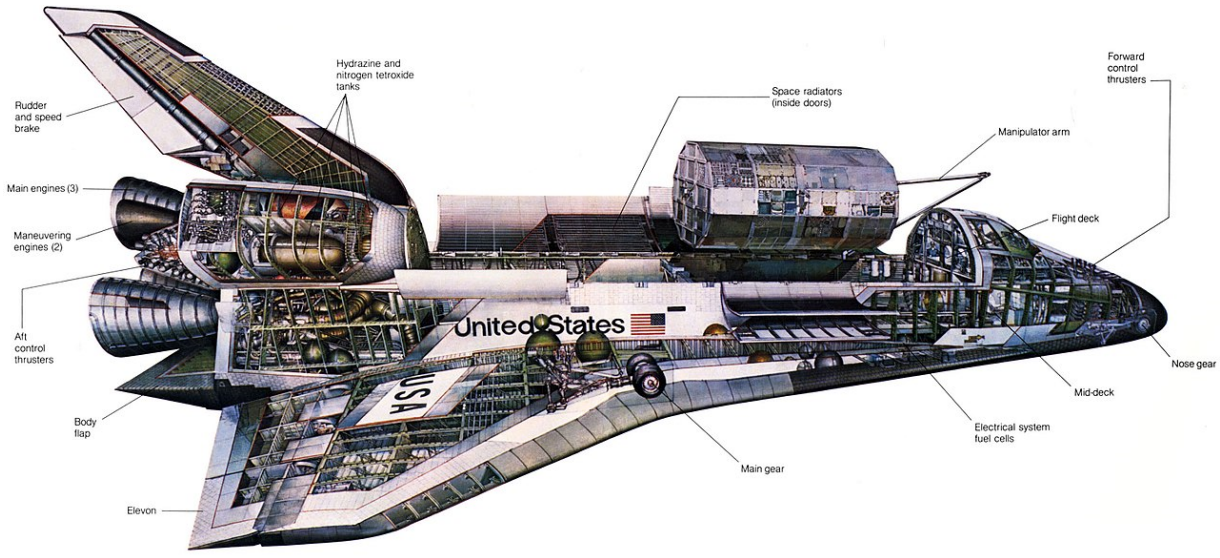
Rocket and spacecraft

A spacecraft is a vehicle or machine designed to fly in outer space. Spacecraft are used for a variety of purposes, including communications, earth observation, meteorology, navigation, space colonization, planetary exploration, and transportation of humans and cargo. All spacecraft except single-stage-to-orbit vehicles cannot get into space on their own, and require a launch vehicle (carrier rocket).

On a sub-orbital spaceflight, a space vehicle enters space and then returns to the surface, without having gone into an orbit. For orbital spaceflights, spacecraft enter closed orbits around the Earth or around other celestial bodies. Spacecraft used for human spaceflight carry people on board as crew or passengers from start or on orbit (space stations) only, whereas those used for robotic space missions operate either autonomously or telerobotically. Robotic spacecraft used to support scientific research are space probes. Robotic spacecraft that remain in orbit around a planetary body are artificial satellites. Only a handful of interstellar probes, such as Pioneer 10 and 11, Voyager 1 and 2, and New Horizons, are on trajectories that leave the Solar System.



Orbital spacecraft may be recoverable or not. By method of reentry to Earth they may be divided in non-winged space capsules and winged spaceplanes.

Humanity has achieved space flight but only a few nations have the technology for orbital launches: Russia (RSA or "Roscosmos"), the United States (NASA), the member states of the European Space Agency (ESA), Japan (JAXA), China (CNSA), India (ISRO), Taiwan (National Chung-Shan Institute of Science and Technology, Taiwan National Space Organization (NSPO), Iran (ISA), and North Korea (NADA).

Space Shuttle

The Space Shuttle was a partially reusable low Earth orbital spacecraft system operated by the U.S. National Aeronautics and Space Administration (NASA), as part of the Space Shuttle program. Its official program name was Space Transportation System (STS), taken from a 1969 plan for a system of reusable spacecraft of which it was the only item funded for development. The first of four orbital test flights occurred in 1981, leading to operational flights beginning in 1982. In addition to the prototype whose completion was cancelled, five complete Shuttle systems were built and used on a total of 135 missions from 1981 to 2011, launched from the Kennedy Space Center (KSC) in Florida. Operational missions launched numerous satellites, interplanetary probes, and the Hubble Space Telescope (HST); conducted science experiments in orbit; and participated in construction and servicing of the International Space Station. The Shuttle fleet's total mission time was 1322 days, 19 hours, 21 minutes and 23 seconds.

Shuttle components included the Orbiter Vehicle (OV) with three clustered Rocketdyne RS-25 main engines, a pair of recoverable solid rocket boosters (SRBs), and the expendable external tank (ET) containing liquid hydrogen and liquid oxygen. The Space Shuttle was launched vertically, like a conventional rocket, with the two SRBs operating in parallel with the OV's three main engines, which were fueled from the ET. The SRBs were jettisoned before the vehicle reached orbit, and the ET was jettisoned just before orbit insertion, which used the orbiter's two Orbital Maneuvering System (OMS) engines. At the conclusion of the mission, the orbiter fired its OMS to de-orbit and re-enter the atmosphere. The orbiter then glided as a spaceplane to a runway landing, usually to the Shuttle Landing

Facility at Kennedy Space Center, Florida or Rogers Dry Lake in Edwards Air Force Base, California. After landing at Edwards, the orbiter was flown back to the KSC on the Shuttle Carrier Aircraft, a specially modified version of the Boeing 747.

The first orbiter, Enterprise, was built in 1976, used in Approach and Landing Tests and had no orbital capability. Four fully operational orbiters were initially built: Columbia, Challenger, Discovery, and Atlantis. Of these, two were lost in mission accidents: Challenger in 1986 and Columbiain 2003, with a total of fourteen astronauts killed. A fifth operational (and sixth in total) orbiter, Endeavour, was built in 1991 to replace Challenger. The Space Shuttle was retired from service upon the conclusion of Atlantis's final flight on July 21, 2011. The U.S. has since relied primarily on the Russian Soyuz spacecraft to transport supplies and astronauts to the International Space Station.

Space Shuttle Description

The Space Shuttle was the first operational orbital spacecraft designed for reuse. It carried different payloads to low Earth orbit, provided crew rotation and supplies for the International Space Station (ISS), and performed satellite servicing and repair. The orbiter could also recover satellites and other payloads from orbit and return them to Earth. Each Shuttle was designed for a projected lifespan of 100 launches or ten years of operational life, although this was later extended.

The person in charge of designing the STS was Maxima Faget, who had also overseen the Mercury, Gemini, and Apollo spacecraft designs. The crucial factor in the size and shape of the Shuttle orbiter was the requirement that it be able to accommodate the largest planned commercial and military satellites, and have over 1,000 mile cross-range recovery range to meet the requirement for classified USAF missions for a once-around abort from a launch to a polar orbit.

The militarily specified 1,085 nmi (2,009 km; 1,249 mi) cross range requirement was one of the primary reasons for the Shuttle's large wings, compared to modern commercial designs with very minimal control surfaces and glide capability. Factors involved in opting for solid rockets and an expendable fuel tank included the desire of the Pentagon to obtain a high-capacity payload vehicle for satellite deployment, and the desire of the Nixon administration to reduce the costs of space exploration by developing a spacecraft with reusable components.

Each Space Shuttle was a reusable launch system composed of three main assemblies: the reusable OV, the expendable ET, and the two reusable SRBs. Only the OV entered orbit shortly after the tank and boosters are jettisoned. The vehicle was launched vertically like a conventional rocket, and the orbiter glided to a horizontal landing like an airplane, after which it was refurbished for reuse. The SRBs parachuted to splashdown in the ocean where they were towed back to shore and refurbished for later Shuttle missions.

Five operational OVs were built: Columbia (OV-102), Challenger (OV-099), Discovery (OV-103), Atlantis (OV-104), and Endeavour (OV-105). A mock-up, Inspiration, currently stands at the entrance to the Astronaut Hall of Fame. An additional craft, Enterprise (OV-101), was built for atmospheric testing gliding and landing; it was originally intended to be outfitted for orbital operations after the test program, but it was found more economical to upgrade the structural test article STA-099 into orbiter Challenger (OV-099). Challenger disintegrated 73 seconds after launch in 1986, and Endeavour was built as a replacement from structural spare

components. Building Endeavour cost about US$1.7 billion. Columbia broke apart over Texas during re-entry in 2003.

A Space Shuttle launch cost around $450 million. Roger A. Pielke, Jr. has estimated that the Space Shuttle program cost about US$170 billion (2008 dollars) through early 2008; the average cost per flight was about US$1.5 billion. Two missions were paid for by Germany, Spacelab D1 and D2 (D for Deutschland) with a payload control center in Oberpfaffenhofen. D1 was the first time that control of a manned STS mission payload was not in U.S. hands.

At times, the orbiter itself was referred to as the Space Shuttle. This was not technically correct as the Space Shuttle was the combination of the orbiter, the external tank, and the two solid rocket boosters. These components, once assembled in the Vehicle Assembly Building originally built to assemble the Apollo Saturn V rocket, were commonly referred to as the "stack".

Responsibility for the Shuttle components was spread among multiple NASA field centers. The Kennedy Space Center was responsible for launch, landing and turnaround operations for equatorial orbits (the only orbit profile actually used in the program), the U.S. Air Force at the Vandenberg Air Force Base was responsible for launch, landing and turnaround operations for polar orbits (though this was never used), the Center served as the central point for all Shuttle operations, the Marshall Space Flight Center was responsible for the main engines, external tank, and solid rocket boosters, the John C. Stennis Space Center handled main engine testing, and the Goddard Space Flight Center managed the global tracking network.

Orbiter vehicle

The orbiter resembled a conventional aircraft, with double-delta wings swept 81° at the inner leading edge and 45° at the outer leading edge. Its vertical stabilizer's leading edge was swept back at a 50° angle. The four elevens, mounted at the trailing edge of the wings, and the rudder/speed brake, attached at the trailing edge of the stabilizer, with the body flap, controlled the orbiter during descent and landing.

The orbiter's 60-foot (18 m)-long payload bay, comprising most of the fuselage, could accommodate cylindrical payloads up to 15 feet (4.6 m) in diameter. Information declassified in 2011 showed that these measurements were chosen specifically to accommodate the KH-9 HEXAGON spy satellite operated by the National Reconnaissance Office. Two mostly-symmetrical lengthwise payload bay doors hinged on either side of the bay comprised its entire top. Payloads were generally loaded horizontally into the bay while the orbiter was standing upright on the launch pad and unloaded vertically in the near-weightless orbital environment by the orbiter's robotic remote manipulator arm(under astronaut control), EVA astronauts, or under the payloads' own power (as for satellites attached to a rocket "upper stage" for deployment.)

Three Space Shuttle Main Engines (SSMEs) were mounted on the orbiter's aft fuselage in a triangular pattern. The engine nozzles could gimbal 10.5 degrees up and down, and 8.5 degrees from side to side during ascent to change the direction of their thrust to steer the Shuttle. The orbiter structure was made primarily from aluminum alloy, although the engine structure was made primarily from titanium alloy.

The operational orbiters built were OV-102 Columbia, OV-099 Challenger, OV-103 Discovery, OV-104 Atlantis, and OV-105 Endeavour.