National Aeronautics and Space Administration

The Apollo Program

The *Apollo* Program, begun in 1961 as a response to the challenge of Soviet space activities, rapidly became the backbone of the American space program. Its original objective was to land a man on the Moon and return him to Earth before the end of the decade. At the time President Kennedy proposed the *Apollo* Program, the United States had achieved only one manned space flight—Alan Shepard's 15-minute suborbital Mercury-Redstone mission. Even the most optimistic space enthusiasts had doubts that the President's goal could be met. An entire new space technology had to be developed—a technology that included orbital rendezvous, extravehicular activities, rocket-powered landings, and deep space navigation, among others. Furthermore, in 1961, knowledge about the lunar surface was of the most general nature, based completely on Earth-based astronomical studies and radar. No features smaller than a kilometer could be resolved, and one school of thought believed the maria to be deep pits filled with electrostatically supported dust into which astronauts might sink.

The *Apollo* Program was nevertheless approved, and development of the Saturn family of launch vehicles, spacecraft, and a deep-space tracking network began. The 10 missions of the manned *Gemini* Program were invaluable in learning how humans could operate in space. The unmanned *Ranger* series included three successful hard-landing missions, which produced the first high-resolution views of the lunar surface. A spectacular series of five *Lunar Orbiter* reconnaissance missions gave us photographs of almost the entire Moon; these photos helped to determine *Apollo* landing sites. In 1966 and 1967, soft-landing *Surveyor* spacecraft produced detailed knowledge of the lunar surface, including physical properties and chemical composition.

In 1967, the *Apollo* Program suffered a major setback. The *Apollo 204* spacecraft caught fire during a ground test, killing astronauts Grissom, White, and Chaffee. Because of this tragedy, spacecraft greatly improved, and rigid safety procedures were developed. By 1968, the first Earth-orbital mission, *Apollo 7*, was flown, followed within months by the first lunar-orbiting mission, *Apollo 8*. The *Apollo 9* mission tested the Lunar Module in Earth orbit and, Apollo 10 tested the Lunar Module in lunar orbit, paving the way for the first manned landing in July 1969.

The six *Apollo* lunar landings, during which 12 astronauts lived, in pairs, on the Moon for as long as 3 days, were extraordinarily productive. Astronauts carried out extensive remote-sensing surveys from lunar orbit that in themselves would have been major scientific accomplishments. The landings permitted the sampling of rocks and soils far beyond that possible with unmanned sample return missions; these sample are still being productively analyzed using new techniques developed in the decades since the samples were collected. The astronauts emplaced six complex geophysical observatories that operated for years; in fact, the laser retroreflectors emplaced with the observatories are still being used for Earth-based astronomical measurements.

The *Apollo* Program was the central element of a much broader space initiative that included the *Gemini*, *Lunar Orbiter*, *Skylab*, and *Apollo-Soyuz* programs. All these were either necessary preparations for the *Apollo* Program, or later efforts using *Apollo* spacecraft and launch vehicles. The Earth-orbiting elements of the "broader" *Apollo* Program were extremely productive. Earth terrain photography from the *Gemini* mission, for example, eventually lead to Landsat. Radar altimetry from Skylab mapped the gravitationally-determined shape of the sea surface from space, thus producing indirectly the first topographical view of the ocean floor. The *Apollo-Soyuz* mission demonstrated satellite-satellite tracking, a valuable technique used to map Earth's gravity field.

The total cost of the *Apollo* Program was $25 billion, spent between 1962 and 1972. The program is generally agreed to have been the supreme technological achievement of a millennium now drawing to a close, a unifying experience for the human race, and the beginning of humanity's expansion into the universe.

Fast Facts

Namesake:	Apollo—Greek God of Prophecy, Sunlight, Poetry, and Music
Lunar Mission:	Three Circumlunar (no landing); Six Landings
Samples Returned:	385 Kilograms of Rock and Soil; Soil Includes Implanted Hydrogen and Helium Atoms from the Sun.

About the Image

Astronaut Harrison ("Jack") Schmitt collects samples of a huge boulder in the Moon's Littrow Valley during the Apollo 17 *Mission in December 1972. This region is one of the most rugged and scenic visited by the six landings of the* Apollo *Program. Beyond the large boulder is the flat floor of the Littrow Valley, covered by dark mare material (lava flows). Beyond the valley are the Taurus Mountains, made up of older, heavily cratered highland rocks. The Lunar Rover, used by the astronauts to explore the surface, is visible to the right of the rock.*

Significant Dates

1961 — President John F. Kennedy proposed that the U.S. land a man on the Moon and return him before the end of the decade
1965 — First manned *Gemini* mission; demonstrated two-man spacecraft, propulsion, and radar
1968 — First manned *Apollo* mission; Earth orbit, 11 days
1968 — First manned flight to Moon, *Apollo 8*; 10 orbits, no landing
1969 — First manned landing on Moon, *Apollo 11*
1971 — First manned surface vehicle on moon, *Apollo 15*
1972 — Last *Apollo* mission to Moon, *Apollo 17*
1975 — *Apollo-Soyuz* Test Program, joint Soviet/American mission

References

1. *Apollo Over the Moon: A View from Orbit*, NASA SP-362, NASA Headquarters, Washington, DC. 1978.
2. *Apollo Expeditions to the Moon*, NASA SP-350, NASA Headquarters, Washington, DC. 1975.
3. Apollo 17 View of the Earth, HQL-255, NASA Headquarters, Washington, DC.

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