Momentum
Internet Lab – Momentum and Collisions

Name:

Date: **Period:**

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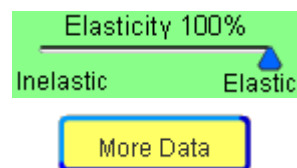
$$\text{momentum} = m \times v$$

ELASTIC Collisions

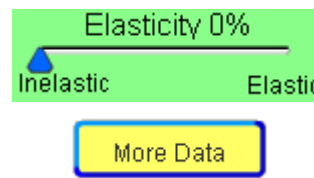$$m_1v_{1before} + m_2v_{2before} = m_1v_{1after} + m_2v_{2after}$$
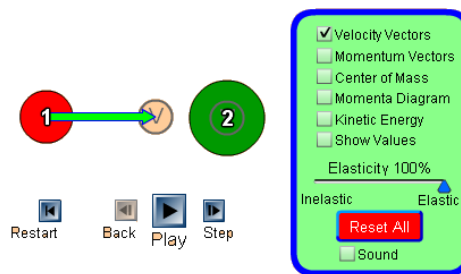
1. What defines a collision as being elastic?

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

#	m_1	m_2	BEFORE COLLISION v_1	v_2	p_{total}	AFTER COLLISION 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

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

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.