

When objects move, they have momentum. Momentum, p , is the product of an object's mass and velocity. During a collision objects transfer momentum to each other, resulting in different motions than before the collision. In this activity you will study the motion colliding objects.

$$\vec{p} = m\vec{v}$$

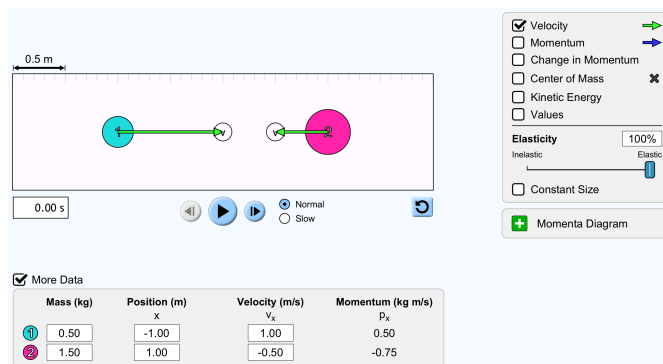
Objective

Investigate the momentum before and after a collision for i) elastic collisions and ii) inelastic collisions

Website: <http://phet.colorado.edu>

Simulations > Physics > Motion > Collision Lab

- Select "Intro" from the main menu
- Check "More Data"



Part 1: Elastic Collisions

$$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$$



1. Prior to simulating the collisions, fill out the mass and initial velocity columns. Simulate the four elastic collisions described below and complete the rest of the table.

#	m_1	m_2	Initial			Final		
			v_{1i}	v_{2i}	p_{total}	v_{1f}	v_{2f}	p_{total}
1	2.0 kg	2.0 kg	1.5 m/s		0 kg·m/s			
2	1.5 kg	3.0 kg		-1.0 m/s	0 kg·m/s			
3	1.0 kg	2.0 kg	2.0 m/s	0.0 m/s				
4	3.0 kg		2.0 m/s	-1.0 m/s	4.0 kg·m/s			

2. Two objects with the same mass move toward each other with the same speed and experience an elastic collision. Compare the **final velocities** (speed and direction) of each object to their **initial velocities**.
3. A less-massive moving object has an elastic collision with a more-massive object that is not moving. Compare the **final velocity** (speed and direction) of the less-massive object to its **initial velocity**.

Part 2: Inelastic Collisions



$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$$

1. Prior to simulating the collisions, fill out the mass and initial velocity columns. Simulate the four inelastic collisions described below and complete the rest of the table.

#	m_1	m_2	Initial			Final	
			v_{1i}	v_{2i}	p_{total}	v_f	p_{total}
1	2.0 kg	2.0 kg	1.5 m/s	0			
2	1.5 kg	3.0 kg	1.5 m/s	-0.75 m/s			
3	1.0 kg	3.0 kg	2.0 m/s	0.2 m/s			
4	1.0 kg		2.5 m/s	-2.0 m/s	-0.5 kg·m/s		

2. Two objects moving toward each other with **different** momentums experience an inelastic collision. In which direction will both objects travel after the collision?
3. A less-massive object is moving in the same direction as a more-massive object, but with a higher speed. They experience an inelastic collision. Compare the **final speed** of the more-massive object to its **initial speed**.
4. Objects 1 has half the mass of object 2 and the objects move toward each other and experience an inelastic collision. If both objects do **not** move after the collision compare the velocity of **both** objects **before** the collision.
5. Show **mathematically** the total momentum before the collision in trial #1 is conserved after the collision.
6. Compare the four elastic collisions with the four inelastic collisions. List any similarities and differences that you notice. How would you describe elasticity?