Space Exploration

Science Background Information

Courtesy STS-82 crew / NASA

All Grades

Since long before documented history, humans have looked to the sky. We've told legends of how stars and constellations came to be and created calendars that chart the paths of the Moon and stars. But only recently in the span of human life have we actually explored the reaches of space beyond our atmosphere.

In 1919American rocket pioneer Robert Goddard envisioned a rocket that could reach the Moon. In 1914 he had received the first patent for a multistage rocket. He was first to develop and launch a rocket fueled with liquid rather than solid fuel, on March 16, 1926. However, it wasn't until about eighteen years later that Goddard's achievements in the area of rocket propulsion truly came to life. On October 3, 1942, using the principles of Goddard's experiments, Wernher von Braun, a German scientist, launched his A4 rocket, and it is this milestone that some would argue marks the beginning of the "space race." This rocket was later used as a war weapon, but its design led to the invention of such rockets as the *Redstone* and *Saturn V* rockets used in the American space programs.

In October 1957, the Soviet Union became the first to put a human-made satellite, *Sputnik*, into orbit. It was nearly three months after the launch of *Sputnik* that Americans launched their first satellite, *Explorer*. This was the first of several missions in which the Soviet Union edged ahead of American scientists. Due to the tremendous pressure put upon American scientists to "outdo" their Soviet counterparts, the National Aeronautics and Space Administration (NASA) was formed on October 1, 1958. In 1961, when cosmonaut Yuri Gagarin became the first person in space, Americans were less than a month behind with the launch of their Mercury-Redstone 3 *Freedom 7* rocket with astronaut Alan Shepard aboard.

Not until July 20, 1969, did America truly take the lead in the space race, when Neil Armstrong and Edwin "Buzz" Aldrin landed on the Moon. Launched in a *Saturn V* rocket, the *Columbia* command module delivered the astronauts to their destination in just over four days. After entering the Moon's orbit, a lunar module was landed on the Moon. It was then that Neil Armstrong uttered his famous words, "That's one small step for a man, one giant leap for mankind." In a total of six *Apollo* missions over the next three years, Americans would be the only people to set foot on the Moon.

In April 1971, the Soviet Union started a new trend in space exploration with the first Earth-orbiting space station, *Salyut 1*. On June 7, 1971, three Soviet cosmonauts boarded the space station *Salyut* and stayed there for twenty-four

days. It would be two years before Americans launched their own space station, *Skylab*. Though it encountered some problems upon its launch, *Skylab* was restored to operational status, and astronauts were able to complete three successful missions aboard *Skylab*, the longest lasting eighty-four days.

April 12, 1981, marked another milestone for American astronauts when the first "reusable" spacecraft, the space shuttle *Columbia*, was launched. This shuttle, designed to accommodate a crew of up to eight people, was the first of several shuttles built by NASA. Four more shuttles were eventually added to the space shuttle fleet, including *Discovery*, *Challenger*, *Atlantis*, and *Endeavour*. In January 1986, the space shuttle program suffered a tremendous setback when *Challenger* exploded seventy-three seconds after takeoff. For nearly two years NASA would not send another shuttle into space.

Manned space missions weren't the only focus of the space race. Beginning with the crewless Soviet *Luna* probes, astronauts and scientists strove to explore regions of the unknown. On September 12, 1959, the *Luna 2* probe became the first spacecraft to impact with the Moon. *Luna 3* was the first to photograph the "dark" side of the Moon in October 1959.

The Moon wasn't the only object in space that people wished to explore. The American *Mariner 2* probe flew past Venus in 1962 becoming the first spacecraft to fly by another planet. Not only did it collect valuable information about the temperature, mass, magnetic field, and atmosphere of Venus, it was also the first craft to make direct observations of solar wind. In November 1964, NASA launched *Mariner 4*, which eight months later completed the first ever flyby of Mars. The *Viking* project, beginning in 1968, marked the first attempt to place landers on the surface of Mars. In 1976, two *Viking* orbiters released landers that touched down upon the surface of Mars and sent back vital information about the surface, atmosphere, and weather of that planet. The orbiters were able to record evidence of surface features such as volcanoes, lava plains, craters, canyons, and surface water. The orbiters were also able to record information about Mars's two moons, Phobos and Deimos.

In 1972, the *Voyager* missions were approved. Designed at first to be a single five-year mission to Jupiter and Saturn, the mission was extended by *Voyager 2*, which traveled past Neptune, Uranus, and beyond. Launched in late 1977, the two *Voyager* probes traveled for nearly two years before reaching Jupiter in early 1979. After

collecting information about the planet and sending it back to Earth, both *Voyager* probes moved on to fly by Saturn in late 1980 and early 1981. Due to the success of the Saturn flyby, *Voyager 2* continued its journey past Uranus and Neptune, passing closest to Uranus on January 24, 1986, and Neptune on August 25, 1989. These two probes have provided us with an enormous amount of information about the four Jovian planets. As of today, the *Voyager* missions continue on their path out of our solar system. Provided there are no failures, scientists estimate there is enough fuel to maintain communication between Earth and the *Voyager* probes until 2030.

The *Pioneer* probes of 1978 and the *Magellan* probes of 1989 provided more detailed information about the surface of Venus. Later in 1989, the *Galileo* probe to Jupiter was launched, and it sent back information not only about the largest planet in our solar system, but also about two of its moons, Europa and Io. Both *Pioneer* and *Galileo* sent data back to Earth until 2003 when their transmissions became to faint to record.

Gathering information about our solar system was not the only focus of the American space program. During the presidency of Ronald Reagan in the 1980s, an international project including Canada, Japan, Europe, and later Russia would begin its formation first in theory, then in design. Nearly fifteen years later in November 1998, the Russian space agency would launch the first module of this project, the *Zarya*. This first module of the *International Space Station* (ISS), a project to include space agencies from around the world, would be joined just two weeks later with the America module *U.S. Unity Node*. When the first crew boarded the *ISS* in March 2000, only these two modules and a Russian service module would be in orbit. By its completion, anticipated to be in 2004, the ISS will be a project involving sixteen countries. Approximately the size of a football field and weighing more than one million pounds, the *ISS* will be composed of eight primary modules including the habitation module, service module, and six laboratories. It will be the largest human-made object to ever orbit the Earth.

As exciting as it may seem, living in space also poses some dangerous situations for astronauts. Because of the effects of microgravity, astronauts experience several problems. They can become nauseated and disoriented, lose important muscle strength, and experience a reduction in heart and respiration rates as well as a loss of body weight and bone calcium. In order to combat the loss of muscle strength, astronauts exercise for about two hours each day they're in space. Astronauts also

take a special medication called biphosphonate, which helps to slow down the loss of bone calcium. Though many of the other problems experienced in microgravity reverse themselves upon return to Earth, the loss of bone calcium is permanent and the most serious of the problems encountered by those who live in space.

Another danger of life in space is harmful radiation. Though the Earth's atmosphere blocks much of this radiation and protects us here on Earth, on the space station there is no atmosphere for protection. Scientists had to develop shields to protect astronauts from this dangerous radiation. Even still, these shields only protect astronauts from about 30 percent of the radiation. The rest of the astronauts' protection comes from vitamins. Astronauts take large doses of vitamins A and C, which help absorb radiation-produced particles in their bodies. NASA scientists are also working on medicines that could help reverse or repair the effects of radiation on astronauts after they return to Earth.

Yet another danger to astronauts is space travel itself. When the space shuttle *Challenger* exploded after takeoff in 1986, crewed space missions were halted for almost two years. Many problems with the shuttles at that time were reviewed and remedied. However, on February 1, 2003, another setback to the shuttle program occurred when the space shuttle *Columbia* disintegrated upon reentry into Earth's atmosphere after a successful 16-day mission. The question now is, should we let the dangers of space travel stand in the way of future exploration or should we continue to explore space no matter what the cost?

The possibilities of future space exploration are endless. Launched in 1990 and fixed in position in 1993, the *Hubble Space Telescope* has provided countless photographs and pieces of information about the universe. It continues to collect information and send it back to Earth on a daily basis. The *Cassini-Huygens* orbiter is scheduled to arrive at Saturn in July 2004. It will orbit Saturn for four years, as well as send its *Huygens* probe through the atmosphere of Saturn's moon Titan to collect information about this fascinating satellite. The *Stardust* probe, launched in 1999, is due to fly by the Comet Wild-2 in 2004. It will be the first time ever that comet particles are collected and returned to Earth. In May through July 2003, two Mars rovers are scheduled to be launched. Upon their landing in early 2004, the rovers will be able to send back the latest information from the surface of Mars. The *Pluto-Kuiper Belt Mission*, scheduled to launch in 2006, will be the first mission to target Pluto. It will take nine years to reach the planet, and the spacecraft is anticipated to pass by Pluto and its moon, Charon, in

2015. For more information regarding future missions to space, go to http://www.jpl.nasa.gov/missions/future_missions.cfm.

What lies in our future in space? One day soon, we may begin building colonies on the Moon or Mars. The current research certainly supports the quest to put life on other planets. The research completed by astronauts on the *International Space Station* alone furthers our knowledge of how to sustain life in space. Will we be building space island resorts in the near future? Will we be able to find a cheaper way to transport humans into space? The possibilities are endless, and our natural curiosity of the unknown will undoubtedly take us in directions that today seem impossible.

Resources List

http://www.nauts.com/vehicles
http://spaceflight.nasa.gov/history/index.html
http://www.nasa.gov/missions/historical/
http://www.nasa.gov/missions/current
http://liftoff.msfc.nasa.gov
http://seds.org/nineplanets/nineplanets/spacecraft.html
http://www.click2history.com/history_flight/history_flight_ch1.htm
http://www.nasm.edu/apollo/apollo.htm
http://www.nasm.si.edu/galleries/gal114/SpaceRace/sec100/sec100.htm
http://www.jpl.nasa.gov/