National Aeronautics and Space Administration

America's Spaceport

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John F. Kennedy Space Center

"This generation does not intend to founder in the backwash of the coming age of space. We mean to be a part of it . . . we mean to lead it."

President John F. Kennedy
Sept. 12, 1962

The John F. Kennedy Space Center -- America's Spaceport -- is the doorway to space. From its unique facilities, humans and machines begin to explore the solar system, reaching out to the sun, the moon, the planets and beyond.

While these spectacular achievements fire the imagination of people throughout the world and enrich the lives of millions, they represent only a beginning. At America's Spaceport, humanity's long-cherished dream of establishing permanent outposts on the new space frontier is becoming a reality.

Yet, our leap toward the stars also is an epilogue to a rich and colorful past . . . an almost forgotten legacy replete with Indian lore, stalwart adventurers, sunken treasure and hardy pioneers.

The sands of America's Spaceport bear the imprint of New World history from its earliest beginnings.

Long before people in modern times erected steel and concrete sentinels, the spaceport was inhabited by dusky-skinned hunters -- the Paleo people -- who crossed the continent from Asia by way of the frozen Bering Sea about 12,000 to 20,000 years ago. When Christopher Columbus landed at San Salvador Island in the Bahamas in the 15th century, the cape area was home to the fierce and often cannibalistic Ais and Timucuan Indians.

By the middle 1800s, these aboriginal tribes had virtually disappeared. They became the victims of internal strife, conflict with the Europeans moving into the area and, worst of all, new and deadly diseases -- some unwittingly brought by the recent arrivals and spread to an Indian population with no built-up immunities. The early European explorers came in search of territory, wealth, religious freedom and even a Fountain of Eternal Youth -- first the Spanish, then the French and English. Among these adventurers were such notables as Juan Ponce de Leon, Hernando de Soto, Pedro Menendez de Aviles, Jean Ribault, and Amerigo Vespucci, discoverer of Cape Canaveral and after whom America was named.

During the centuries that followed, Florida, which straddled the main sea route between Europe and the Gulf of Mexico, was bitterly contested by the European powers.

The modified German V-2 rocket takes off as the first launch from Cape Canaveral on July 24, 1950. The rocket attained an altitude of 10 miles. Note the primitive facilities, including a tarpaper shack serving as a blockhouse and the pad service structure made from painters scaffolding.

Throughout this swashbuckling era, America's Spaceport remained a virtual wilderness. But its coastal waters reverberated to the sounds of muskets and cannons as pirates and privateers preyed upon Spanish treasure ships laden with riches from the mines of Mexico and Peru. Shoals, reefs and storms also exacted their toll on the treasure fleets, leaving behind a sunken bonanza reaped by modern-day treasure hunters.

By the early 18th century, America's Spaceport echoed with the footsteps of other intruders: English settlers and their Indian allies -- the latter to become known as the Seminoles -- from colonies in Georgia and South Carolina. Thus began a new era of conflict and expansion that would continue until the end of the Second Seminole War in 1842.

Against this backdrop, permanent settlement of the spaceport area began. And in the years following the American Civil War, small rural towns and communities sprang up along a 70-mile stretch of mainland, rivers and beaches later to become known as Brevard County, Fla. The principal industries were agriculture, fishing and tourism.

Entering the Space Age

After World War II, however, another kind of industry, destined to bring explosive growth and international stature, took root in the area. Brevard County, by virtue of its most prominent geographical feature -- Cape Canaveral -- became the focal point of a new era of exploration: the Space Age.

The first step in the transformation began in October 1949, when President Harry S. Truman established the Joint Long-Range Proving Ground -- currently known as the Eastern Range -- a vast over-water military rocket test range that now extends 5,000 miles along the Atlantic coast from Cape Canaveral to Ascension Island.

The Cape was ideal for testing missiles. Virtually uninhabited, it enabled personnel to inspect, fuel and launch missiles without danger to nearby communities. The area's climate also permitted year-round operations, and rockets could be launched over water instead of populated areas.

The first launch from the Cape was conducted by a military-civilian team July 24, 1950. The rocket, a modified German V-2 with an attached upper stage, attained an altitude of 10 miles. By the late 1950s, the military services had elevated their sights from missile testing to launching artificial satellites. On Jan. 31, 1958, America's first satellite, Explorer I, launched from Launch Complex-26 at Cape Canaveral by a military-civilian team from the Army's Missile Firing Laboratory. This group, under the direction of Dr. Kurt H. Debus, a key member of the famed Wernher von Braun rocket team, later formed the nucleus of the Kennedy Space Center.

Perched atop a Juno I rocket, America's first satellite, Explorer I, awaits launch Jan. 31, 1958. The Army-civilian launch team looking on formed the nucleus of NASA's Kennedy Space Center in Florida.

With the creation of the National Aeronautics and Space Administration, or NASA, in October 1958, the nation turned its attention to the peaceful exploration of space. Cape Canaveral thundered with the sound of rockets carrying sophisticated instruments and payloads to explore humankind's newest frontier. And soon, a new breed of pioneers -- American astronauts -- were soaring skyward

Rocket pioneers Wernher von Braun and Dr. Kurt H. Debus at rollout of the first Apollo/Saturn V from the Vehicle Assembly Building on May 26, 1966. Von Braun, then director of NASA's Marshall Space Flight Center, was responsible for design and development of the Saturn V. Debus, the first director of NASA's Kennedy Space Center, created the mobile concept of launch operations used at the spaceport.

The steel framework of the Vehicle Assembly Building rises on Merritt Island, Fla., during construction of America's Spaceport in November 1964. The low structure at right is the Launch Control Center.

from the Cape to take their first halting steps beyond Earth.

But even as the first Americans ventured into space, more ambitious undertakings were planned. In May 1961, President John F. Kennedy announced that the U.S. would send men to the moon and back by the end of the decade. The program, called Apollo, would require the largest rocket ever built -- the 363-foot-tall Saturn V. The Cape, which had served so well up to now, was inadequate as a launch site for the monstrous vehicle, and another location was needed.

Debus, representing NASA, and Lt. Gen. Leighton I. Davis, representing the Department of Defense, organized a joint study to find a new launch site. They considered Hawaii, Texas, the California coast, an island off the coast of Georgia, islands in the Caribbean and Merritt Island, Fla., as possible sites.

The study concluded that Merritt Island offered compelling advantages. Several small communities were within driving range, and larger cities, such as Daytona Beach, Vero Beach and Orlando, were only slightly farther. Locating to Merritt Island also would allow NASA to share facilities of the Atlantic Missile Range, avoiding costly duplication. Only at this location could the same NASA launch organization continue operations at the Cape Canaveral complex while building the spaceport. Debus and Davis recommended the acquisition of the northern part of Merritt Island. The choice was endorsed by NASA and the Defense Department, and Congress authorized NASA to acquire the property.

The space agency began acquisition in 1962, taking title to 83,894 acres by outright purchase. NASA negotiated with the state of Florida for use of an additional 55,805 acres of state-owned submerged land, most of which lies within the Mosquito Lagoon. The investment in property reached about $71,872,000.

In July 1962, the Launch Operations Directorate at the Cape separated from NASA's Marshall Space Flight Center by executive order. It became the Launch Operations Center, an independent NASA installation, with Debus as its first director. It was renamed the John F. Kennedy Space Center in December 1963, in honor of America's slain president.

Pad A takes shape at the seaside Launch Complex 39 in December 1964. The pad hardstand contains 68,000 cubic yards of concrete.

NASA started construction of the massive Apollo-Saturn facilities in 1963. In December 1964, launch elements of Houston's Manned Spacecraft Center -- now the Johnson Space Center -- were transferred to Kennedy. The following October, the Goddard Space Flight Center's Field Projects Branch on the Cape was incorporated

On July 16, 1969, humans departed from the spaceport's Launch Complex 39 to walk on the moon for the first time in history. Following completion of the Apollo-Soyuz Test Project in 1975, the facilities of the spaceport were modified to support the nation's newest launch vehicle: the reusable space shuttle.

From Redstone and Saturn to the space shuttle, from the time of the earliest scientific and application satellites to the threshold of the International Space Station era, Kennedy has been the primary launch base for the nation's crewed and uncrewed civilian space programs. It is here, at America's Spaceport, that the dreams and aspirations of space planners reach fruition -- where the individual parts of a space mission come together for the first time, to be melded into a single, cohesive element and boosted into space.

At Launch Complex 39, where rockets were once readied for flight to the moon, engineers and technicians prepare the reusable space shuttle for crewed Earth-orbital missions. Uncrewed military and commercial rockets are processed and launched at complexes on nearby Cape Canaveral, under the oversight of the U.S. Air Force.

Cargo destined for space -- whether a planetary explorer to survey Jupiter, or a communications or Earth-observing satellite -- are assembled and tested in specially designed and equipped laboratories.

From the first launch April 18, 1981, through today, Kennedy has launched 130 space shuttle missions. To date, there have been five shuttle servicing missions to NASA's Hubble Space Telescope and 32 shuttle missions supporting the International Space Station. Three more shuttle missions are planned to complete construction of the international research facility in space.

Since 1958, the spaceport team has launched hundreds of expendable launch vehicles, primarily Deltas, Atlas-Centaurs, Atlas-Agenas and Titan-Centaurs. Most planetary and astrophysics spacecraft lifted off from NASA-operated facilities on Cape Canaveral, while polar-orbiting missions, primarily Earth science payloads, launched from Vandenberg Air Force Base in California. These launches also occurred from the

Payloads that will be carried into orbit by the space shuttle, such as the SHI Research Double Module (SHI/RDM), also known as SPACEHAB, are assembled and checked out in specially designed and equipped facilities at the spaceport.

A Delta rocket lifts off from Cape Canaveral's Launch Complex-17 on April 7, 2001. The workhorse of the nation's space program, Delta has put into orbit more scientific, weather and communications satellites than all other vehicles of its class combined.

Kwajalein Atoll in the South Pacific and Kodiak Island in Alaska. At the cusp of the 21st century, Delta IV rockets were introduced at the Cape to lift larger and more sophisticated weather satellites into Earth orbit, providing weather forecasters higher-fidelity data to predict and monitor severe weather. Also, Atlas V rockets have been used to launch spacecraft to the moon, Mars and even Pluto.

The history of Kennedy is a chronicle of the Space Age, written in the blinding glare and thunder of rockets and space vehicles. Its distinguished record of achievement in the development and conduct of space vehicle checkout and launch operations is unmatched. And so it is today, Kennedy -- America's Spaceport -- is the "gateway to the universe," home port for voyages of exploration undreamed of centuries ago and staffed by men and women who, like their forebears, still dream of discovering and settling new worlds.

The elements of space shuttle Discovery are integrated in one of the cavernous high bays of the Vehicle Assembly Building. The platforms slide in and out, allowing workers to reach all levels of the vehicle. The shuttle is in the foreground and behind it is the huge external fuel tank, bracketed by solid rocket boosters.

People and Facilities

As the future unravels, the people and resources of America's Spaceport will continue to be a major force in our nation's effort to explore and utilize space for the benefit of all humanity.

The men and women of the Kennedy Space Center team are a very special resource of the United States and the world. Their skills and capabilities, many of which are found only at America's Spaceport, have been utilized for every American spaceflight to date.

All who work at the spaceport are members of the team, even if their jobs are not directly involved with launch operations. Most of the hands-on work is performed by contractors. The center has a government work force of about 2,000 civil service employees, co-ops and students. There are about 11,000 contractor employees. These numbers can fluctuate, depending on the programs and responsibilities assigned to the center.

The largest contractor organization handles space shuttle processing and launch operations, as well as astronaut training and mission operations at NASA's Johnson Space Center in Houston. At Kennedy, this includes everything from repairing shuttle tiles and recovering the solid rocket boosters at sea to refurbishing the shuttle main engines for their next flight.

The second-largest contractor at Kennedy supports the facility itself, providing upkeep and maintenance for the buildings and grounds, and operating the support computers, and electrical, mechanical, painting, rigging and other shops.

The third major contractor is involved with the complicated process of preparing the spacecraft and other payloads for launch. Several other firms provide various operational, support and housekeeping functions.

Some of the more unusual facilities in which people work are the giant Vehicle Assembly Building, one of the largest enclosed structures in the world; three orbiter processing facilities, which are filled with complicated equipment to prepare shuttles for flight; Launch Pad 39A, from which shuttles lift off; NASA-operated shuttle support and spacecraft checkout facilities on Kennedy

In the blockhouse on Cape Canaveral Air Force Station's Launch Complex 36-A on July 23, 2001, members of the NASA-industry launch team make final checks before launch of the GOES-M satellite, one in a series of advanced geostationary weather satellites in service.

A spaceport worker is dwarfed by the massive track of a crawler-transporter, carrying a mobile launcher platform and space shuttle Endeavour's stack from the Vehicle Assembly Building to Launch Pad 39B on Sept. 19, 2008. Space shuttle launch operations require experience and skills found nowhere else in the world.

Readying a space shuttle for flight is an exacting job. Soichi Noguchi, with the Japan Aerospace Exploration Agency, or JAXA, takes a close look at some of the tiles underneath shuttle Atlantis.

and Cape Canaveral Air Force Station; and a host of other processing and support facilities. Some of the buildings on the Cape and Kennedy are specially designed for spacecraft assembly and checkout, and others for hazardous work, such as installing explosive ordnance and loading propellants.

The heart of Kennedy is its engineering work force. People with electrical, mechanical, electronic and computer engineering degrees have the necessary background to begin work here. After that, it may take years to learn some of the more unusual functions of their jobs.

The engineering departments perform work alongside other groups that might be found at any industrial facility. Logistics personnel order supplies and keep them available in warehouses. Another organization operates a facilitywide bus system and supplies vehicles for local use. Writing and graphics departments produce a variety of publications that are printed on- and off-site. A janitorial force keeps the facilities clean, and a guard force provides security.

The diversity of occupations and the pioneering thrust of America's Spaceport make it a special place to work. Watching a rocket or space shuttle blaze a fiery trail into the sky, hearing and feeling the thunder of its passage, is a fringe benefit not available to many elsewhere.

In a Space Station Processing Facility clean room, two workers perform prelaunch processing activities on the Canadian Space Agency's space station remote manipulator system before it is installed in the cargo bay of a space shuttle. The mechanism, built in Canada, helps astronaut crews handle payloads in space.

On Oct. 7, 1958, just six days after NASA was formally organized out of the old National Advisory Committee for Aeronautics, the infant agency initiated Project Mercury, the first American human spaceflight program.

Considering that only four American satellite launch attempts out of 13 had been successful at the time, this was an undertaking of high ambition. The task of making the launch systems, rockets and spacecraft safe enough to risk a human life was a daunting challenge.

The Redstone, one of the most reliable launch vehicles available, was chosen first for “man-rating” -- upgrading in reliability to be as safe as human talent and ingenuity could make it. This meant the pad, the checkout and launch procedures, and the tracking systems all had to be re-examined. Astronaut escape and rescue systems had to be designed and installed, and Kennedy Space Center personnel trained in their use.

On May 5, 1961, after extensive preparations and several frustrating and nerve-wracking launch attempts, Alan Shepard became the first American to make a suborbital flight. His Mercury-Redstone vehicle reached an altitude of 116 miles and splashed down about 304 miles out into the Atlantic.

The seven Mercury astronauts -- the first Americans chosen to venture into the new frontier of space -- front row, from left, are Walter Schirra, Donald Slayton, John Glenn and Scott Carpenter. Back row, from left, are Alan Shepard, Virgil “Gus” Grissom and Gordon Cooper.

Alan Shepard and Gus Grissom completed two suborbital flights before an Atlas vehicle roared off Complex-14 on Feb. 20, 1962, carrying John Glenn. After three trips around the world, the Mercury spacecraft he had named Friendship 7 parachuted to a safe landing in the Atlantic Ocean.

Gus Grissom followed on an almost identical flight July 21, 1961. The Kennedy team had adapted to the tough new requirements of human spaceflight and America had entered a new era.

For Mercury orbital flights, NASA selected the larger and more powerful Atlas, until then only used as an intercontinental ballistic missile by the U.S. Air Force. After two successful missions -- the second of which carried the chimpanzee Enos into space for two orbits -- John Glenn launched Feb. 20, 1962, aboard a Mercury-Atlas. He became the first American to complete three trips around Earth. Glenn was followed by Scott Carpenter, Wally Schirra and Gordon Cooper, the latter staying in orbit a full day after his launch on May 15, 1963.

The next step in the nation's human space program was Project Gemini, which served as a bridge between the Mercury flights and the more difficult Apollo missions to come.

For the larger two-man Gemini spacecraft, the Air Force Titan missile was chosen and man-rated.

The first crewed Gemini vehicle launched March 23, 1965, and the 10th and final one Nov. 11, 1966. During the brief span of 20 months, 20 astronauts were sent into orbit. Seven uncrewed target vehicles launched in the same time period for rendezvous practice and other associated functions. When the program was completed, enough had been learned about launching and operating crewed vehicles in space to make fulfilling President John F. Kennedy's commitment to a moon landing a real possibility.

For the Apollo lunar landing program, an entirely new family of launch vehicles was required: the massive and powerful Saturn rockets. Eleven Saturn I launches were followed by several of the more powerful Saturn I-B launches. Both vehicles were initially used to test uncrewed elements of the three-person Apollo spacecraft. They launched

A Titan II vehicle carrying the Gemini 11 spacecraft heads for space from Launch Complex-19, where all 10 crewed Gemini flights began. Charles Conrad and Richard Gordon made four practice rendezvous with a target vehicle, reached an altitude of 851 miles and flew with the hatch open for more than two hours.

Apollo 11 heads for Launch Pad 39A atop its giant Saturn V rocket. Riding a mobile launcher that towered more than 400 feet into the air, with a total weight on the crawler-transporter treads of more than 18 million pounds, an Apollo/Saturn V vehicle in motion on the crawlerway was an awesome and unforgettable sight.

from new complexes constructed by NASA on Cape Canaveral.

On Nov. 9, 1967, the first Saturn V -- 363 feet tall, and still the largest vehicle ever flown -- launched on a test flight from Launch Complex 39 at the spaceport. This powerful three-stage vehicle produced more than 7.5 million pounds of thrust, equal to about 180 million horsepower -- enough to place almost a quarter of a million pounds of payload into Earth orbit.

Apollo 7, the first crewed Apollo mission, lifted off into Earth orbit Oct. 11, 1968, on a Saturn I-B vehicle. Two months later on Dec. 21, Apollo 8 -- the third flight of the Saturn V and the second crewed launch of an Apollo spacecraft -- took Frank Borman, James Lovell and William Anders to the moon and into orbit around it. Considering the short test history of the launch vehicle and the spacecraft, the mission was more than daring, it was a feat of incredible courage.

Next, the Kennedy team launched Apollo 9 on March 3, 1969, sending three astronauts into Earth orbit to test the lunar module in microgravity. This new vehicle was a lightly built, insect-shaped craft designed to descend to the lunar surface.

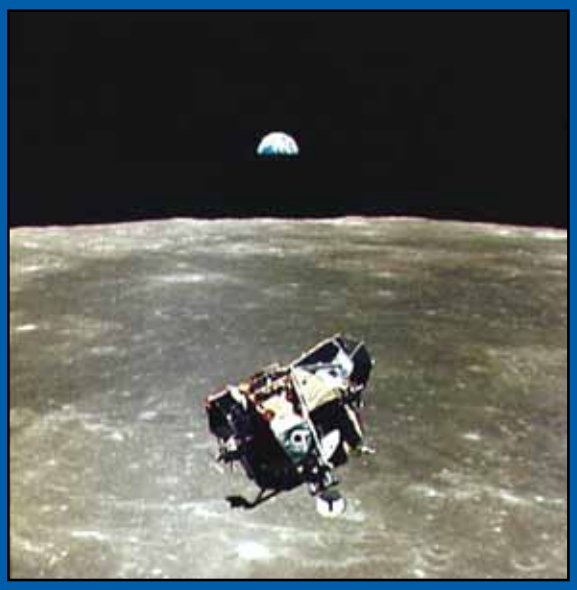
On May 18, 1969, a second Apollo/Saturn V flew toward the moon. Apollo 10 tested another lunar module, this time in lunar orbit. On July 16, 1969, all the parts, planning, care and labor came together for the launch of Apollo 11. Neil Armstrong and Edwin “Buzz” Aldrin became the first humans to set foot on the surface of another planetary body, while their crewmate Michael Collins kept a lonely vigil in the orbiting command module.

Through December 1972, the Kennedy team processed and launched six more of the giant Apollo/Saturn V vehicles, maintaining a hectic pace that never evolved into a repetitive and routine job. A wealth of scientific data and physical artifacts came back from the moon, and still are being studied today. Apollo entered history books as humankind’s greatest and most far-reaching feat of scientific exploration.

In the early 1970s, the Apollo Program came to a close. But the Kennedy team still had to process and launch one more of the huge Saturn V vehicles. On May 14, 1973, Kennedy hurled the world’s first orbital workshop, Skylab 1, into space.

Skylab was an inert Saturn V third stage that had been internally modified to function as a crewed scientific laboratory, with three other scientific and operational modules added. Skylab launched without an astronaut crew. The Kennedy team later sent up three separate astronaut crews to occupy it. They were transported by Apollo/Saturn I-B vehicles launched from modified facilities at the spaceport’s Launch Complex 39.

Skylab produced a bonanza of scientific information and proved that humans could work in space for extended periods of time. The final crew launched Nov. 16, 1973, and stayed in space for 84 days. This length of time in microgravity remained the record for



The ascent stage of the Apollo 11 lunar module floats over the eerie, crater-scarred landscape of the moon after Neil Armstrong and Edwin "Buzz" Aldrin successfully lifted off using the descent stage as a stable launch platform. This photo was taken through the orbiting Apollo spacecraft window by Michael Collins. After the rendezvous in orbit, the astronauts headed for Earth half shadowed in darkness, above the bleak lunar horizon.

Astronaut Thomas Stafford, center left, and cosmonaut Aleksey Leonov meet in the module temporarily connecting their spacecraft in orbit. The Apollo-Soyuz mission was the first international meeting in space. The two vehicles remained docked together for several days, and astronauts and cosmonauts visited each other's spacecraft.

American astronauts until 1995, when Norman Thagard exceeded it while working aboard the Russian Space Station Mir.

One last mission remained before America entered a long hiatus from human spaceflight. On July 15, 1975, the last Apollo/Saturn I-B lifted off from Launch Complex 39. It carried three American astronauts into space to rendezvous with a Russian Soyuz spacecraft and its crew of two cosmonauts. The Apollo-Soyuz Test Project remained the only such international meeting for 20 years, until space shuttle Atlantis rendezvoused and docked with Mir in June 1995.

The Apollo-Soyuz flight also was the last American crewed space vehicle that could fly only once. NASA needed a more economical way to get into orbit and safely back to Earth . . . and the era of the reusable space shuttle was afoot.

Skylab, the orbital workshop that was a precursor to the International Space Station, floats above a heavily clouded Earth. The solar array on the left side of the workshop is missing and an improvised sunshade protects the main body from excessive heat accumulation. Skylab was repaired in orbit after suffering damage during ascent, and went on to complete a highly successful mission. It was one of the largest habitable structures ever placed in orbit at that time.

For nearly two decades, NASA had blazed new trails across the heavens with expendable vehicles and spacecraft, but the cost had been high. To continue the exploration and utilization of space on a permanent basis, a more economical way to reach orbit was urgently needed. This was apparent well before the end of the Apollo era, and work already had started on a new type of space vehicle. The reusable orbiter that resembled an airplane and could fly again became the space shuttle, and it required a new philosophy of operations. No longer would a vehicle be prepared for a single flight. In the future, the same vehicle would return many times to NASA's Kennedy Space Center in Florida, to be processed and launched once more.

The space shuttle was very different from the Apollos and Saturns, and far more sophisticated and technically complex. It was designed, tested and built with limited funds. To help keep costs down, Kennedy engineers adapted the Apollo launch facilities, rather than building all new ones. The huge Vertical Assembly Building was converted to handle shuttle components, and renamed the Vehicle Assembly Building. The three mobile launchers used for Saturn vehicles were modified to stack and carry the new vehicle, and pads A and B were given new above-ground configurations.

Some new facilities were mandatory. A 3-mile-long landing strip was one of the first constructed. The shuttle would land at Kennedy after enough landing experience had been gained on the extra-long, dry lake beds at Edwards Air Force Base in California. Three large, highly specialized two-bay buildings called orbiter processing facilities were constructed near the Vehicle Assembly Building. Spacecraft checkout and assembly facilities were modified to process and integrate a large number of payloads each year. Many other modifications were required throughout the center. This rebuilding and conversion process became the main activity at Kennedy during the years following the Apollo-Soyuz flight.

Space shuttle Endeavour begins backing out of Orbiter Processing Facility-2 for rollover to the Vehicle Assembly Building, where it will be mated with its external fuel tank and solid rocket boosters.

Several vehicles escort space shuttle Atlantis as it inches toward Launch Pad 39A on Sept. 4, 2008.

With a roll of thunder and riding a pillar of flame, space shuttle Discovery launches into the blue sky over America's Spaceport on the STS-95 mission. The flight was the second for Mercury astronaut John Glenn and his first on a shuttle.

The first shuttle intended for spaceflight, Columbia, arrived at America's Spaceport in March 1979. A great deal of work remained to be done. Both Kennedy and NASA's Johnson Space Center, which was the lead design agency, were very busy for the next 610 days in an orbiter processing facility. They had to perform the remaining assembly work and a series of major modifications.

Columbia then spent another 35 days in the Vehicle Assembly Building and 105 days on Launch Pad 39A, before lifting off on April 12, 1981. John Young and Robert Crippen became the first two astronauts to enter orbit in a reusable spacecraft and to land it like an airplane at the end of the mission.

The launch of the first space shuttle was a true milestone for Kennedy. The launch team had learned new checkout and launch procedures. Two entirely new sets of computers, called the launch processing system, had been installed in two of the old Apollo/Saturn V firing rooms in the Launch Control Center, and crews had been trained in their use.

Once the first shuttle mission was finished and Columbia returned to Kennedy, the center went into high gear again.

One more shuttle was launched in 1981, three in 1982, four in 1983, five in 1984, and nine in 1985 -- the latter a total that had

On a Hubble Space Telescope servicing mission in 1999, European Space Agency astronaut Claude Nicollier, works at a storage enclosure using a Hubble power tool.

seemed unobtainable back in 1981.

As 1986 began, NASA was close to having the ability to launch a shuttle every month, or 12 per year. There were four shuttles in the fleet, in order of first flight, were Columbia, Challenger, Discovery and Atlantis. Then, on Jan. 28, tragedy struck. Challenger and its crew were lost during the launch of STS-51L, the 25th space shuttle mission. The longest and most intensive investigation ever conducted by NASA up to that point indicated the primary culprit in the Challenger accident was an inadequate design of the field joints between the solid rocket booster segments. These were redesigned and retested. Many other critical flight systems also were re-examined and recertified at the same time. The unique checkout and launch facilities at the spaceport, as well as the detailed procedures and software that determined their operation were thoroughly reviewed and improved where necessary. It took 32 months before everyone was satisfied that the vehicle and its crew were now made as safe as humanly possible for spaceflight.

The shuttle had just started fulfilling its promise of frequent and economical access to orbit before the Challenger accident. A large variety of scientific and commercial spacecraft had been launched. One expensive scientific spacecraft had been repaired in orbit, and two large commercial satellites were recovered from improper orbits and returned to the ground. Both were later re-launched and entered active service, saving their owners many millions of dollars compared to buying new spacecraft.

The shuttle was becoming a true national and international asset, carrying into space student experiments, small business payloads and foreign payload specialists who accompanied their scientific experiments into orbit.

The Hubble Space Telescope, a joint program of NASA and the European Space Agency, has made many contributions. The large telescope launched in April 1990 aboard Discovery on the STS-31 mission. Hubble made the deepest look into the universe revealing thousands of galaxies, supporting the fact that the universe made most of its stars long ago when the universe was one-tenth its present age, and that the vast majority of stars are only one-fifth the mass of our sun.

Hubble also made the first surface map of Pluto and discovered that massive black holes

The Unity connecting module moves toward the payload bay of space shuttle Endeavour at Launch Pad 39A. Part of the International Space Station, Unity is a connecting passageway to the research facility's living and working areas.

are common throughout the universe.

The next major task for the space shuttle fleet, the assembly of a permanently crewed space station, had already been authorized by President Ronald Reagan and Congress in January 1984. But the problems that caused the loss of Challenger and its crew had to be found and corrected before shuttles could fly again.

Discovery lifted off Sept. 27, 1988, on the STS-26 Return to Flight mission. The flight was a complete success. By 2003, shuttles had flown 112 missions, more than four times the 24 safe flights that preceded Challenger's last flight, and had settled into a steady launch rate of about six times a year.

On Nov. 20, 1998, the Zarya control module, the first component in constructing the International Space Station, launched. In the following four years, the space station grew to include the Russian-built service module, Zvezda; the U.S.-built Unity node; the U.S. Destiny lab; a Canadian-built robotic arm to aid in construction; and several trusses. In addition, Italian-built multi-purpose logistics modules began regular service as cargo modules, especially for experiments. Nov. 2, 2000, marked the first human presence on the space station with the three-person crew of Commander Bill Shepherd, Soyuz Commander Yuri Gidzenko and Flight Engineer Sergei Krikalev.

Thus, NASA's goal of steady progress toward living and working on the new frontier of space began. Since the October 2000 launch, there has been a permanent human presence on the space station.

On Feb. 1, 2003, another tragedy struck. The flagship of the fleet, Columbia, and its STS-107 crew members were lost on the return to Kennedy. A yearlong formal investigation followed. The Columbia Accident Investigation Board (CAIB) report in 2004 concluded:

The physical cause of the loss of Columbia and its crew was a breach in the Thermal Protection System on the leading edge of the left wing, caused by a piece of insulating foam which separated from the left bipod ramp section of the External Tank at 81.7 seconds after launch, and struck the wing in the vicinity of the lower half of Reinforced Carbon-Carbon panel number 8. During re-entry, this breach in the Thermal Protection System allowed superheated air to penetrate through the leading edge insulation and progressively melt the aluminum structure of the left wing, resulting in a weakening of the structure until increasing aerodynamic forces caused loss of control, failure of the wing, and break-up of the orbiter.

Kennedy adopted the recommendations of the CAIB for improving safety, and worked for an expected Return to Flight mission in 2005. On July 26, 2005, space shuttle Discovery launched with a crew of seven to the International Space Station. After a successful 13-day mission, which included testing camera views around the outside of the shuttle, Discovery returned to Earth. It landed at Edwards Air Force Base in California on Aug. 9, 2005.

Space Shuttle Discovery, atop a modified Boeing 747 Shuttle Carrier Aircraft, is towed to the mate/demate device at the spaceport's Shuttle Landing Facility. The cross-country ferry flight became necessary when two days of unfavorable weather conditions forced Discovery and its STS-114 crew to land at Edwards Air Force Base in California.

For decades, NASA's uncrewed space programs have compiled an enviable record of achievement in space science, applications and research. During this span, hundreds of launches were conducted for programs ranging from solar system exploration to improved weather forecasting, global communications and Earth resource studies. These projects, which have more than repaid the nation's investment in time, money and technical talent, depended on the development and evolution of a varied fleet of rockets.

The origins of this fleet were primarily military. When NASA was created in October 1958, it lacked the launch vehicles and facilities to carry out its mandate to explore space, and drew heavily on rocket systems under development by the armed services.

During its first year of operation, for instance, NASA awarded a contract to McDonnell Douglas to upgrade the Thor-Able missile, developed under Air Force management, to become the Thor-Able-Delta launch vehicle -- later known simply as the Delta. A group of employees from the Naval Research Laboratory had been at the Cape for some time, launching the early Vanguard vehicles that placed America's second satellite into orbit. With the establishment of NASA, this group became the Launch Operations Branch of the Goddard Space Flight Center, and later formed the nucleus of the "Unmanned Launch Operations" directorate of the Kennedy Space Center. Another early launch team from Goddard was responsible for the engineering management and configuration control of the Delta vehicle. In 1965, this team also was phased over into Kennedy.

The upgraded Thor-Able vehicle soon acquired the reputation of being "Dependable Delta." By the end of 1989, more than 180 had been launched by NASA, from facilities on Cape Canaveral and Vandenberg Air Force Base in California. This was more than all other vehicles of an equivalent size combined. The Delta has been continuously upgraded throughout the years.

Workers on Launch Pad 17-B at Cape Canaveral Air Force Station, mate the Mars Exploration Rover Opportunity, to its Delta rocket. The second of twin rovers sent to Mars, Opportunity is equipped with a robotic arm, a drilling tool, three spectrometers, and four pairs of cameras that allow it to have a humanlike, 3-D view of the terrain. The rovers landed safely on Mars in 2004 and lasted much longer than their scheduled three-month mission.

On Launch Pad 36-A at Cape Canaveral Air Force Station, a Centaur upper stage is mated to the lower stage Atlas IIA rocket for the GOES satellite launch.

A worker conducts a light sensor test on NASA's Kepler spacecraft, set to survey the Milky Way galaxy for Earth-size and smaller planets in or near the habitable zone and determine how many of the billions of stars have such planets.

Delta II rockets can be configured as two- or three-stage launch vehicles with three, four or nine strap-on solid rocket boosters and two sizes of payload fairings, depending on mission requirements. Delta II rockets can carry payloads ranging from 1,965 to 4,723 pounds to geosynchronous transfer orbit, or GTO, and 5,934 to 13,281 pounds to low-Earth orbit. Two-stage Delta II rockets typically fly low-Earth orbit missions, while three-stage Delta II vehicles generally deliver payloads to GTO or are used for deep space and planetary exploration missions.

The Delta IV is the most advanced family of launch vehicles developed by The Boeing Company in partnership with the U.S. Air Force Evolved Expendable Launch Vehicle Program. Delta IV rockets can accommodate single or multiple payloads on the same mission and can carry satellites weighing between 9,285 pounds and 28,950 pounds to GTO. Delta IV rockets also can launch satellites to polar orbits, sun-synchronous orbits and the International Space Station orbit with the capability to lift more than 50,000 pounds to low-Earth orbit.

NASA also adopted another Air Force-developed stage, the Agena, and combined it with a Thor first stage. This was the first NASA vehicle launched from Vandenberg, and the first to have solid motors strapped to the outside of the first stage for extra power. NASA launched a total of 12 Thor-Agenas from the West Coast. The Agena also was adapted to fly on top of an Atlas booster, creating a larger and more powerful combination than either of the other two. This vehicle performed well for many missions, but eventually was phased out in favor of an even more powerful combination, the Atlas booster and a new stage called Centaur.

Developed under NASA contract by General Dynamics, builder of the Atlas, Centaur was the first stage to use liquid hydrogen for its fuel. Liquid oxygen remained the choice for the oxidizer. Centaur uses very high-performing engines, and its pressure stabilized, thin-wall, stainless-steel design is the most weight efficient in the world.

A Delta IV rocket awaits liftoff on March 4, 2010, on a flight to lift a weather satellite into orbit. Workers moved the mobile service tower back from the rocket on launch day to permit a launch. A satellite, called GOES-P, is inside the payload fairing at the top of the Delta IV.

The salmon sky and red, boulder-strewn expanse of Mars' Utopian Plain, as seen by the camera of NASA's Viking 2 lander shortly after setting down on the planet's surface Sept. 3, 1976. Portions of the lander are in the foreground. Planetary exploration of the solar system is one of the most exciting and scientifically rewarding aspects of the America's space program.

After the last Atlas-Agena launched in March 1968, the Delta and the Atlas-Centaur became the standard uncrewed launch vehicles for NASA. One test flight and six operational launches were conducted of a new, more powerful vehicle, a combination of Titan and Centaur. The latter was needed to launch two Helios spacecraft to the sun, two unusually heavy Vikings to Mars, and two Voyagers to the outer giant gas planets.

Uncrewed launch operations continued to place the large majority of spacecraft in orbit until the space shuttle became operational. As the new system matured, many payloads were shifted from uncrewed launch vehicles to the shuttle. But after the loss of Challenger and its crew, the decision was made to reserve the shuttle primarily for scientific spacecraft. Responsibility for the launch of the Delta, Titan and Atlas-Centaur vehicles was assumed extensively by their manufacturers and the U.S. Air Force. All three vehicles have been used to launch payloads for the Air Force, NASA and commercial customers on a contract basis.

Automated spacecraft have performed some of the most spectacular feats of the American space program. Surveyors landed softly on the moon, helping to pave the way for later Apollo missions. Mariners provided detailed photographs of the cloud-tops of Venus and the surfaces of Mars and Mercury. Two Viking landers descended to the surface of Mars and searched for evidence of life, while two orbiters mapped almost the entire planet from overhead. Two Pioneers went to Jupiter, and one flew onward to Saturn. Two much larger Voyager spacecraft followed them to both planets, and one of these has now visited Uranus and Neptune as well.

NASA's ambitious plan to send spacecraft to Mars was realized with the November 1996 Mars Global Surveyor Project, which studied the planet's surface, atmosphere, and gravitational and magnetic fields. One month later, the Mars Pathfinder delivered the rover, named Sojourner, to the surface to study and record data about ancient rocks. The Cassini satellite arrived at Saturn in July 2004.

In June and July of 2003, two Mars Exploration Rovers, named Spirit and Opportunity, launched from Cape Canaveral Air Force Station aboard Delta II rockets. Both reached Mars in January 2004. The mission of the two identical rovers was to develop the history of climate and water at two sites on Mars, where conditions may once have been favorable for life. They navigated around obstacles while driving cross the Martian surface, traveling up to about 130 feet each Martian day.

By far, however, the largest number of uncrewed spacecraft remain in orbit around the Earth. So many communications, weather and other types of satellites have crowded into geosynchronous orbit -- that region above the equator at about 22,240 miles altitude, where a velocity of 6,878 miles an hour toward the east will keep a satellite apparently motionless in the sky -- that international agreements have been worked out on assigning spaces. Weather and other Earth-observation satellites patrol our planet steadily in north-south polar orbits. Scientific explorers in many types of orbits have returned a wealth of information that could not have been obtained any other way.

NASA's Terra satellite captures the unmistakable swirl of Hurricane Katrina as it straddles the Gulf of Mexico and heads toward Louisiana on Aug. 28, 2005.

The two gantries of Launch Complex 36, foreground, where Atlas rockets are launched, still stand on the easternmost point of Cape Canaveral. But the gantries in a line extending north from the right-hand pad in this 1964 photograph have mostly been dismantled. Corrosion from the salt air weakened the steel structures until they were no longer safe.

The following table lists some of the more notable spacecraft launched by the Kennedy teams, with brief descriptions of the results.

Launch Spacecraft	Date	Mission Description/Results
TIROS 1	4/1/60	Relayed thousands of cloud pictures, demonstrating the feasibility of satellite observations in weather forecasting.
Mariner 2	8/27/62	First U.S. interplanetary probe to reach the planet Venus.
Syncom 2	7/26/63	First communications satellite in geosynchronous orbit; proved out the concept widely used today.
Ranger 7	7/28/64	First U.S. spacecraft to impact on the moon; returned a series of photos and other data.
Intelsat 1 (Early Bird)	4/6/65	First international communications satellite. Intelsat grew to become largest international carrier in history.
Surveyor 1 .	5/30/66	Performed first U.S. soft landing on the moon, sending back thousands of excellent surface photographs.
Mariner Mars 6	2/24/69	Passed within 3,220 km (2,000 miles) of Mars' equatorial region, returning the first good photographs for the U.S.
Pioneer 10	3/2/72	Performed flyby of Jupiter, returning first close-up photographs and measuring radiation emissions.
LANDSAT 1	7/23/72	First satellite to perform major assessment of Earth resources from space.
Pioneer 11	4/5/73	Performed flyby of Jupiter and first flyby of Saturn.
Mariner Venus/Mercury	11/3/73	Performed a flyby of Venus, then continued on to Mercury and completed the first three flybys of that planet.
Helios 1	12/10/74	Approached the sun to within outer solar corona and took density, temperature, velocity and magnetic field measurements.
Viking 1	8/20/75	Placed an orbiter in orbit around Mars and a lander on the surface; obtained voluminous data in the search for life.
GOES 1	10/16/75	First weather satellite to photograph complete disk of the Earth every 30 minutes from geosynchronous orbit.
PALAPA 1	7/8/76	First geosynchronous-orbit, domestic-communications satellite in Southeast Asia. PALAPAs now also serves Thailand, Singapore, and Malaysia.
Voyager 2	9/5/77	Performed flybys of Jupiter, Saturn, Uranus and Neptune, and some of their moons.
Pioneer Venus Orbiter	5/20/78	Placed in orbit around Venus to study the atmosphere and surface; compiled radar maps of surface features.
Pioneer Venus Multiprobe	8/8/78	Sent four probes into the Venusian atmosphere five days after the orbiter arrived; returned much useful data.
International Sun-Earth Explorer (ISEE)	8/12/78	Third International Sun-Earth Explorer; examined solar wind and its interaction with Earth's magnetosphere. Renamed International Cometary Explorer (ICE) and redirected in 1983 to make the first flyby of a comet -- Giacobini-Zinner -- on Sept. 11, 1985.
HEAO 2	11/13/78	Examined selected X-ray astronomical sources in detail with the largest X-ray telescope ever made.
Infrared Astronomical Satellite (IRAS)	1/25/83	Made first detailed infrared examination of the universe; discovered new stars being born and possible evolution of new planetary systems.
COBE	11/18/89	Measured the diffuse infrared and microwave radiation from the early universe to the limits set by our astrophysical environment.
SOHO	12/3/95	Gathered data on the internal structure and outer atmosphere of the sun, and on the origin of the solar wind.
NEAR	2/17/96	Conducted the first long-term, close-up look of an asteroid's surface. For a year, NEAR studied Eros' physical properties.

Launch Spacecraft	Date	Mission Description/Results
Mars Global Surveyor	11/7/96	Conducted a global mapping of Mars by studying the planet's surface, atmosphere, and gravitational and magnetic fields.
Mars Pathfinder	12/4/96	Delivered a lander and small robotic rover, Sojourner, to Mars' surface to study and record data about ancient rocks.
Cassini	10/15/97	Cassini used gravity-assist flybys of the planets Venus and Jupiter, then arrived at Saturn in July 2004.
Lunar Prospector	1/6/98	Provided the first global maps of the moon's surface elements and its gravitational and magnetic fields.
Stardust	2/7/99	Brought comet material back to Earth and collected interstellar dust.
EOS/TERRA	12/18/99	Consisted of a science component and a data system, supporting a coordinated series of polar-orbiting and low-inclination satellites for long-term global observations of the land surface, biosphere, solid Earth, atmosphere and oceans.
GOES I-M	1994-2001	NASA-developed payload for the National Oceanic and Atmospheric Administration (NOAA); launch vehicle services contract. Launched into geosynchronous Earth orbit.
Mars Exploration Rover Spirit	6/10/03	The two identical spacecraft reached Mars in January 2004, landing at two sites to explore farther and examine rocks better than anything that has ever landed on Mars.
Mars Exploration Rover Opportunity	7/6/03	
SCISAT-1	8/12/03	Spacecraft investigated chemical processes that control the distribution of ozone in the Earth's atmosphere, particularly at high altitudes.
Space Infrared Telescope Facility (SIRTF)	8/25/03	Fourth and last of the Great Observatories, the telescope is obtaining images and spectra by detecting the infrared energy, or heat, radiated by objects in space.
MESSENGER	8/3/04	First spacecraft ever sent to orbit and map the planet Mercury.
Gravity Probe B	4/20/04	Spacecraft orbited Earth to test Albert Einstein's general theory of relativity.
Mars Reconnaissance Orbiter	8/12/05	Searching for evidence that water persisted on the Martian surface, and provided, in tremendous detail, landing sites for incoming landers.
Deep Impact	1/12/05	The first space mission to probe beneath the surface of a comet and reveal the secrets of its interior.
New Horizons	1/19/06	Headed to the edge of our solar system, the reconnaissance mission will explore the composition of Pluto, its moon, Charon, and the Kuiper Belt.
Dawn	9/27/07	Headed to the Vesta asteroid and dwarf planet Ceres, celestial bodies believed to have formed early in the history of the solar system.
Phoenix	8/4/07	A lander studying the history of water in the Martian arctic and searching for evidence of a habitable zone.
Fermi (GLAST)	6/11/08	A spacecraft exploring the most extreme space environments, such as black holes and solar flares.
LRO	6/18/09	A robotic scout gathering crucial data about the lunar environment, such as potential resources, safe landing sites and the characterization of radiation.
Kepler	3/6/09	Searching for Earth-size and smaller planets around other stars, especially in the habitable zone, where liquid water might exist on the surface.
SDO	2/11/10	Spacecraft that will study the sun in unprecedented detail and how it affects space weather.

Roaring rockets. Peaceful nature trails. Exciting educational exhibits. Pristine seashores. The nation's only human launch site, and one of Central Florida's most popular tourist destinations, the Kennedy Space Center Visitor Complex offers guests a wide variety of things to see and do.

Each year, more than 1.5 million visitors from around the world explore the past, present and future of America's space program at the visitor complex. Since 1995, every aspect of this 70-acre facility has been entirely redeveloped and enhanced, promising guests a "day of fun, a lifetime of inspiration."

The KSC Tour takes guests on a narrated excursion with self-paced stops at the Launch Complex 39 observation gantry, where they view space shuttle launch pads; the Apollo/Saturn V Center, where they relive the launch of Apollo 8 from mission control, walk beneath a massive Saturn V rocket and enjoy "front-row seats" as a human lands on the moon; then drive by the Vehicle Assembly Building and orbiter processing facilities. Wildlife tours are available to groups of 10 or more when arranged in advance.

In addition to its tours, the complex offers a variety of programs, exhibits and films. Visitors can strap into the sights, sounds and sensations of a real space shuttle launch in the "Shuttle Launch Experience" simulation facility. The complex's daily Astronaut Encounter program aims at inspiring children to pursue academic excellence. It is the only place in the world where children and families may come face to face with a real astronaut every day.

New additions to the complex include "Eye on the Universe: The Hubble Space Telescope," a pathway where guests can enjoy the powerful imagery taken by NASA's crown jewel; "Treasures Gallery," an exhibit in the Apollo/Saturn V Center with artifacts from the Apollo moon missions; and "Exploration Station," a 10,000 square-foot interactive classroom that is always staffed with a member of Kennedy's Educator Resource Center. Long-time favorites include the Rocket Garden and Shuttle Plaza. Visitors also are encouraged to watch five-story-tall space films at the world's only back-to-back IMAX theaters.

The Rocket Garden at the Kennedy Space Center Visitor Complex features eight authentic rockets from the past, including a Mercury-Atlas rocket. The garden also features climb-in Mercury, Gemini and Apollo capsule replicas, seating pods and informative graphic elements.

The KSC Visitor Complex is accessible to the public and open for business every day of the year except Christmas and certain launch days.

The visitor complex is located 45 minutes east of Orlando on State Road 405 (accessible from U.S. Highway 1, State Road 3 and Interstate 95). The complex is operated for NASA by Delaware North Parks Services of Spaceport Inc. For more information, call 321-449-4444 or visit **www.kennedyspacecenter.com**.

The Educator Resource Center, located in the Center for Space Education at the complex, provides extensive facilities to aid teachers in the preparation of aerospace-related teaching materials. These include a large number of aerospace publications, videotapes, 35mm slides, text data and computer programs that can be copied on-site.

For more information about the Educator Resource Center or Exploration Station, or to make reservations, call 321-867-4090. To find out more about NASA Kennedy's education programs, visit **www.nasa.gov/offices/education/centers/kennedy/home/index.html**.

The "other side" of America's Spaceport is less known, perhaps, but an equally treasured national asset. Under agreements between NASA and the Department of Interior, all but the operational areas of Kennedy are designated as the Merritt Island National Wildlife Refuge, including 25 miles of undeveloped beach that forms the Canaveral National Seashore.

This gentle but untamed land swarms with wildlife. More than 500 species of birds, mammals, reptiles and amphibians are found here. Some, like the American bald eagle, sea turtle, wood stork, alligator and the ponderous manatee, or sea cow, are on the endangered or threatened species list.

Recreational activities also are abound: freshwater and surf fishing, in-season waterfowl hunting, bird-watching, swimming in the ocean, canoeing and hiking nature trails.

Most of the refuge and all of the seashore are open to visitors during daylight hours, except when space operations require a closure. Seashore headquarters is located in nearby Titusville, Fla. A wildlife refuge visitor center is located east of Titusville, on State Road 402.

A snowy egret is spotted near the Kennedy Space Center.

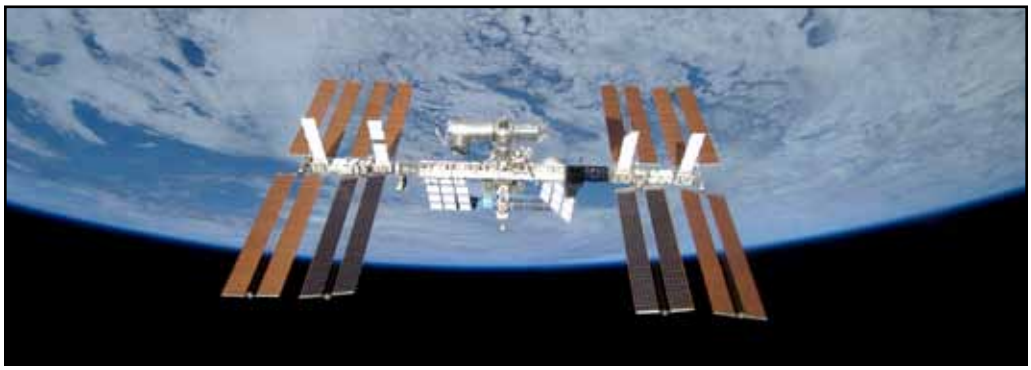
The Canaveral National Seashore is an unspoiled mecca for swimming, sunbathing and surf fishing.

Many important scientific and commercial spacecraft have launched on space shuttles since the first flight in 1981, including a number of interplanetary explorers. Among the more notable scientific spacecraft was Magellan, which used radar to map the surface of Venus, providing excellent profiles of this cloud-shrouded planet. The Hubble Space Telescope launched into Earth orbit in April 1990 and became the most powerful telescope in history. In April 1991, the Compton Gamma Ray Observatory also launched into Earth orbit, and is the largest telescope to operate in the very high-energy range. Ulysses looped around Jupiter and out of the planetary plane, becoming the first spacecraft to directly examine the south and north poles of the sun. The Galileo mission sent a probe plunging into Jupiter, while an orbiter analyzed the giant planet and several of its largest moons from space.

The Earth-orbiting Chandra X-Ray Observatory, launched in July 1999, was designed to make astrophysical observations of celestial objects from normal stars to quasars. It allowed scientists to understand the nature of physical processes that take place within astronomical objects, and understand the history and evolution of the universe.

The Space Infrared Telescope Facility, launched in August 2003, was designed to obtain images and spectra by detecting the infrared energy, or heat, radiated by objects in space. Now named Spitzer, the largest infrared telescope ever launched into space is the fourth and final element in NASA's family of orbiting "Great Observatories." For more than five years, its highly sensitive instruments gave a unique view of the universe and peered into regions of space that were hidden from optical telescopes. In 2009 when the telescope ran out of coolant, it began a second career to study slightly warmer stars and asteroids.

On the commercial side, satellite communications now provide several billion dollars in revenue each year, and continue to steadily grow. These spacecraft fly primarily on uncrewed vehicles but the space shuttle did place several in orbit. The ability of a single transponder, on a satellite often providing 30 or more, to bring television into every home in most countries is unique to the space program. Satellite observations and the data they produce, such as from the Geostationary Operational Environmental Satellites, greatly improve the ability of meteorologists to make more accurate and longer-range weather forecasts. Earth resources spacecraft provide powerful



Backdropped by the blackness of space and Earth's horizon, the nearly complete International Space Station is seen from space shuttle Discovery as the two spacecraft begin their relative separation March 25, 2009.

tools to help in locating new mineral and water resources, as well as measuring the effects of human activities on land and sea.

A major program, “Mission to Planet Earth,” operated economical satellites with improved capabilities to observe, monitor and analyze Earth’s very complex environment. This included gaining a better understanding of the relationships between solar radiation and Earth’s atmosphere, and tracking the ozone layer and the “ozone hole” over Antarctica. The Earth Observing System and National Oceanic and Atmospheric Administration satellites have been instrumental in expanding the available data on Earth’s environment.

Many other commercial and scientific spacecraft launched into Earth orbit by space shuttles and rockets. Hundreds of human-tended experiments have been conducted in the microgravity of orbit, including international crews performing several Spacelab and shuttle missions.

In 1995, NASA astronauts began rotating assignments on the Russian space station Mir, with space shuttles docking with the station on a regular basis. This continued until the International Space Station welcomed its first permanent crew Nov. 2, 2000. The station is the largest construction project ever attempted in space.

The United States and its partners in Europe, Japan, Russia and Canada are just about finished constructing the exceptional research facility. There has been continuous occupation of the space station since 2000, with rotating crew assignments.

The station greatly improves our ability to utilize the space environment for the benefit of humanity. Shuttle-transported elements brought to NASA’s Kennedy Space Center for future payloads are first checked out in the 457,000-square-foot Space Station Processing Facility in the center’s Industrial Area. Once construction of the station, which is now larger than a five-bedroom house, is complete, it is set to become a full-time National Lab.

Multi-purpose logistics modules, built by the Italian Space Agency, have enabled transporting of experiments to the space facility plus needed supplies and equipment. The first crews set up residence for three to six months in duration. Through March 2010, 32 space shuttle flights have supported the space station and 23 Expedition crews have called it home.

Two probes, the Mars Global Surveyor and Mars Pathfinder, launched in late 1996. Two additional orbiters launched in late 1998 and early 1999 but were lost after arriving at Mars. The Mars Odyssey spacecraft successfully launched in 2001 and was designed to map the Martian surface. Cassini launched in 1997 on a four-year mission to explore Saturn, its rings and moons. The Mars Exploration Rovers launched in 2003 to determine the history of the climate and water on Mars.

Uncrewed interplanetary exploration will continue, with highly sophisticated spacecraft launched on expendable launch vehicles. Following completion of space station assembly, the space shuttle fleet is scheduled to retire.

Astronauts Steven Smith and John Grunsfeld replace gyroscopes inside NASA’s Hubble Space Telescope on the STS-103 servicing mission in December 1999.

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