
Rocket

Rockets have made spaceflight possible and changed the nature of modern warfare. Rocket-powered launch vehicles carry satellites and astronauts into orbit and send space probes on their way to distant planets. Within a generation, rockets will send astronauts to Mars. Rockets also power a wide range of modern weapons, from small rocket-propelled grenades to massive intercontinental missiles.

The Saturn V rocket being prepared for the first crewed lunar landing mission in 1969. A technician is working on the entrance of the lunar capsule.



The driving force of missiles and space vehicles

Rocket basics

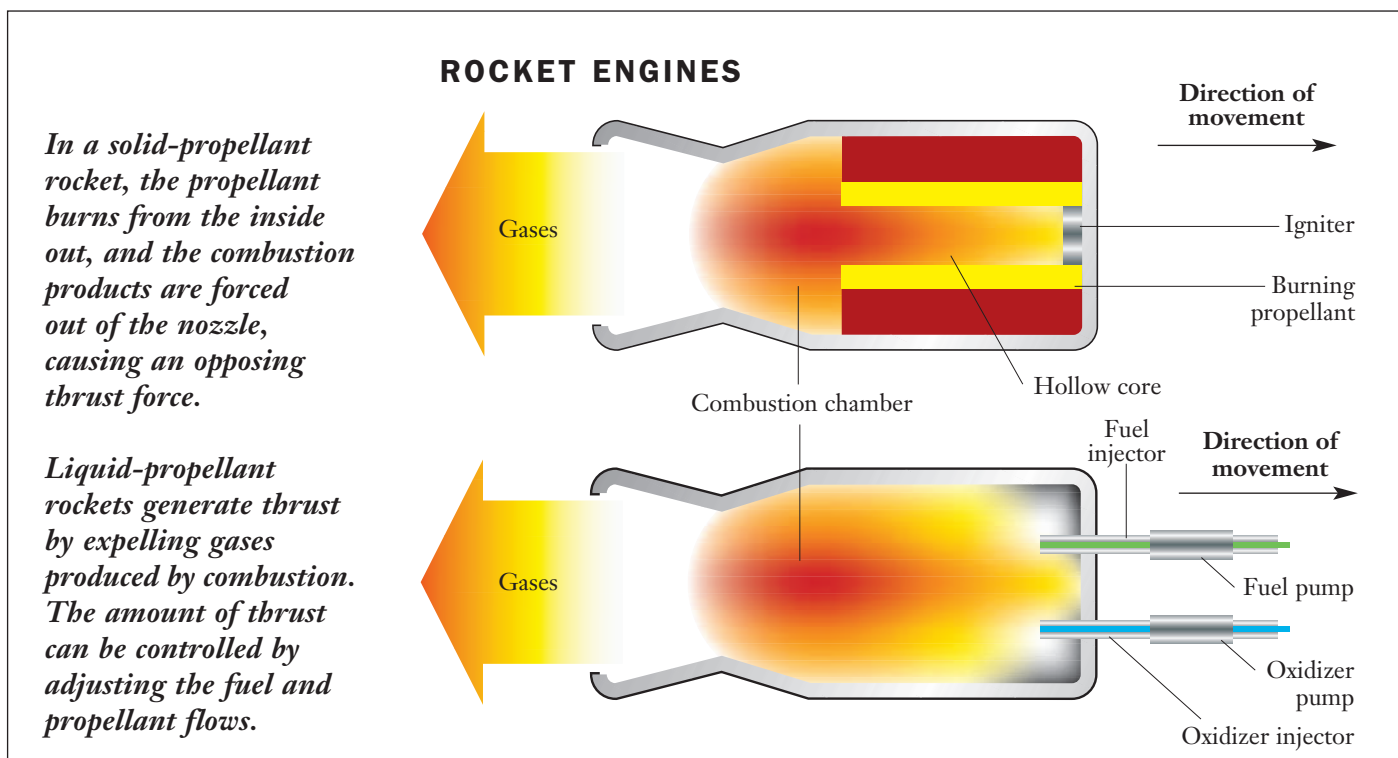
A rocket works by blasting a high-speed stream of gas out from one end through a nozzle or a set of nozzles. Blasting out this gas creates a force that pushes the rocket in the opposite direction. Rockets create the stream of gas that drives them by burning a fuel. Burning, also called combustion, is a chemical process in which a material combines with oxygen.

When things burn on Earth, the chemicals in them combine with oxygen in the air. Because there is no atmosphere in space, rockets must carry a source of oxygen with them. The oxygen source that rockets carry is called the oxidizer. The fuel and oxidizer together are called the propellant. Many large rockets use liquid hydrogen (LH₂) or kerosene as their fuel and liquid oxygen (lox) as their oxidizer. Other rockets use different fuels. Their oxidizers are either liquid oxygen or oxygen-rich chemicals such as hydrogen peroxide. In solid-fueled rockets, both fuel and oxidizer are solid chemicals rather than liquids.

The force that a rocket produces is called its thrust. To get a rocket off the ground, its thrust must be much higher than the weight of the rocket. To get a 266,100-pound (120,700 kg) Lockheed Martin Athena-2 rocket off the ground, for example, its main engine produces a thrust of 325,845 pounds (147,800 kg).

Early rockets

Until the 20th century, all rockets were solid-fueled. About 900 years ago, the first rockets were developed in China. This happened soon after the invention of black powder (gunpowder), the first explosive. Black powder is a mixture of charcoal (carbon), sulfur, and saltpeter (potassium nitrate), and it makes a simple but effective rocket propellant. Carbon and sulfur burn in the oxygen contained in the potassium nitrate. The Chinese, Mongols, and Arabs were using rockets as weapons by the 13th century. Rockets were used in Europe soon after. These early rockets were tubes of explosives attached to long spears



or sticks, like large bottle rockets. The tube was made of a light material such as cardboard. Lighting a fuse in the base ignited the black powder and set the rocket off. The stick stabilized the rocket so that it flew straight.

After the 14th century, the Chinese stopped using rockets as military weapons but continued to use them as fireworks. European countries developed military rockets until the 17th century. They then switched their attention to cannons and other guns, which were more accurate and had a longer range than cardboard rockets. Although rockets had fallen out of favor in the West, armies in India used them. In the mid-18th century, Indian scientists invented rockets with tubes made of iron instead of cardboard. These rigid tubes could not catch fire and could hold a larger amount of propellant. This gave them a range of more than half a mile (around 1 km).

Rocketry in the 19th century

Rocket development continued throughout the 19th century. In 1844, English engineer William Hale (1797–1870) invented a rocket with angled exhaust holes. The holes made the rocket spin like a rifle bullet, so it did not need a long, unwieldy stick to stabilize it. Engineers found

other uses for rockets, including devices that could carry lifelines to ships in difficulty, rocket harpoons for hunting whales, and the distress flare. A distress flare is a type of firework that fires a brilliant light into the sky to attract help when a boat or ship in trouble.

Rocket pioneer

By the end of the 19th century, improvements in artillery (large guns) made rockets obsolete as weapons again. However, some scientists and writers thought rockets could provide a way to get people into space. The first person to study the practical problems of space travel was a

HIGHLIGHTS



- ◆ Chinese scientists invented the first rockets, which were powered by black powder.
- ◆ Rockets produce their thrust by burning a fuel with an oxidizer.
- ◆ The combination of fuel and oxidizer is called the propellant.