The **Moon** is Earth's only known natural satellite,[nb 4][6] and the fifth largest satellite in the Solar System. It is the largest natural satellite of a planet in the Solar System relative to the size of its primary, having a quarter the diameter of Earth and 1⁄81its mass.[nb 5] The Moon is the second densest satellite after Io, a satellite of Jupiter. It is in synchronous rotation with Earth, always showing the same face; the near side is marked with dark volcanic maria among the bright ancient crustal highlands and prominent impact craters. It is the brightest object in the sky after the Sun, although its surface is actually very dark, with a similar reflectance to coal. Its prominence in the sky and its regular cycle of phases have since ancient times made the Moon an important cultural influence on language, calendars, art and mythology. The Moon's gravitational influence produces the ocean tides and the minute lengthening of the day. The Moon's current orbital distance, about thirty times the diameter of the Earth, causes it to appear almost the same size in the sky as the Sun, allowing it to cover the Sun nearly precisely in total solar eclipses.

The Moon is the only celestial body on which humans have landed. While the Soviet Union's Luna programme was the first to reach the Moon with unmanned spacecraft in 1959, the United States' NASA Apollo program achieved the only manned missions to date, beginning with the first manned lunar orbiting mission by Apollo 8 in 1968, and six manned lunar landings between 1969 and 1972—the first being Apollo 11. These missions returned over 380 kg of lunar rocks, which have been used to develop a detailed geological understanding of the Moon's origins (it is thought to have formed some 4.5 billion years ago in a giant impact event involving Earth), the formation of its internal structure, and its subsequent history.

After the Apollo 17 mission in 1972, the Moon has been visited only by unmanned spacecraft, notably by the final Soviet Lunokhod rover. Since 2004, Japan, China, India, the United States, and the European Space Agency have each sent lunar orbiters. These spacecraft have contributed to confirming the discovery of lunar water ice in permanently shadowed craters at the poles and bound into the lunar regolith. Future manned missions to the Moon have been planned, including government as well as privately funded efforts. The Moon remains, under the Outer Space Treaty, free to all nations to explore for peaceful purposes.

Name and etymology

The English proper name for Earth's natural satellite is "the Moon".[7][8] The noun *moon* derives from *moone* (around 1380), which developed from *mone* (1135), which derives from Old English *mōna* (dating from before 725), which, like all Germanic language cognates, ultimately stems from Proto-Germanic **mænōn*.[9]

The principal modern English adjective pertaining to the Moon is *lunar*, derived from the Latin *Luna*. Another less common adjective is *selenic*, derived from the Ancient Greek *Selene* (*Σελήνη*), from which the prefix "seleno-" (as in *selenography*) is derived.[10]

Formation

Main article: Giant impact hypothesis

Several mechanisms have been proposed for the Moon's formation 4.527 ± 0.010 billion years ago,[nb 6] some 30–50 million years after the origin of the Solar System.[11] These include the fission of the Moon from the Earth's crust through centrifugal forces,[12] which would require too great an initial spin of the Earth,[13] the gravitational capture of a pre-formed Moon,[14] which would require an unfeasibly extended atmosphere of the Earth to dissipate the energy of the passing Moon,[13] and the co-formation of the Earth and the Moon together in the primordial accretion disk, which does not explain the depletion of metallic iron in the Moon.[13] These hypotheses also cannot account for the high angular momentum of the Earth–Moon system.[15]

The prevailing hypothesis today is that the Earth–Moon system formed as a result of a giant impact: a Mars-sized body hit the nearly formed proto-Earth, blasting material into orbit around the proto-Earth, which accreted to form the Moon.[16] Giant impacts are thought to have been common in the early Solar System. Computer simulations modelling a giant impact are consistent with measurements of the angular momentum of the Earth–Moon system, and the small size of the lunar core; they also show that most of the Moon came from the impactor, not from the proto-Earth.[17] However, meteorites show that other inner Solar System bodies such as Mars and Vesta have very different oxygen and tungsten isotopic compositions to the Earth, while the Earth and Moon have near-identical isotopic compositions. Post-impact mixing of the vaporized material between the forming Earth and Moon could have equalized their isotopic compositions,[18] although this is debated.[19]

The large amount of energy released in the giant impact event and the subsequent reaccretion of material in Earth orbit would have melted the outer shell of the Earth, forming a magma ocean.[20][21] The newly formed Moon would also have had its own lunar magma ocean; estimates for its depth range from about 500 km to the entire radius of the Moon.[20]