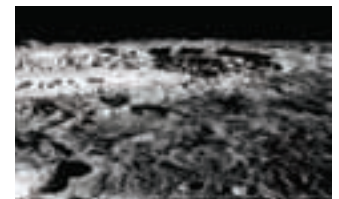
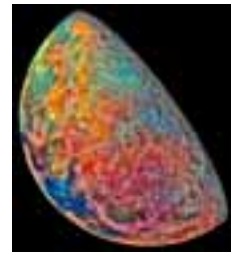


# Earth's Moon





The regular daily and monthly rhythms of Earth's only natural satellite, the Moon, have guided timekeepers for thousands of years. Its influence on Earth's cycles, notably tides, has also been charted by many cultures in many ages. The presence of the Moon stabilizes Earth's wobble on its axis, leading to a stable climate over billions of years, which may have affected the course of the development and growth of life on Earth. From Earth, we see the same face of the Moon all the time because the Moon rotates just once on its own axis in very nearly the same time that it travels once around Earth (called synchronous rotation). Patterns of dark and light features on the near side have given rise to the fanciful "Man in the Moon" description. The light areas are lunar highlands. The dark features, called maria (Latin for seas), are impact basins that were filled with dark lava between 4 and 2.5 billion years ago.

How did the Moon come to be? The leading theory, based on research, is that a Mars-sized body collided with Earth and the resulting debris from both Earth and the impactor accumulated to form our natural satellite approximately 4.5 billion years ago (the age of the oldest collected lunar rocks). When the Moon formed, its outer layers melted under very high temperatures, forming the lunar crust, probably from a global "magma ocean" — a sea of molten rock. The lunar highlands contain the remnants of rocks that floated to the surface of the magma ocean.

After the ancient time of volcanism, the Moon cooled and has since been nearly unchanged, except for a steady rain of "hits" by meteorites and comets. Impacts over billions of years have ground up surface areas into powder. Because the Moon has essentially no atmosphere, even the tiniest meteorites strike the surface. The Moon's surface is charcoal gray and sandy, with much fine soil. This powdery blanket of lunar soil is called the lunar regolith. The regolith is thin, ranging from about 2 meters (7 feet) on the youngest maria to perhaps 20 meters (70 feet) on the oldest surfaces in the highlands.

Four impact craters are used to date objects on the Moon: Nectaris, Imbrium, Eratosthenes, and Copernicus. Lunar history is carved up into time segments associated with the date of each crater. A Copernican feature, for example, is associated with a

crater that is similar in age to the Copernicus impact crater, that is, 1 billion years old or less.

The Moon was first visited by the U.S.S.R. spacecraft Luna 2 in 1959, and a number of U.S. and U.S.S.R. robotic spacecraft followed. The U.S. first sent a series of Ranger spacecraft, designed to relay images and data and then crash-land onto the surface. This series was followed by the Surveyors, the first U.S. spacecraft to make lunar soft-landings. The first human landing on the Moon was on July 20, 1969. Twelve American astronauts walked upon its surface and brought back 382 kilograms (842 pounds) of lunar rock and soil to Earth during the Apollo lunar surface exploration missions of 1969 to 1972. The chief repository of the Apollo samples is NASA's Johnson Space Center in Houston.

Startling results from the Clementine and Lunar Prospector spacecraft indicate that there may be water ice on the Moon. Though a controlled crash of the Lunar Prospector in 1999 produced no observable signature of water, the issue of whether ancient cometary impacts delivered ice that is harbored in dark, cold areas of the Moon is still an open question.

In 2004, President George W. Bush announced a new Vision for Space Exploration that includes sustained robotic and human exploration of the solar system and beyond. It begins with robotic exploration of the Moon with an orbiter and then a lander, with a human return to the Moon by 2018. The Moon would be a test-bed for technologies to support human exploration of the Moon, Mars, and beyond.

## FAST FACTS

|   |   |
|---|---|
| Mean Distance from Earth                | 384,400 km (238,855 mi)                   |
| Orbit Period                            | 27.32 Earth days                          |
| Orbit Eccentricity (Circular Orbit = 0) | 0.05490                                   |
| Orbit Inclination to Ecliptic           | 5.145 deg                                 |
| Inclination of Equator to Orbit         | 6.68 deg                                  |
| Rotation Period                         | 27.32 Earth days                          |
| Equatorial Radius                       | 1,737.4 km (1,079.6 mi)                   |
| Mass                                    | 0.0123 of Earth's                         |
| Density                                 | 3.341 g/cm <sup>3</sup> (0.61 of Earth's) |
| Gravity                                 | 0.166 of Earth's                          |
| Temperature Range                       | -233 to 123 deg C (-387 to 253 deg F)     |

## SIGNIFICANT DATES

1610 — Galileo Galilei is the first to use a telescope to make scientific observations of the Moon.

1959–1960 — Luna 1, 2, and 3 are the first to fly by, impact, and photograph the far side of the Moon.

1966 — Surveyor 1 makes the first soft landing on the Moon.

1969 — Astronaut Neil Armstrong is the first of 12 humans to walk on the lunar surface.

1996 — Clementine data indicate water ice at the south pole.

1998 — Lunar Prospector data indicate that ice exists at both lunar poles.

## ABOUT THE IMAGES



**1** The dark areas of this lunar image are lava-filled impact basins. The bright ray crater on the bottom is the Tycho impact basin.

**2** Apollo 12 astronaut Charles Conrad visits Surveyor 3, a robotic spacecraft that landed on the Moon three years earlier.

**3** This boot print marks one of the first steps human beings took on the Moon in July 1969.

**4** False-color images help scientists identify different types of soil on the Moon's surface.

**5** An illustration of future astronauts investigating a lava cave on the Moon.

**6** The Apollo 8 crew took this picture of Earth rising over the surface of the Moon in 1968.

**7** Copernicus Crater is part of the youngest assemblage of lunar rocks. The photo was taken by Lunar Orbiter 2 in 1966.

## FOR MORE INFORMATION

[solarsystem.nasa.gov/planets/profile.cfm?Object=Moon](http://solarsystem.nasa.gov/planets/profile.cfm?Object=Moon)