Exploration Timeline

Humans have been asking questions about our Moon since we first looked up at it in the sky.

What is our Moon made of? What are the light and dark markings? Does the Moon have oceans and an atmosphere?

As telescopes became ever more powerful, the Moon's rugged surface was revealed in increasing detail, but observations from Earth could not answer many scientific questions.

What caused the craters on the Moon? Is the Moon geologically active?

It was not until 1959 that the first spacecraft flyby, launched by the Soviet Union, captured close images of the lunar landscape. Over the next decade, orbiters and landers with increasingly sophisticated instruments gathered information. These spacecraft provided high-resolution images of the Moon's surface, including the farside, as well as information about the Moon's gravity field and surface radiation levels. These missions helped scientists understand the geologic processes that shaped the Moon's surface, especially impact cratering and volcanic activity, and helped scientists and engineers select landing sites. The new instruments yielded new information, and lots of new questions.

How did the Moon form? How has the Moon evolved? What is the age of the Moon?

NASA's Apollo program landed 12 astronauts on the Moon in 6 missions between 1969 and 1972. The astronauts collected seismic and magnetic data, investigated soil properties, and collected 842 pounds (382 kilograms) of rock and regolith — lunar "soil." These samples, brought back to Earth, revealed a surprising history, especially concerning the age of the Moon. The composition of the lunar highlands crust suggested that a magma ocean once covered the Moon. The samples confirmed that the Moon's craters are not volcanos, but were created by asteroid impacts. The astronauts found that rock ejected from impact basins and craters blankets much of the lunar surface. The Apollo missions provided astounding insights into the formation and evolution of our Moon — and Earth. But the missions landed on only a few places on the Moon; in fact, less than 1% of the lunar surface has been visited!

What is the compositional variability of Moon rocks? What resources might be available?

Between 1994 and 2006, lunar orbiters Clementine (Department of Defense and NASA), Lunar Prospector (NASA), and SMART-1 (European Space Agency) applied new technologies to study the lunar surface. They measured reflected "light" — electromagnetic radiation — of different wavelengths to give global information about elemental and mineral abundances on the Moon's surface. This information, validated by the Apollo sample analyses, allowed scientists to map the chemical composition of rocks across the whole Moon. One result of this work is the suggestion that frozen water, possibly delivered by comets, may be present near the Moon's poles!

As new data are collected and analyzed, new questions arise to drive exploration, and new objectives are identified to focus scientific and engineering efforts. In 2004, the President of the United States declared that astronauts will return to the Moon to live and work. Several missions will prepare the way, including the Japan Aerospace Exploration Agency's orbiter Kaguya and Chang'e-1 of the China National Space Administration, already in orbit at the Moon. The Indian Space Research Organization's Chandrayaan-1 orbiter carries two NASA instruments to characterize lunar resources and search for ice at the poles. NASA's paired missions, the Lunar Reconnaissance Orbiter and the Lunar Crater Observation and Sensing Satellite, will permit scientists and engineers to characterize the hazards and resources of the lunar environment, test equipment for human habitation, and select landing sites for our return to the Moon. The Moon will be a "test bed" for new technologies that will allow our exploration of the solar system. Human exploration of the Moon will allow scientists to address exciting unanswered questions about our Moon — and to come up with new questions.

Is the current model of the Moon's formation correct? Why are the basalts in the basins so variable?

Is the Moon still volcanically active?