of comets that take more than 200 years to make their return are often spectacular events because they retain more ice.



COMET MCNAUGHT

Single apparition

These comets make just one passage around the Sun before they either collide with it, or are flung out of the Solar System.

see also The Universe pp.30–33 ▶ Missions to the Solar System pp.38–39 ▶