

Common Student Ideas about Forces and Motion

Common Student Idea	Scientific Explanation
If an object is moving, there must be a force acting on it. Motion implies force.	Forces cause <i>changes in motion</i> . If something is moving, no force is necessary to keep it moving, but a force is needed to make it stop moving or to change direction.
Forces get things going, but do not stop things. An object stops because it runs out of force or runs out of energy.	This misconception stems from common everyday observations, e.g. students seeing that objects which have been pushed across the floor come to a stop (and not seeing friction as a force acting on the object). Objects do not “contain” force, so they cannot “run out of” force. All forces are interactions (push or pull, touch or tug) between two objects. A foot might interact with a soccer ball to get it moving in a certain direction. The grass it rolls and air it moves through each exert a force pushing the soccer ball in the direction opposite to the kick, causing an object to slow and eventually stop its motion.
All objects eventually slow down and stop.	If there are no forces acting on a moving object, there will be no change in its motion, and it will never stop. Objects in outer space, where there is not air resistance or friction acting on an object will keep going in the same direction they are moving indefinitely. That is why a rocket in outer space needs only to use the thruster for a short burst to change its speed or direction in outer space. Objects that we are more familiar with on Earth always have the force of some material – air, water or the surface it sits on – pushing back in the opposite direction of its motion. For that reason, everything we experience on Earth eventually slows down and stops.
Force is transferred from one object to another.	Force is not a thing that can be transferred from one place to another or one object to another. It describes an interaction between two objects. Students often confuse the idea of a force with energy. Energy is always conserved, meaning that it can be transferred from one object to another and can change from one form to another (such as motion, heat, light or sound).
A force needs to keep being applied to cause constant motion	In a world of with no friction, a constant force does not cause constant motion, but causes an <i>increase</i> in an object’s speed. This is difficult to understand because of our everyday experiences that objects slow down and stop unless additional force pushes or pulls an object. However, in a world without friction (the force pushing back on a moving object), an object in motion will continue in motion forever.
Objects move only when people push or pull them (people have the power to move things).	Some students believe that inert objects cannot exert a force. They can alter an object's motion, like a wall stops a ball thrown at it, but they don't exert a force. However, any two objects that interact through direct contact, or through indirect contact such as gravity or magnetism, exert forces on one another. A sandwich sitting on a plate exerts a downward force on the plate, while the plate exerts an equal upward force on the sandwich. Neither object is a person – but both exert force.

<p>An object at rest has no forces pushing or pulling on it.</p>	<p>Students regard objects at rest as being in a natural state in which no forces are acting on the object. Students think air pressure, gravity, or an intervening object (like a table) is in the way keeps and object stationary. However, an object at rest usually has many forces acting on it including the downward force of gravity, the downward force of air pressure, and the upward force of whatever surface the object sits upon.</p>
<p>Inanimate objects (like a table or chair) do not exert forces.</p>	<p>Anything that touches something else exerts a force on it. Forces are touches and tugs. Some students are hesitant to believe that passive objects can exert a force.</p>