

Rockets

It takes a staggering amount of energy to break free from Earth's gravitational pull and fly into space. The only vehicles capable of doing this are rockets, which harness the explosive power of burning fuel to lift cargo such as satellites and spacecraft into orbit. Most of a rocket's weight is fuel, and nearly all of it is consumed in the first few minutes, burning at a rate of up to 15 tonnes every second.

People used rockets as weapons for hundreds of years before they became safe and powerful enough to reach space. Since the first spaceflight in 1944, rockets have got larger and more complicated. A modern rocket is really several rockets in one, with separate "stages" stacked cleverly together. When the lowest stage runs out of fuel, it drops off, making the remaining vehicle lighter. The stage above then ignites. The cargo is usually in the uppermost stage, under the rocket's nose. Most rockets are built to fly to space only once and are destroyed as their parts fall back to Earth.



Crew module
This is the only part of the Orion spacecraft that will return to Earth, using a parachute to splash down in the ocean.

Onwards to Mars

Powered by its own rocket engine, the Orion spacecraft will be able to carry astronauts further into space than ever before. The crew will live inside the conical section at the front, which is based on the command module used by astronauts during the Apollo Moon missions.

Service module
The central section of the Orion spacecraft carries fuel and other supplies.

Spacecraft engine
Orion's engine will be able to propel the craft to Mars in three to four months.

Boosters
Two booster rockets provide most of the thrust needed for liftoff. They produce enough thrust to lift a house for a whole day.

Escape rocket
The nose cone is a small rocket designed to carry the crew module away safely during an emergency.

Steering engines for escape rocket



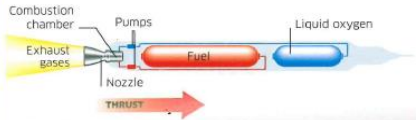
Launch pad
The SLS's space journey will start at the Kennedy Space Center in Florida, USA. Launch pad 39B was once used by the Apollo Moon missions and the Space Shuttle.

Space Launch System

Standing taller than the Statue of Liberty, the Space Launch System (SLS) is a giant new rocket being built by NASA for spaceflights in the 2020s. When complete, it could launch manned spacecraft to the Moon, near-Earth asteroids, and Mars. The configuration shown here has one main rocket stage and two booster rockets on the side. Inside the rocket's nose is the Orion spacecraft, with its own rocket engine. Taller configurations with an extra stage will allow the SLS to launch larger cargoes.

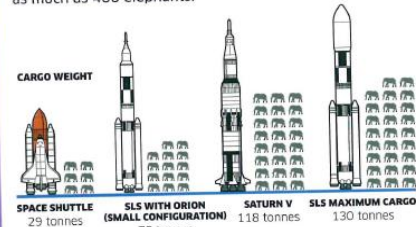
How rockets work

Most of the body of a rocket is taken up by huge tanks containing fuel and an oxidizer (a chemical needed to make fuel burn). Once ignited, these two chemicals react explosively to make hot gases, which rush out of the rear nozzle. The rush of hot gases creates the force of thrust that pushes the rocket forwards.



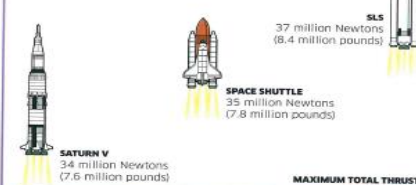
Cargo weight

The heavier a rocket's cargo, the more fuel is needed to lift it, which adds further to the weight. The Saturn V rocket used for the Apollo Moon missions carried a cargo as heavy as 24 elephants, but the whole rocket weighed as much as 400 elephants.



Thrust

The force that pushes a rocket is called thrust. To reach low Earth orbit, a rocket must generate enough thrust to reach a speed of 29,000 kph (18,000 mph) – nine times faster than a bullet.



Main engines

At the base of the rocket are four RS-25 engines – the same kind of engine that was used to power space shuttles. Working together, the SLS's main engines and boosters produce as much power as 13,400 train engines.