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

Play with the Sims → Physics→ Motion → Collision Lab Run Now!

Introduction:
When objects move, they have *momentum*. Momentum, p, is the
product of an object's mass (kg) and its velocity (m/s). The unit for
momentum, p, is kg·m/s. 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.

$$\boxed{\text{momentum} = m \times v}$$

ELASTIC Collisions

$$\boxed{m_1 v_{1before} + m_2 v_{2before} = m_1 v_{1after} + m_2 v_{2after}}$$
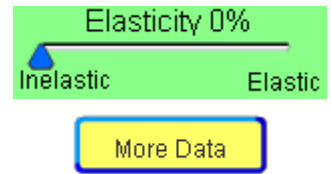
1. What defines a collision as being elastic?

2. Simulate the four elastic collisions below. Complete the table using math formulas and the simulation.

#	m_1	m_2	BEFORE COLLISION		p_{total}	AFTER COLLISION	
			v_1	v_2		v_1	v_2
1	2.0 kg	2.0 kg	1.5 m/s		0 kg·m/s		
2	2.5 kg	5.0 kg		-1.0 m/s	0 kg·m/s		
3	3.0 kg	6.0 kg	2.0 m/s	0.0 m/s			
4	6.0 kg		2.0 m/s	-1.0 m/s	8.0 kg·m/s		

3. Two objects with the same mass move toward each other with the same speed and experience an elastic
    collision. Compare the **final velocities** of each object to their **initial velocities**.

4. A less-massive moving object has an elastic collision with a more-massive object that is not moving.
    Compare the **initial velocity** (speed and direction) of the less-massive object to its **final velocity**.

INELASTIC Collisions

$$m_1 v_{1before} + m_2 v_{2before} = (m_1 + m_2) \, v_{after}$$

Elasticity 0%

Inelastic   Elastic

More Data

5. What defines a collision as being inelastic?

6. Simulate the four inelastic collisions below. Complete the table using math formulas and the simulation.

#	m_1	m_2	BEFORE COLLISION		p_{total}	AFTER COLLISION
			v_1	v_2		v_1 and v_2
1	2.0 kg	2.0 kg	1.5 m/s	0		
2	3.0 kg	6.0 kg	1.5 m/s	-0.75 m/s		
3	1.5 kg	5.0 kg	2.0 m/s	0.2 m/s		
4	10.0 kg		2.0 m/s	-1.0 m/s	10.0 kg·m/s	

7. Two objects moving toward each other with **different** momentums experience an inelastic collision. In which direction will both objects travel after the collision?

8. 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. Describe the **speed** of the **more-massive** object after the collision.

9. 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.

10. Show **mathematically** the total momentum before the collision in trial #1 is conserved after the collision.