How Rockets Work

In simple language, Newton's Laws of Motion:

First Law
Sfnigxw ex viwx viqemr ex viwx erh sfnigxw mr motion remain in motion in a straight line unless acted upon by an unbalanced force.

Second Law
Force equals mass times acceleration (or f = ma).

Third Law
For every action there is an equal and opposite reaction.

Before looking at each of these laws in detail, a few terms should be explained.

Rest and *Motion*, as they are used in the Ăvwxpe{0 ger fi gsrjywmrk2 Fsxl xivqw evi relative. They mean rest or motion in relation to surroundings. You are at rest when sitting in a chair. It doesn't matter if the chair is in the gefmr sj e nix tperi sr e gvsww1gsyrxv} ămklx2 You are still considered to be at rest because the airplane cabin is moving along with you. If you get up from your seat on the airplane and walk down the aisle, you are in relative motion because you are changing your position inside the cabin.

Force is a push or a pull exerted on an sfnigx2 Jsvgi ger fi i|ivxih mr qer} {e}w0 such as muscle power, movement of air, and electromagnetism, to name a few. In the case of rockets, force is usually exerted by burning rocket propellants that expand explosively.

Unbalanced Force refers to the sum total or rix jsvgi i|ivxih sr er sfnigx2 Xli jsvgiw sr e gsʅii gyt wmxxmrk sr e hiwo0 jsv i|eqtpi0 evi mr

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on a launch pad, needs the exertion of an
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amount of the thrust (force) produced by
the rocket engines has to be greater than
the force of gravity holding it down. As long
as the thrust of the engines continues, the
rocket accelerates. When the rocket runs out
of propellant, the forces become unbalanced
again. This time, gravity takes over and causes
the rocket to fall back to Earth. Following its
"landing," the rocket is at rest again, and the
forces are in balance.

There is one very interesting part of this law that has enormous implications for
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atmospheric drag (friction) is greatly reduced or eliminated. Within the atmosphere, drag is an important unbalancing force. That force is virtually absent in space. A rocket traveling away from Earth at a speed greater than 11.186 kilometers per second (6.95 miles per second) or 40,270 kilometers per hour (25,023 mph) will eventually escape Earth's gravity. It will slow down, but Earth's gravity will never slow it down enough to cause it to fall back to Earth. Ultimately, the rocket (actually its payload) will travel to the stars. No additional rocket thrust will be needed. Its inertia will cause it to continue to travel outward. Four spacecraft are actually doing that as you read this. *Pioneers 10* and *11* and *Voyagers 1* and *2* evi sr nsyvri}w xs
the stars!

Newton's Third Law

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back to the second law later.) This is the law of motion with which many people are familiar. It is the principle of action and reaction. In the case of rockets, the action is the force produced by the expulsion of gas, smoke, and
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A Taste of Real Rocket Science

Naturally, launching rockets into space is more complicated than Newton's laws of motion imply. Designing rockets that can egxyepp} pmjx s(levxl erh viegl svfmxep zipsgmxmiw or interplanetary space is an extremely complicated process. Newton's laws are the beginning, but many other things come into play. For example, air pressure plays an important role while the rocket is still in the atmosphere. The internal pressure produced by burning rocket propellants inside the rocket engine combustion chamber has to be greater than the outside pressure to escape through the engine nozzle. In a sense, the outside air is like a cork in the engine. It takes some of the pressure generated inside the engine