

On July 5, 2016, the moon passed between NOAA's DISCOVER satellite and Earth.

## **ABOUT THE MOON**

### **Quick Facts**

- **Radius:** 1,079.6 miles | 1,737.5 kilometers
- **Distance from Earth:** 238,855 miles | 384,400 kilometers

### **More Stats**

The fifth largest moon in the solar system, Earth's moon is the only place beyond Earth where humans have set foot. The brightest and largest object in our night sky, the moon makes Earth a more liveable planet by moderating our home planet's wobble on its axis, leading to a relatively stable climate. It also causes tides, creating a rhythm that has guided humans for thousands of years. The moon was likely formed after a Mars-sized body collided with Earth. Earth's only natural satellite is simply called "the moon" because people didn't know other moons existed until Galileo Galilei discovered four moons orbiting Jupiter in 1610.

### **Size and Distance**

With a radius of 1,079.6 miles (1,737.5 kilometers), the moon is less than a third the width of Earth. If Earth were the size of a nickel, the moon would be about as big as a coffee bean.

The moon is farther away from Earth than most people realize. The moon is an average of 238,855 miles (384,400 kilometres) away. That means 30 Earth-sized planets could fit in between Earth and the moon.

The moon is slowly moving away from Earth, getting about an inch farther away each year.



Earth's moon compared to Earth

## **Orbit and Rotation**

The moon is rotating at the same rate that it revolves around Earth (called synchronous rotation), so the same hemisphere faces Earth all the time. Some people call the far side — the hemisphere we never see from Earth — the "dark side," but that's misleading. As the moon orbits Earth, different parts are in sunlight or darkness at different times. The changing illumination is why, from our perspective, the moon goes through phases. During a "full moon," the hemisphere of the moon we can see from Earth is fully illuminated by the sun. And a "new moon" occurs when the far side of the moon has full sunlight, and the side facing us is having its night.

The moon makes a complete orbit around Earth in 27 Earth days and rotates or spins at that same rate, or in that same amount of time. Because Earth is moving as well — rotating on its axis as it orbits the sun — from our perspective, the moon appears to orbit us every 29 days.

## **Formation**

The leading theory of the moon's origin is that a Mars-sized body collided with Earth about 4.5 billion years ago. The resulting debris from both Earth and the impactor accumulated to form our natural satellite 239,000 miles (384,000 kilometres) away. The newly formed moon was in a molten state, but within about 100 million years, most of the global "magma ocean" had crystallized, with less-dense rocks floating upward and eventually forming the lunar crust.

## **Structure**

Earth's moon has a core, mantle and crust.

The moon's core is proportionally smaller than other terrestrial bodies' cores. The solid, iron-rich inner core is 149 miles (240 kilometres) in radius. It is surrounded by a liquid iron shell 56 miles (90 kilometres) thick. A partially molten layer with a thickness of 93 miles (150 kilometres) surrounds the iron core.

The mantle extends from the top of the partially molten layer to the bottom of the moon's crust. It is most likely made of minerals like olivine and pyroxene, which are made up of magnesium, iron, silicon and oxygen atoms.

The crust has a thickness of about 43 miles (70 kilometres) on the moon's near-side hemisphere and 93 miles (150 kilometres) on the far-side. It is made of oxygen, silicon, magnesium, iron, calcium and aluminium, with small amounts of titanium, uranium, thorium, potassium and hydrogen.

Long ago the moon had active volcanoes, but today they are all dormant and have not erupted for millions of years.

## **Surface**

With too sparse an atmosphere to impede impacts, a steady rain of asteroids, meteoroids and comets strikes the surface of the moon, leaving numerous craters behind. Tycho Crater is more than 52 miles (85 kilometres) wide.

Over billions of years, these impacts have ground up the surface of the moon into fragments ranging from huge boulders to powder. Nearly the entire moon is covered by a rubble pile of charcoal-gray, powdery dust and rocky debris called the lunar regolith. Beneath is a region of fractured bedrock referred to as the megaregolith.

The light areas of the moon are known as the highlands. The dark features, called maria (Latin for seas), are impact basins that were filled with lava between 4.2 and 1.2 billion years ago. These light and dark areas represent rocks of different composition and ages, which provide evidence for how the early crust may have crystallized from a lunar magma ocean. The craters themselves, which have been preserved for billions of years, provide an impact history for the moon and other bodies in the inner solar system.

If you looked in the right places on the moon, you would find pieces of equipment, American flags, and even a camera left behind by astronauts. While you were there, you'd notice that the gravity on the surface of the moon is one-sixth of Earth's, which is why in footage of moonwalks, astronauts appear to almost bounce across the surface.

The temperature reaches about 260 degrees Fahrenheit (127 degrees Celsius) when in full sun, but in darkness, the temperatures plummet to about -280 degrees Fahrenheit (-173 degrees Celsius).

## **Atmosphere**

The moon has a very thin and weak atmosphere, called an exosphere. It does not provide any protection from the sun's radiation or impacts from meteoroids.

## **Potential for Life**

The many missions that have explored the moon have found no evidence to suggest it has its own living things. However, the moon could be the site of future colonization by humans, though there are no immediate plans to do so.

## Moons

Earth's moon has no moons of its own.

## Rings

The moon has no rings.

## Magnetosphere

The early moon may have developed an internal dynamo, the mechanism for generating global magnetic fields for terrestrial planets, but today, the moon has a very weak magnetic field. The magnetic field here on Earth is many thousands of times stronger than the moon's magnetic field.

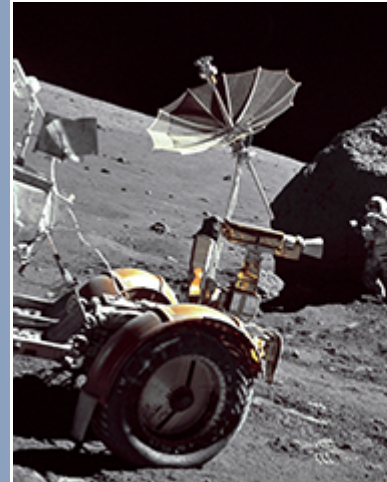
## Exploration

Human beings have studied the moon for millennia, watching its phases change and observing eclipses — both solar and lunar. During a solar eclipse, our moon moves between Earth and the sun and blocks the sunlight. In a lunar eclipse, Earth blocks the sun's light that normally lights up the moon, so we see Earth's shadow over the face of the moon. From Earth, we see the moon get dark and often turn red. This happens because Earth's atmosphere scatters blue and green light while it bends yellow, orange and red wavelengths toward the moon.

The moon is the most explored body in our solar system besides Earth, having been visited by numerous spacecraft from multiple space agencies around the world. It's also the only place besides Earth where human beings have set foot.

## Significant Dates:

- **1609:** Thomas Harriot becomes the first person to use a telescope aimed at the sky and sketches the moon. Later he made the first maps of the moon.
- **1610:** Galileo Galilei publishes scientific observations of the moon in *Sidereus Nuncius* (Starry Messenger).
- **1959-1976:** The U.S.S.R.'s Luna program of 17 robotic missions achieves many "firsts" — including the first glimpse of the far side of the moon — and three sample returns.
- **1961-1968:** The U.S. Ranger, Lunar Orbiter, and Surveyor robotic missions pave the way for Apollo human lunar landings.
- **1969:** Astronaut Neil Armstrong is the first human to walk on the moon's surface.
- **1994-1999:** Clementine and Lunar Prospector data suggest that water ice may exist at the lunar poles.
- **2003:** The European Space Agency's SMART-1 lunar orbiter inventories key chemical elements.
- **2007-2008:** Japan's second lunar spacecraft, Kaguya, and China's first lunar spacecraft, Chang'e 1, both begin one-year missions orbiting the moon; India's Chandrayaan-1 soon follows in lunar orbit.
- **2008:** The NASA Lunar Science Institute is formed to help lead NASA's research activities related to lunar exploration goals.
- **2009:** NASA's Lunar Reconnaissance Orbiter and LCROSS launch together, beginning the U.S. return to lunar exploration. In October, LCROSS was directed to impact a permanently shadowed region near the lunar south pole, resulting in the discovery of water ice. LRO is still exploring the moon from orbit.
- **2011:** Twin GRAIL spacecraft launch to map the interior of the moon from crust to core, and NASA begins the ARTEMIS mission to study the moon's interior and surface composition. After a successful mission, the twin GRAIL spacecraft were directed to impact the moon in 2012.
- **2013:** NASA launches LADEE to gather detailed information about the structure and composition of the thin lunar atmosphere. The successful mission ended in April 2014.
- **14 December 2013:** China becomes the third nation to safely land a robotic spacecraft on the moon with the touchdown and deployment of Chang'e 3's Yutu rover.



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## Pop Culture

Our lunar neighbour has inspired stories since the first humans looked up at the sky and saw its grey, cratered face. Some observers saw among the craters the shape of a person's face, so stories refer to a mysterious "man in the moon." Hungrier observers compared its craters to cheese and dreamed of an entire sphere made of delicious dairy products.

The moon made its film debut in a 1902 black and white silent French film called *Le Voyage Dans la Lune* (a trip to the moon). And a year before astronauts walked on the moon, *2001: A Space Odyssey* (1968) told the story of astronauts on an outpost on the moon. Decades later, it is still widely regarded as the best science fiction movie ever made.

In reality, while we do not yet have a moon colony, spacecraft have left lots of debris on the lunar surface, and astronauts have planted six American flags on the moon. But that doesn't mean the United States has claimed it; in fact, an international law written in 1967 prevents any single nation from owning planets, stars, or any other natural objects in space.