Action and Reaction

Newton's third law of motion states:
when one object exerts a force on a second object, the second one exerts a force on the first that is = in size and opposite in direction.

In other words:
For every action force, there is an equal and opposite reaction force.

Some examples of this law include:
jumping on a trampoline
blowing up a balloon & releasing it
leaping from a boat towards the dock & falling in the water

Action jumping on a trampoline, exerts a force on the trampoline
Reaction trampoline exerts an = force upward
Result person flies high into the air

Newton's third law can be used to describe how a swimmer moves through the water. With each stroke, the swimmer's arm exerts a force on the water. The water pushes back on the swimmer with an equal force in the opposite direction. The swimmer moves forward because the action force acts on the water; the reaction force acts on the swimmer. The swimmer, having less mass than the pool full of water, accelerates more than the water.

An important point to keep in mind when dealing with Newton's third law is that action-reaction forces always act on different objects. So, even though the forces may be equal, they are not balanced. In the case of the swimmer, water pushes her forward, overcoming the friction (or drag) she encounters. Thus, a net force, or unbalanced force, acts on the swimmer, and a change in motion can take place.

Momentum

If a toy truck rolls toward you, you can easily stop it with your hand. However, you probably would not fare very well if it were a full-size semi, even if it were moving at the same speed as the toy truck. It takes more force to stop a semi because it has more momentum than the toy truck. Momentum is a property a moving object has because of its mass and velocity. Momentum can be calculated with the equation below, in which p represents momentum.

Momentum = mass x velocity

OR $p = mv$

The unit for momentum is Kg · m/s.

A large boulder and a small boulder may be careening down a mountain at the same velocity, but the large rock has more momentum because it has greater mass. A speeding bullet has large momentum because it has high velocity, even if it has a small mass. A ~~stampeding~~ bumbling elephant may have low velocity, but because of its large mass, it has a large momentum.

Conserving Total Momentum

The momentum of an object doesn't change unless its mass, or velocity, or both change. But momentums can be transferred from one object to another. Think about a game of pool. Before the game starts, all of the balls are motionless. Therefore, the total momentum of the balls is zero. There can be no momentum because none of the balls has a velocity.

Think about what happens when a cue ball rolls across the pool table and hits the group of balls that are standing still. At first, the rolling ball has momentum, and the motionless balls have none. When the cue ball collides with the balls that were at rest, all of the balls begin moving. They gain momentum. The cue ball slows down and loses momentum. If you were to measure the total momentum of all the balls before and after the collision, it would be the same. The momentum the group of balls gains is equal to the momentum that the cue ball loses. Total momentum is Conserved — it doesn't change.

The law of conservation of momentum states:

the total amount of momentum of a group of objects does not change unless acted upon by an outside force.