



National Aeronautics and
Space Administration

Space Shuttle *Columbia* Lifts Off Into Space





The Space Shuttle *Columbia* lifts off into space from the NASA Kennedy Space Center, Florida. *Columbia* is one of NASA's four reusable launch vehicles used to carry payloads and crewmembers into space to conduct experiments in a microgravity environment. The Space Shuttle system consists of four parts: the orbiter, external tank, and two solid rocket boosters.

In the launch configuration, the orbiter and two solid rocket boosters (SRB) attach to the external tank (ET) in a vertical or nose-up position on the launch pad. Four bolts attach each of the SRB's to the platform.

The silo-like brown external tank contains the propellants for the three main engines on the orbiter. At launch, the Space Shuttle's main engines ignite first at T minus 6 seconds. When computers verify the engines are operating at the proper thrust level, they send a signal to ignite the SRB. At T minus 0 seconds, the holddown explosive bolts blow and the Space Shuttle lifts off the launch pad.

Little more than 2 minutes into the flight, the SRB's, their fuel expended, jettison. The boosters briefly continue to ascend, while small motors fire to push them away from the Space Shuttle. The boosters turn and begin to descend. Parachutes deploy to decelerate them for a safe splashdown in the Atlantic Ocean. Two ships recover the boosters and return them to a processing facility for refurbishment and eventual reuse.

Meanwhile, the orbiter and external tank continue to ascend, using the thrust of the three main engines. Approximately eight minutes after launch, the three Space Shuttle engines shut down and the external tank jettisons from the orbiter. The external tank continues on a ballistic trajectory and enters the atmosphere where it disintegrates.

After main engine cut-off, the orbiter and the external tank move along a trajectory that, if not corrected, would result in the vehicle entering the atmosphere about halfway around the world from the launch site. However, a brief firing of the orbiter's two Orbital Maneuvering System (OMS) thrusters changes the trajectory and orbit is achieved. The OMS engines are also used on orbit for any velocity changes and reentry.

Facts and Figures

Orbiter

Wing Span	23.79 meters
Length	37.24 meters
Height	17.27 meters
Payload Bay	18.3 meters x 4.6 meters
Payload Weight (launch max.) (approx.)	24,948 kilograms

Main Engine (each)

Thrust at 100% throttle setting:

Sea Level	1,670 kilonewtons
Vacuum	2,100 kilonewtons

External Tank (ET)

Length	47 meters
Diameter	8.4 meters
Gross Weight (full)	750,980 kilograms

Solid Rocket Booster (SRB, each)

Length	45.46 meters
Diameter	3.7 meters
Thrust at Lift-off	14,685 kilonewtons
Gross Weight (approx.)	589,670 kilograms

Operations

Gross Lift-off Weight (approx.)	2,041,200 kilograms
Total thrust at launch	33,327 kilonewtons
SRB separation altitude	50 kilometers
SRB splashdown distance from KSC	260 kilometers
ET separation altitude (approx.)	120 kilometers
Orbital velocity (approx.)	27,869 kilometers/hour

Space Shuttle Launch to Orbit Profile

