Newton's Laws of Motion! Year 10 Science at Home

You can help! Your child is learning about Newton's three laws of motion — the foundation of classical mechanics — and how they explain everything from a football kick to a rocket launch. These laws are also the basis for all engineering design.

Why are we learning this? Newton's laws and life in remote communities

Newton's three laws of motion explain the physics of everyday life in remote northern Australia. The physics of driving on remote outback roads — understanding braking distances, momentum and why seatbelts save lives — is governed by Newton's first and second laws. Wet season flooding requires understanding force and water pressure (Newton's laws of fluids). The boomerang, one of the first sophisticated flying tools ever developed by humans, works through a combination of Newton's laws and aerodynamics — the shape, spin and air resistance create a curved return path that Aboriginal engineers worked out through observation and experiment over thousands of years. Understanding these laws helps your child see the physics in the world around them.

My child will learn to:

✓ State Newton's three laws
Accurately state Newton's first law (inertia), second law (F=ma) and third law (action-reaction pairs).

✓ Apply laws to real scenarios
Use F=ma to calculate forces and predict acceleration; identify action-reaction pairs in everyday situations.

✓ Explain momentum
Define momentum (p = mv) and apply the law of conservation of momentum to simple collision problems.

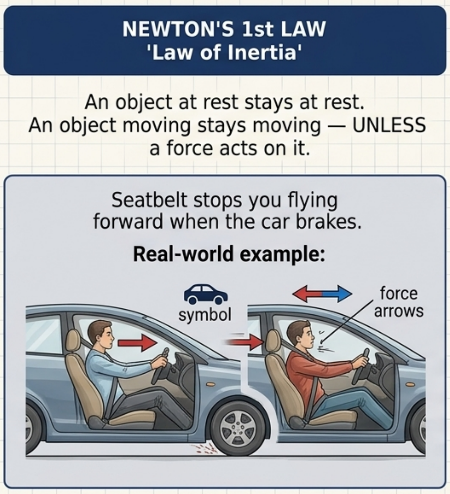
✓ Connect to engineering
Explain how Newton's laws are applied in the design of vehicles, safety systems and aerospace engineering.

Big ideas to know:

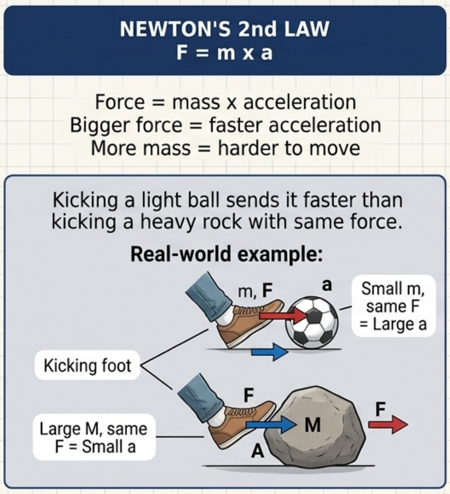
Newton's First Law — Inertia
An object at rest stays at rest, and an object in motion stays in motion at the same speed and in the same direction, unless acted on by an unbalanced force. This is the law of inertia. Inertia is the tendency of an object to resist changes to its motion. Heavier objects have more inertia. This is why you lurch forward when a car brakes suddenly — your body wants to keep moving even though the car has slowed. It is also why seatbelts are essential — without them, the passenger keeps moving forward at the car's previous speed when the car stops abruptly.

Newton's Second Law — F=ma
The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass. In equation form: F = ma (Force = mass x acceleration). This means: double the force, double the acceleration; double the mass, halve the acceleration. So a heavy four-wheel drive takes much longer to stop than a small car travelling at the same speed — it has more mass, so the same braking force produces less deceleration. This law is the basis of all force calculations in engineering and physics.

Newton's Third Law — Action and Reaction
For every action (force), there is an equal and opposite reaction force. Forces always come in pairs — if object A pushes on object B, then object B pushes back on object A with exactly the same force in the opposite direction. When you push off the ground to jump, your feet push down on the Earth, and the Earth pushes up on you (that is what lifts you!). A rocket engine works by pushing gas backwards — the reaction force pushes the rocket forwards. A gun recoils because the bullet pushes back on it when fired.



Law 1



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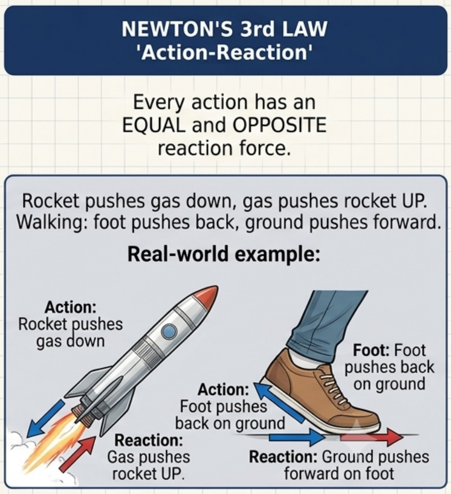

Law 3

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Applying Newton's laws to real situations

Situation	Newton's Law(s) involved	Explanation
Seatbelt saving a life in a crash	First Law (Inertia)	In a crash, the car stops suddenly. Without a seatbelt, passengers keep moving forward (inertia) until they hit the windscreen. The seatbelt applies a backward force to stop the passenger with the car.
Rocket launching into space	Second and Third Laws	Second Law: a more powerful engine (larger force) gives a larger acceleration, but more fuel (mass) reduces it. Third Law: burning gases are expelled backward; the reaction force pushes the rocket forward.
Football/AFL kick going further with more force	Second Law (F=ma)	More leg force → greater ball acceleration → higher final speed → ball travels further. Lighter football → easier to accelerate → need less force for same speed.
Swimming — pushing water backward	Third Law	Swimmer pushes water backward with their hands/feet. Water pushes the swimmer forward with an equal and opposite reaction force.
Car braking distance on wet road	Second Law (F=ma)	On a wet road, friction (braking force) is reduced. With less force and same mass, deceleration is less — so braking distance is much longer. Hence speed limits in wet weather.
Jumping off a canoe onto land	Third Law	You push backward on the canoe to jump forward. The canoe pushes you forward — but also gets pushed backward. If the canoe is light, it shoots back fast!

Think Like a Scientist — Test Newton's Laws

Try these at home: 1. Tablecloth trick — pull a cloth quickly from under objects on a table. The objects should stay in place. Why? (Inertia!) 2. Measure how long it takes to stop your bike from different speeds. Does it take more than double the distance to stop when going twice as fast? (Yes! Because kinetic energy is proportional to speed squared.) 3. Push a skateboard/trolley with different loads — does more weight mean slower acceleration?

Ask: "If a car travelling at 60 km/h takes 20 m to stop, how long do you think it takes to stop from 120 km/h?" (Much more than 40 m — actually about 80 m, because kinetic energy = ½mv², so doubling speed quadruples energy.) This is the physics of why speed limits reduce accidents dramatically.

Newton's Laws to observe at home:

1. First Law: push a cup on a smooth table and then stop pushing — it keeps going (inertia)
2. First Law: eggs on a plate — yank the plate away quickly; the eggs stay (if lucky!
3. Second Law: throw a cricket ball hard vs softly — measure the acceleration
4. Second Law: push same trolley with half, then double the load — notice the difference
5. Third Law: blow up a balloon, let it go — jet propulsion! Third Law in action

Questions to ask your child

1. State Newton's First Law. Give an example from everyday life that demonstrates it.
2. A car of mass 1,000 kg accelerates at 3 m/s². What is the net force on the car?
3. Why does a heavier vehicle take longer to stop than a lighter one, given the same braking force?
4. Identify the action-reaction pair when a fish uses its tail to swim forward.
5. Why do astronauts float in the International Space Station — are they weightless?
6. How does a rocket engine use Newton's Third Law to produce thrust?
7. Why is the stopping distance much more than doubled when speed is doubled?

Car braking distance is a powerful real-world application of Newton's laws. The RAA/RACQ publish braking distance tables for different speeds and road conditions. Look one up together. Ask: at 60 km/h, how many car lengths does it take to stop? What about 100 km/h? This makes the physics personal and relevant to road safety.

Key words to know:

Inertia	The tendency of an object to resist changes to its motion — more mass = more inertia
Force	A push or pull acting on an object — measured in Newtons (N)
Acceleration	The rate of change of velocity — measured in metres per second squared (m/s²)
Newton's First Law	An object stays at rest or in uniform motion unless acted on by an unbalanced force
Newton's Second Law	Force = mass × acceleration (F = ma) — more force means more acceleration; more mass means less
Newton's Third Law	Every action has an equal and opposite reaction — forces always come in pairs
Momentum	The product of an object's mass and velocity (p = mv) — a measure of how hard it is to stop a moving object

Key words to look up	What school will check	Try it at home!
Inertia · Force · Acceleration · Newton's First Law · Newton's Second Law · Newton's Third Law · Momentum	By the end of Year 10, your child needs to apply Newton's three laws of motion to analyse a range of situations including force calculations using F=ma, identify action-reaction pairs, and relate Newton's laws to conservation of momentum.	Next time you are in a car, notice the feeling when it accelerates or brakes. Can you feel Newton's First Law? When you feel pushed back into the seat as the car accelerates — that is inertia. When you feel pulled forward as the car brakes — that is inertia again. Your body wants to keep doing what it was doing!