CosmicFacts

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The space shuttle program

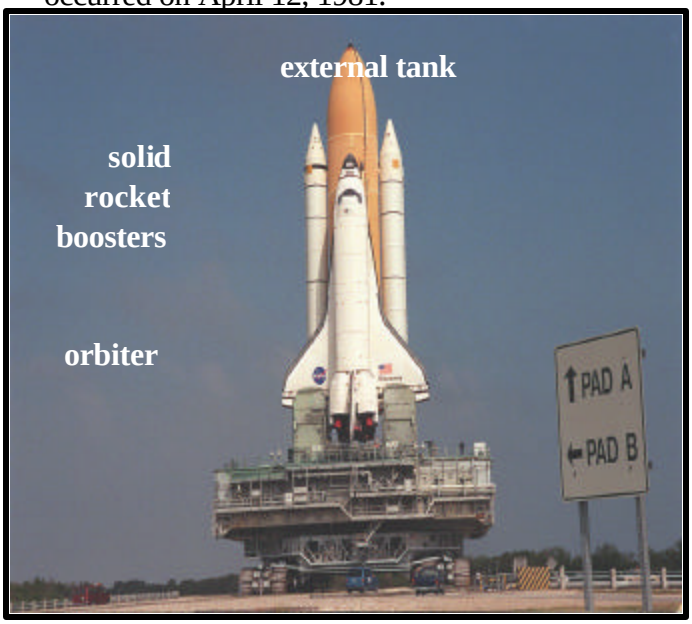
The space shuttle program, also called the **Space Transportation System** (STS), officially started in January, 1972 by the Unites States space agency NASA (National Aeronautical and Space aaAdministration). The shuttle sytem was designed so that most of the components can be reused. Some of the main goals of the space shuttle program were to greatly reduce the cost of sending cargo into space and to make spaceflight more routine. Unfortunately the cost reductions were not fully realized and space travel into Earth orbit is only slightly more routine. However, the space shuttle is very versatile vehicle and has accomplished many tasks in Earth orbit.

The Space Transportation System consists of three major components: the **orbiter**, the **external tank**, and the **solid rocket boosters**. The orbiter looks like an airplane and is 37.2 metres long and has a wing span of 23.8 metres. The crew cabin has two decks: the flight deck and the mid deck. The cargo bay is located between the crew cabin and the tail section. At the rear of the tail section are the three main liquid-fuel rocket engines used to launch the shuttle into orbit. Two additional, but smaller rockets engines are also located here. These two engines are used to make adjustments to the shuttle's orbit and to drop the shuttle out of orbit at the end of a mission. The orbiter also has 44 smaller rocket engines located at the tail and forward sections that are used to point the vehicle.

The orbiter is attached to the external tank, which has a characteristic orange-rust colour. The external tank supplies liquid oxygen and liquid hydrogen to the orbiter's three main engines during launch. The external tank is the only part that is not reused. Once the fuel has been used, the tank separates and falls into the Pacific Ocean and is not recovered.

The orbiter's three main engines are not powerful enough to get the shuttle into orbit. The two solid rocket boosters are needed to achieve orbit. The boosters are strapped to the sides of the external tank. As the name would suggest, the boosters use solid fuel rather than liquid fuel. They are like extremely large firecrackers. Once they are started, they can not be stopped. The boosters provide 82 percent of the thrust at liftoff, while the orbiter's three main engines provide the other 18 percent of thrust. After the boosters have used their fuel, they also fall into the Pacific Ocean, but under three huge parachutes. The boosters are recovered by boat, and are reused.

Five space-capable orbiters were built: **Columbia**, **Discovery**, **Challenger**, **Atlantis**, and **Endeavour**. Tragically, Challenger and her crew of seven astronauts were lost shortly after liftoff on January 28, 1986. Endeavour was built to replace Challenger. The first orbiter built was called **Enterprise**. However, Enterprise was only used for ground tests and gliding and landing tests, and was never sent into space. Columbia was the first shuttle launched (STS-1 mission) into space, and this occurred on April 12, 1981.



NASA photograph

All shuttle missions are launched from the Kennedy Space Center, which is located on the east coast of Florida. The old Apollo launch pads were converted for shuttle launches. There have been 110 shuttle missions by the end of June 2002.

A great deal of activity and care are required to prepared a space shuttle for launch. Each mission is unique with its own set of goals and objectives. The following is a general overview of a typical shuttle flight.

The ignition sequence occurs in several steps. The three main engines on the orbiter are started first. In fact, they are started one after another within a fraction of a second. Once the main engines are at full thrust and working properly, then the two solid rocket boosters are ignited. Once the boosters are ignited the shuttle must liftoff. The boosters are so powerful that the shuttle appears to pop off the launch pad. Shortly after liftoff the vehicle does a roll along its vertical axis. This maneuver points the shuttle to the right direction so it can enter the proper orbit. At about two minutes after liftoff the solid rocket boosters have used their fuel and separates from the external tank. The external tank continues to supply fuel to the orbiter's three main engines. The main engines are stopped at about eight and half minutes after liftoff. Shortly after main engine cutoff, the external tank separates from the orbiter. At this point the orbiter is in Earth orbit. However, the initial orbit is elliptical. About 45 minutes into the first orbit, the orbit is made circular by briefly firing the orbiter's two smaller rocket engines located in the tail section. Shortly after achieving the proper orbit, the huge cargo bay doors are opened. Not only does opening the doors expose the cargo bay to space, the bay doors also radiates excess heat that the orbiter generates during its normal operations.

Once in orbit, the shuttle and its crew can perform many activities. A variety of satellites have been delivered into Earth orbit by the shuttle. On several occasions satellites have been captured and they have either been repaired or serviced in orbit or returned to Earth. Instrumentation in the cargo bay on several missions have been used to study the Earth or used for astronomical observations. Astronauts have perform spacewalks in order to repair satellites, test
new equipment, or conduct experiments. The shuttle was designed to allow for a variety of experiments to be carried out in the crew cabin. Many of these experiments deal with medical research, plant growth, animal behavior, production of new materials, and biotechnology, just to name a few. The shuttle also docked nine times with the Russian Mir space station from 1995 to 1998.

Space shuttles generally orbit the Earth once every 90 minutes at a altitude ranging from 220 to 700 kilometres. Crew size typically range from five to seven astronauts, and mission duration range from four to 17 days. The amount of cargo a space shuttle takes into orbit varies from mission to mission, but the maximum cargo capacity by weight is about 29,500 kilograms.

At the end of each mission, the shuttle must deorbit and return to Earth. First the cargo bay doors are closed. Then the tail of the shuttle is pointed into the direction of travel. The two smaller rocket engines are fired to slow the shuttle's speed and this causes the orbiter to drop out of orbit. The orbiter enters the atmosphere and the friction from the air continues to slow the vehicle. Certain parts of the orbiter are cover with special tiles, which protects the vehicle from the heat of friction as it passes through the upper atmosphere at high speed. The orbiter has no engine power during landing, and lands as a very heavy, and very fast glider. The pilot only has one try to land safely. The shuttles either land at the Kennedy Space Centre in Florida or at Edwards Air Force Base in California.

Over the next several years, the space shuttle program and astronauts from many different countries, including Canada, will be heavily involved with the construction of the new International Space Station, which was started in 1998.

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