



## Planets: FAQ About Planets, Asteroids and Comets

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### **What's a planet?**

A very good question and one that you might think is easily answered. Unfortunately, at present this is not the case. For decades, astronomers have struggled with a precise meaning for a planet since so many things can describe a planet. Within the last decade, astronomers have debated the terms that might best define a planet. For example, traits such as mass, roundness, diameter, rate of rotation, magnetic field, distance from Sun, etc., have been used variously in that definition of planet, though not one or any combination of characteristic traits have proved satisfactory.

Prior to these more recent debates, the traditional view, though not a distinct definition, held that a planet was a sizable body in orbit around its host star, such as planets in our Solar System. But, since the start of the millennium, astronomers had discovered other objects in the Solar System, potentially larger than the known smallest planets, hence the need to define a planet.

### **So what do we call a planet?**

So far, there is no single definition, though there are several broad guidelines. In an attempt to clarify the debate, the International Astronomical Union (IAU), the organization that oversees the naming of celestial objects, opted recently for at least three characteristics that help to define

a planet. First, a planet in our Solar System must orbit the Sun. Second, it must have enough mass to generate gravity sufficient for the planet to assume hydrostatic equilibrium (i.e., a nearly round shape). Third, for the body to be considered a planet, it must also "clear its neighborhood", a phrase from the IAU's own guidelines issued in 2006, which means that the body must rid itself of any nearby remnants of its own formation.

In general, planets in the Solar System have been lumped into two broad categories, namely, terrestrial and Jovian. Terrestrial planets generally resemble Earth with a hard surface, relatively small diameter, and some combination of rocky and metallic composition; Jovian planets resemble Jupiter with a gaseous atmosphere, no hard surface, and relatively large diameter.

### **So how many planets are there in the Solar System?**

As a result of the IAU's guidelines in 2006, eight planets exist, namely, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. There are now at least three "dwarf" planets, which includes Pluto, a former asteroid known as Ceres, and a recently discovered distant world (larger than Pluto) now known as Eris. By the way, asteroids, which also were once known as minor planets, are termed by the more generic phrase as "small Solar System bodies".

## And Pluto is not a planet any more?

Presently that is correct. Again, as a result of the IAU's recent guidelines, Pluto, which was traditionally viewed as a planet since its discovery, was reclassified as a "dwarf" planet due to its vicinity to its fellow Kuiper Belt Objects, true leftovers from the Solar System's formation.



### It's eight planets now

As a result of guidelines issued by the IAU in 1996, the Solar System now has a total of eight planets. In this artist's rendering, both terrestrial (i.e., small like Earth) and Jovian (i.e., large like Jupiter) are shown in a side-by-side comparison of relative size.

Image by IAU/Martin Kornmesser.

## What are Kuiper Belt Objects?

Also known by the acronym KBO, Kuiper Belt Objects are described to be icy remnants at the fringe of the plane of the Solar System, likely the leftovers of frozen gas and elemental dust pushed to the outskirts beyond Neptune by the increasing brightness and radiation from the early, formative Sun. These icy remnants can also form the nuclei of comets. And among these remnants astronomers have detected several sizable KBOs, which have the potential to be considered as dwarf planets. Eris is one such world, marginally larger than Pluto, but firmly a part of the Kuiper Belt; other KBOs which may be dwarf planets (if they can be proved to be spherical) are currently (and unofficially) named Sedna, Varuna, Ixion, and Quaoar.

## Is there anything else "out there"?

At the known fringe of the Solar System, there appears to be much more. The Kuiper Belt (more accurately known as the Edgeworth-Kuiper Belt or EKB), which is the origin of KBOs, lies, for the most part, within the general plane of the Solar System, which makes it roughly shaped as a flattened disk. This disk of dusty, frozen

gaseous material is thought to extend out to a Solar System radius nearly 40,000 times the distance between the Sun and the Earth.

Beyond the EKB and surrounding the whole of the Solar System in roughly a spherical shape is the Oort Cloud (more fairly termed the *pik*-Oort Cloud). This cloud, composed of icy, dusty material similar to that found in the EKB, is thought to extend to a Solar System radius of 2000 times the distance between Pluto and the Sun (or 100,000 times the distance between the Sun and the Earth), which would place the edge of the Oort Cloud at one-quarter the distance, or at least one light-year, to the nearest star beyond the Sun. The Oort Cloud is thought to be, like the EKB, a ready supply of comet nuclei.

## What's a comet?

A comet is an icy, dusty body, originating in either the EKB or the Oort Cloud, which can find its way to the interior of the Solar System as a result of gravitational attraction by the Sun or large planets. Most of the time we see a comet depicted with a tail as a swath of light across the night sky. But even at the Solar System's fringe the icy debris, which may not necessarily sprout a tail, may be referred to as a comet. That is, large chunks of that icy debris will accrete, or clump together, to form the nucleus, or head, of a comet that potentially may find its way to the Sun. If a comet nucleus of icy, dusty debris does fall toward the Sun and veers near the Earth, potentially it will form the classic appearance of a comet's sweeping tail across our night sky.

## Then what makes the tail of a comet?

As a comet nucleus from the EKB or the Öort Cloud is attracted to the interior of the Solar System by the gravity of the Sun, the Sun's radiation begins to dissolve, or sublimate, the ices in the nucleus that hold the debris together. The sublimating ices loosen any trapped dusty debris, which then builds as a shroud of dust and gas, known as the coma, around the comet's nucleus.

The pressure of sunlight pushes at the dusty debris, causing it to point in a direction away from the Sun. The dusty debris, losing velocity as it falls away from the comet rushing toward the Sun, will form a dust tail, trailing behind the coma. The solar wind, a fairly constant outward flow of energetic particles from the surface of the Sun ionizes the gaseous material, subsequently pushing it straight back from the Sun and making it glow. It is possible for a comet to show both a gas tail and a dust tail, though not always.

## How often do we see comets?

One cannot predict the appearance of a previously unknown comet; only when it is found visually, often with the aid of telescopes and spacecraft, can one confirm its appearance. On Earth, many comets are found by amateur astronomers, who make the time to scan the skies with telescope and binocular. If the comet is found to be on a path toward the Sun that carries it close to Earth, then we may be witness to a dazzling apparition in our night skies.

Sometimes comets may not find a fiery end in their headlong plunge to the Sun. Instead, comet nuclei might approach the Sun in orbits that allow them to return one day to the vicinity of the Earth. These are called periodic comets, because their amount of time, or period, to orbit the Sun is predictable. On the other hand, comets that make a single appearance, never to return to the interior of the Solar System, are called non-periodic comets.

## How are comets named?

From at least the latter 19th century through the entire 20th century, it has been customary for comets to be named after their discoverers. If an observer finds a comet, and its presence is confirmed by subsequent observations by others, the comet is named after the first discoverer. Comets can have more than one discoverer. Two (and occasionally up to three coincidental discoverers') names have been appended to comets in past decades.

It has also been customary for comets with orbital periods shorter than 200 years to be defined as short-period comets. When comets' orbits become well determined, usually after two passages through perihelion (or closest approach to the Sun), they then receive a permanent designation as a periodic comet. More recently, a more formal system of naming comets instituted by IAU classifies comets by their year of discovery and their periodicity.

## Where do asteroids fit in with planets and comets?

Known previously as minor planets, asteroids are large chunks of rock and metal thought to be the leftovers of material from the beginning of the Solar System. Most of the known asteroids move around the Sun in paths between the orbits of Mars and Jupiter. Others orbit closer to the Sun (and are known as Apollo asteroids); still others orbit far from the Sun within the orbit of Jupiter (and are known as Trojan asteroids). There are several classifications of asteroids, based on their proximity to the Sun or to certain planets.

Up until Pluto was reclassified as a dwarf planet, asteroids were lumped into a general designation known as minor planets, since they exhibited traits similar to the traditional terrestrial planets. Today many thousands are known and named. Astronomers are especially interested in Apollo asteroids, as they pose a remote threat of collision with our home planet should they cross Earth's orbit.