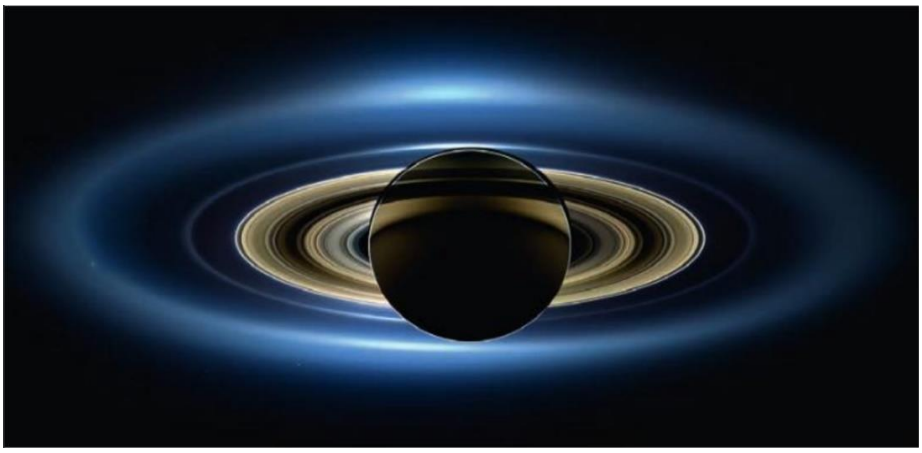
Planets

A planet is a celestial body orbiting around the Sun or other stars and whose mass is such that its gravity gives it a nearly round shape.



Credit: NASA/JPL-Caltech/SSI

Saturn and its rings

View recorded by the Cassini spacecraft on 19 July 2013, with the planet's disc eclipsing the Sun, revealing the ring system that bears a deep resemblance to the circumsolar disc.

In 2006, the IAU General Assembly adopted a new definition of a planet in the Solar System: a celestial body orbiting around the Sun, whose mass is such that gravity gives it a nearly round shape, and which has cleared away any other body likely to move in a nearby orbit. The table at the top of the next page presents the eight planets thus defined, all of which move in elliptical orbits whose planes are similar to that of the Earth's orbit.

A planet sends back some of the energy it receives from its star as infrared radiation which carries far less energy than that received (by a 4,000 factor in the case of Earth). As they gradually contract under the effect of gravity, gas giants heat up and ultimately radiate more energy than that received from the Sun. The IAU also established the dwarf planet category, defined as celestial bodies whose mass is such that gravity gives them a nearly round shape, but which haven't cleared their orbital neighbourhood of other celestial bodies. The second table presents the five dwarf planets thus defined.

When it formed from an interstellar cloud, the Sun was shrouded with a gas disc studded with grains of dust, aggregates of solid-state substances. Beyond the frost line (~5 AU from the Sun), the disc was cold enough for water ice to also aggregate into grains. Like dust balls found under a bed, these grains in the circumsolar disc formed lumps that gravity assembled into billions of planetesimals (size: 5-10 km). The most massive absorbed everything in their area of influence to form planet embryos whose mass increased with their distance from the Sun.

Planet	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Terrestrial planets							
Mercure	2,440	0.055	58.65	0.387	0.241	0	None
Venus	6,052	0.815	243.0	0.723	0.615	1	CO_2, N_2
Earth	6,378	1.000	1.000	1.000	1.000	1	N_2, O_2
Mars	3,396	0.107	1.026	1.524	1.881	2	CO_2, N_2
Gas giants							
Jupiter	71,492	317.8	0.414	5.203	11.86	67	H_2, He
Saturn	60,268	95.16	0.448	9.537	29.45	62	H_2, He
Uranus	25,559	14.54	0.718	19.19	84.02	27	H_2, He
Neptune	24,764	17.15	0.671	30.10	164.9	14	H_2, He

Characteristics of the planets in the Solar System

This table summarises the main characteristics of the planets in the Solar System. The columns provide the following information:

(1) Equatorial radius (km)
(2) Mass ($M_\otimes$)
(3) Rotation period (day)
(4) Orbit semi-major axis (AU)
(5) Revolution period (year)
(6) Number of authenticated satellites
(7) Atmosphere (composition)

The Earth is taken as reference for the first five columns. For example, the mass of Jupiter is 317.8 times greater than the Earth's and the year on Uranus is about 84 Earth-years long.

Beyond the frost line, the mass of planetary embryos exceeded 10 Earth masses ($M_\otimes$). They built up a gaseous envelope by accretion, which would eventually collapse if the envelope's mass exceeded 100 $M_\otimes$, a process that resulted in gas giants like Jupiter or Saturn. Otherwise, the envelope dispersed and all that remained was a gas giant with a rock and ice core surrounded by a thick atmosphere (total mass: ~15 $M_\otimes$), like Uranus or Neptune. Below the frost line, the less massive planetary embryos disrupted one another to the point of colliding. Violent collisions ensued, leaving only the four bodies known today as terrestrial, or telluric, planets.

Since 1995, astronomers have been discovering exoplanets, celestial bodies similar to the planets in our solar system which orbit other stars. The first to be formally identified (mass: 146 $M_\otimes$) revolves around the star 51 Peg, at 50.1 ly from the Sun. To date, over 5,000 exoplanets have been detected and considered confirmed, some of them about the size of Earth.

Dwarf planet	(1)	(2)	(3)	(4)	(5)	(6)
Ceres	487	0.068	2.766	0.0798	4.5992	0
Pluto	1,185	1.000	39.45	0.2502	247.74	5
Haumea	980	0.305	43.28	0.1909	284.12	2
Makemake	717	0.15–0.40	45.71	0.15	309	0
Eris	1,163	1.263	67.78	0.441	558	1

Characteristics of the dwarf planets in the Solar System

(1) Equatorial radius (km)
(2) Mass (in Pluto mass units, i.e. 1.314 × 1,022 kg)
(3) Orbit semi-major axis (AU)
(4) Orbital eccentricity
(5) Revolution period (year)
(6) Number of authenticated satellites

Translated from 'Les planètes',* Passeport pour les deux infinis, *IN2P3/Dunod, https://pass2i.ijclab.in2p3.fr/ (French); updated with ICHEP2024 conference (https://ichep2024.org) for IPPOG