

Explore a cultural and scientific timeline of lunar activities starting 4.5 billion years ago up to the present!



A Lunar Timeline

“To gaze upward at the
Moon...is to gaze deeply into
a well of history.”

–Scott Montgomery

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4.5 billion years ago The Moon is formed when a Mars-sized planet now named “Theia” collides with the Earth, spinning out the material that would form our companion satellite, which technically makes us part of a binary planet system. This hypothesis was developed at Tucson’s Planetary Sciences Institute by local scientists William Hartmann and Donald Davis and published in 1975. Sarah T. Stewart-Mukhopadhyay and colleagues recently have modified this so-called “Big Splat” to include what they call a “synestia” stage, which is a huge vaporous cloud in which both the Moon and the Earth form. More poetically, “The Moon formed inside the Earth when the Earth was a synestia,” Stewart says. This modified model of the giant Theia impact scenario accounts for the striking similarities in the geochemistry of both the Earth and the Moon, which is unprecedented in the Solar System.

At different points in its history, the Moon is bombarded by comets and meteorites, leading to its rugged, crater-covered surface, impact-induced lava flows, wide plains called “maria” (Latin for sea, though they were oceans of lava) and mountain formation. These origins were not well understood until the 20th century.

Approximately 10,000 to 50,000 years ago someone apparently keeps track of Moon phases on a bone, an indication of the Moon’s use as a time-keeper, according to

a still-controversial theory by Alexander Marshack. In any case, some ancient cultures had observatories to track not only solar events, such as the equinox, but also, for example, the Moon's path in the sky. In some societies the Moon originates time itself.

450 BCE Greek philosopher and mathematician Anaxagoras correctly deduces that the Moon shines by reflected sunlight, though this will still be contested by some thinkers until after Galileo.

Circa 300 BCE Aristarchus deduces that the Earth is larger than the Moon and that the Sun is much larger than either. He speculated that the Sun was at the center of the Solar System.

Circa 129 BCE Greek mathematician Hipparchus determines the distance from the Earth to the Moon, close to the actual value of about 240,000 miles.

Circa 46 BCE to 120 ACE Plutarch mentions some features seen on the naked-eye Moon.

Circa First Century ACE Al-Haitham writes *On the Nature of the Spots Seen in the Moon*.

Circa 1500 Painter Jan van Eyck includes a realistic depiction of the Moon's surface in a painting of Christ's crucifixion. This is the first known realistic rendering of the Moon. It is soon followed by private notebook drawings by Leonardo da Vinci.

1600 William Gilbert draws a naked-eye map of the Moon.

1609 Thomas Harriot is the first to draw features of the Moon through the telescope, what was then a recent invention.

1610 Galileo Galilei observes the Moon through a telescope of his own design and manufacture. His observations are scientific in nature, resulting in drawings that show the Moon's rough terrain, including valleys, high mountains and circular depressions. Galileo also discovers the satellites of Jupiter and vast new swaths of stars visible only with magnification. His book *The Starry Messenger* is a best-seller and is an important text in the long struggle between science and the Church. Galileo, a faithful Catholic, would be censured by the Pope in the years ahead for his scientific truths. His discoveries would thus disprove the prevailing view, in part derived from Aristotle, that the Moon is a perfectly smooth sphere. The nature of

the lunar surface (including possible life) and the origin of its features would be debated for centuries.

1634 Johannes Kepler's *Somnium*. One of many fictional accounts of a lunar voyage in the history of Western literature and science.

1638 John Wilkins publishes *The Discovery of a World in the Moone*, one of many books to come proposing the existence of "Selenites," or life on the Moon. (Selene was a Greek Moon goddess.)

1651 Giovanni Riccioli and Francesco Grimaldi publish the best lunar maps to date and introduce surface feature names that are still in use today.

1676-1707 Maria Clara Muller produces some 300 drawings of the Moon. Only a handful survive.

1753 Roger Boscovich correctly argues against a lunar atmosphere, but adherents to this idea would continue to promote it for at least another century and a half, including in an influential book by Edmund Neison in 1876, which was the first major scientific book in English on the Moon.

1824 Wilhelm G. Lohrmann publishes sections of the first great lunar map, but he cannot complete a planned large version before his death.

1825 Eccentric astronomer Franz von Paula Gruithuisen announces (erroneously) the existence of a city on the Moon, the latest installment in a long cultural obsession with intelligent or other life on the Moon and elsewhere in the universe.

1835 The New York Sun publishes hoax articles announcing that life exists on the Moon and has been seen by astronomers in South Africa.

1837 Jakob Beer and Johann Mädler publish *Der Mond*, a book so thorough and with maps so good the volume has the effect of stultifying interest in our companion satellite for years.

Late 19th and early 20th century Multiple authors produce several lunar maps and atlases.

1865 Jules Verne publishes *From the Earth to the Moon*, followed by *About the Moon*.

1901 H.G. Wells publishes *The First Men in the Moon*.

1903 W.H. Pickering publishes the first photographic lunar atlas that amateur astronomers can afford. He begins a multi-decade quest to argue for what he calls a “new selenography” which admits for the possibility of snow, clouds, plants and insects on the Moon. In this, he is unsuccessful.

1913 Mary Blagg publishes the massive *Collated List of Lunar Features*, with nearly 5,000 entries, which will lead to a co-authored two-volume *Named Lunar Formations* in 1935 approved by the International Astronomical Union. When lunar mapping began in the 17th and 18th centuries, what names to apply to which features was variable and controversial.

1931 Walter Goodacre’s *The Moon, with a Description of its Surface Formations*, is published with Francis Pease photos from the 100-inch Hooker telescope at Mt. Wilson.

1949 Trained astrophysicist and working business executive Ralph Baldwin publishes his book *The Face of the Moon*, which argues (correctly) for impacts of heavenly bodies forming nearly all of the Moon’s craters instead of Moon-wide volcanism.

1959 The Soviet probe Luna 1 flies by the Moon, the first human artifact to reach the satellite. It shows that the Moon has no magnetic field. The same year Luna 2 is deliberately crashed into the Moon, scattering a supply of hammer-and-sickle medallions. To cap off 1959, Luna 3 orbits the entire Moon and takes the first photographs of the far side.

1960 Gerard Kuiper founds the Lunar and Planetary Laboratory at University of Arizona, leading to an internationally renowned center for lunar and planetary science. LPL is at the forefront of pre-Apollo lunar studies and its scientists are intimately involved in Apollo mission planning. Among other notable discoveries are William K. Hartmann's observation—from a photograph projected onto a globe—of a far side giant impact basin, Mare Orientale, sometimes just visible on the edge of the nearside. LPL continues to be a leader in planetary science today.

1961 President John F. Kennedy announces that the United States will send a man to the Moon within 10 years and return him safely home. This is the same month the U.S. sent its first astronaut, Alan Shepard, into space on a sub-orbital shot. Unlike the Soviet Union, we had not yet orbited an astronaut. The first man in space was Yuri

Gagarin in April 1961 on an orbital mission. The first American to orbit the Earth was John Glenn in 1962.

1960s The ambitious U.S. Ranger, Lunar Orbiter and Surveyor programs pave the way for American astronauts to land on the Moon and return a treasure trove of science and photography.

1966 Russia's Luna 9 makes a controlled landing on the Moon, the first ever.

1968 NASA's Apollo 8 is the first crewed mission to fly to the Moon and back. On this lunar-orbital mission, the iconic "Earthrise" photo is taken, credited with helping spark the environmental movement. Tucson High graduate Frank Borman commands the mission.

1969 NASA's Apollo 11 lands the first humans on the Moon.

1970 Russia's Luna 16 becomes the first automated probe to retrieve and return lunar samples. Luna 17 lands with an automated rover.

1971 Apollo 15 lands on the Moon with a lunar buggy. This is the first of the “J missions,” with a special focus on doing science.

1972 Apollo 17 is the last, for now, human lunar mission.

1991 Lunar Prospector crashes into the lunar south pole and finds evidence of lunar ice.

1994 A joint Department of Defense and NASA mission, Clementine, orbits the Moon and maps and studies the Moon in multiple wavelengths of light.

2007 Japan’s SELENE probe provides breathtaking high-definition video of the Moon, improving topographical mapping of the Moon and providing the first gravity map of the far side.

2008 India’s Chandrayaan-1 discovers water molecules in the lunar “soil” or regolith. It is now known that the Moon has water reserves on the surface and at the poles, where water ice is found in permanently shadowed craters. These findings have helped spur commercial and international interest in returning to the Moon to stay.

2009 NASA's Lunar Reconnaissance Orbiter confirms hydrogen at the poles and the LRO Camera provides incredible views of the lunar surface, among multiple science findings.

2017 By now, so-called "new space" companies such as SpaceX and Blue Origin are shaking up how we imagine going to space and, with findings of lunar water, there is a growing consensus that, as NASA puts it now, the path is "Moon to Mars." Space Policy Directive 1 tasks NASA with making this vision real, while relying on commercial partners for low-earth orbit and assistance from them and international partners to return to the Moon to stay.

2018 Researchers writing in *Astrobiology* suggest that computer models show the likelihood of warm surface water on the Moon early in its history, leading to the possibility that life may have briefly arose there or been transported there from meteorites blasted off the surface of the Earth.

2018 China's ambitious lunar program includes the Chang'e 4 lander, which successfully touches down on the far side of the Moon, the first such craft to ever do so. China has plans for more missions, including human crews for the Moon.

2019 A private Israeli mission to the Moon is launched and a lander is scheduled to land there in April (unfortunately it crashes).

2020 NASA projects a test flight of its new heavy-lift rocket the Space Launch System along with the new deep-space Orion crew capsule, though no astronauts will be on board.

2022 NASA plans a crewed test flight around the Moon and the start of approximately annual human flights to lunar orbit to build the Gateway, an orbiting lunar outpost.

2024 Estimate for when uncrewed, human-rated vehicles will land on the Moon.

2024-2028 Estimate for the first U.S. human crews to return to the surface of the Moon.

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