How do rockets work?

KS2 KS3 Ages 7-14 ⏰ 3 min read

A rocket works by throwing mass in one direction, which pushes the rocket in the other direction. That's Newton's Third Law: every action has an equal and opposite reaction. Burning fuel produces hot gas; the rocket engine throws that gas out the back at enormous speed; the rocket goes forward (or upward).

Blow up a balloon and let it go without tying it. It shoots across the room — not because the air pushes against something, but because throwing air backwards pushes the balloon forwards. A rocket works on exactly the same principle, just with burning gas at thousands of metres per second instead of balloon air. You don't need anything to push against. Rockets work perfectly in the vacuum of space — better, in fact, because there's no air resistance.

Why is it so hard to reach orbit?

You need to reach about 7.9 kilometres per second — roughly 28,440 km/h — to stay in low Earth orbit. At that speed, you're moving so fast that as you fall towards Earth's curved surface, the surface curves away beneath you at the same rate. You're perpetually falling but never hitting the ground. Reaching that speed requires enormous energy, which means enormous fuel. The problem is that fuel is heavy, and carrying heavy fuel requires more fuel. A typical rocket is 85–90% fuel by mass at launch.

What are rocket stages?

Because empty fuel tanks are dead weight, most rockets shed parts as they go. A multi-stage rocket drops the first-stage engines and tanks when empty, then fires the second stage. Lighter and faster, it continues to orbit. This staging was the critical insight that made spaceflight practical. SpaceX's Falcon 9 goes further — landing and reusing its first stage, dramatically reducing the cost of reaching orbit.

Why do rockets need oxygen in space?

Burning fuel requires oxygen. In the atmosphere, engines can use atmospheric oxygen. Rockets carry their own — liquid oxygen stored cryogenically and fed into the

combustion chamber alongside the fuel. The most common fuels for modern rockets are liquid hydrogen (used by NASA's Space Launch System) and kerosene (used by SpaceX's Falcon 9). Both burn with liquid oxygen to produce thrust.