

WOW sheet

Newton's first law

The first of Sir Isaac Newton's three laws of motion, Newton's first law says:

An object at rest tends to stay at rest and an object in motion tends to stay in motion.

This law is also known as the **law of inertia**.

Inertia is the property of matter which causes matter to resist change in motion. In other words, inertia makes things want to keep doing what they are already doing.

Newton's first law of motion tells us that objects tend to keep moving how they are already moving. If an object is at rest (not moving), it stays at rest. If an object is moving, it keeps moving.

Does the second part seem strange? If you throw a ball up in the air, does it keep moving up forever?

Inertia is overcome by outside force

The full version of Newton's first law actually has two more parts:

An object at rest tends to stay at rest and an object in motion tends to stay in motion in a straight line at a constant speed unless acted upon by an outside force.

In the world around us, we see lots of examples of objects at rest staying at rest. Think about a rock sitting in a grassy field. Objects that are moving, however, don't keep moving forever. The full version of Newton's first law of motion explains why.

First of all, objects in motion not only stay in motion, they move in a straight line and at a constant speed.

An object at rest tends to stay at rest and **an object in motion tends to stay in motion in a straight line at a constant speed** unless acted upon by an outside force.

In other words, objects tend to maintain a constant **velocity**.

Velocity is a measure of both speed and direction. If you change either speed or direction, you change velocity. Newton's first law says that objects tend to maintain a constant velocity, which means that objects don't spontaneously:

- speed up,
- slow down, or
- change direction.

On its own, an object won't change speed or direction. That includes if the object's speed is zero (in other words, if the object is at rest).

However, you know that it is possible to get objects to speed up, slow down or change directions. But this takes an outside force.

An object at rest tends to stay at rest and an object in motion tends to stay in motion in a straight line at a constant speed **unless acted upon by an outside force.**



Think about a ball slowly rolling towards you that you then kick hard, sending it flying off in a new direction. This change in speed and direction is caused by an outside force (in this case, you) acting on the object (the ball).

The force acting on the object might be something we can see, like you kicking the ball. It could also be something in the environment, like gravity, friction or air resistance.

Here's an example

Imagine you are standing very still, with your arm straight out in front of you, holding a coin in your closed fist. You aren't moving and neither is the coin. The coin is at rest.

Now imagine you open your fingers.

Why doesn't the coin stay at rest? Why does the coin start to move?

Because an outside force, gravity, is acting on the coin, changing its velocity, and making it fall to the ground.

If there are no outside forces in the environment (for example, in the vacuum of deep space) then there's nothing to act on an object. In that case, a moving object would keep moving in a straight line and at a constant speed forever.

