

newtons third law

Newton's Third Law of Motion states:

**For every action, there is an equal and opposite reaction.**

### What it means

Whenever one object exerts a force on another object, the second object exerts a force **of equal magnitude but in the opposite direction** on the first.

### Key idea (formula form)

$$F_{AB} = -F_{BA}$$

- $F_{AB}$ : force on object B due to A
- $F_{BA}$ : force on object A due to B
- The minus sign shows the forces act in opposite directions

### Important points

- The forces act on **different objects**, not the same one
- They happen **simultaneously**
- They are **always equal in size and opposite in direction**

### Everyday examples

- **Walking:** Your foot pushes the ground backward → the ground pushes you forward
- **Rocket launch:** Rocket pushes gases downward → gases push rocket upward
- **Swimming:** You push water backward → water pushes you forward

If you want, I can give you a simple diagram or a few practice questions to help you understand it better.

Does space rockets use this principle

Yes—space rockets rely directly on Newton’s Third Law.

## How it works

A rocket burns fuel and **pushes hot gases out of its engine backward at high speed.**

According to Newton’s Third Law:

The gases push backward → the rocket is pushed forward with equal force.

## Why this works even in space

A common misconception is that rockets need air to “push against.” They don’t.

- **Rockets carry their own fuel and oxidizer**
- **The engine creates high-speed exhaust gases**
- The force comes from the **interaction between the rocket and its exhaust**, not the surrounding air

## Simple way to picture it

Think of letting go of an inflated balloon:

- Air rushes out one way
- The balloon shoots in the opposite direction

That’s exactly the same principle rockets use—just much more controlled and powerful 🚀

If you want, I can break it down with a diagram or explain how thrust is calculated.

compare those engines with table

Here’s a clear comparison of **rocket engines (Newton’s Third Law in space)** vs a familiar **jet engine (air-breathing engine)** so you can see how they differ:

| Feature                      | Rocket Engine 🚀   | Jet Engine ✈️   |
|------------------------------|---|---|
| <b>Working Principle</b>     | Expels exhaust gases backward → rocket moves forward (Newton’s 3rd Law) | Pushes air backward after combustion → aircraft moves forward |
| <b>Need for Air (Oxygen)</b> | ❌ No (carries its own oxygen/oxidizer)                                  | ✅ Yes (takes oxygen from atmosphere)                          |
| <b>Works in Space?</b>       | ✅ Yes   | ❌ No  |
| <b>Fuel System</b>           | Fuel + oxidizer stored onboard  | Uses fuel but gets oxygen from air                            |

| Feature                  | Rocket Engine 🚀                                   | Jet Engine ✈️  |
|--------------------------|---|--|
| <b>Thrust Production</b> | High-speed exhaust gases from combustion chamber  | Intake air → compress → burn fuel → exhaust          |
| <b>Efficiency</b>        | Less efficient in atmosphere                      | More efficient within atmosphere                     |
| <b>Speed Range</b>       | Can reach extremely high speeds (escape velocity) | Limited by air resistance and design                 |
| <b>Complexity</b>        | Mechanically simpler (no air intake system)       | More complex (compressors, turbines, intake systems) |
| <b>Examples</b>          | Space rockets (e.g., Falcon 9, ISRO rockets)      | Aircraft engines (e.g., Boeing, fighter jets)        |

## Quick takeaway

- **Both follow Newton's Third Law**
- **Rockets** are designed for space (self-contained)
- **Jet engines** are designed for air travel (depend on atmosphere)

If you want, I can also compare **different types of rocket engines (solid vs liquid vs hybrid)** in a similar table.