Simple 1D Collisions and Momentum Conservation

http://phet.colorado.edu/sims/collision-lab/collision-lab_en.html

Introduction: When objects move, they have *momentum*. **Momentum, p, is simply the product of an object's mass (kg) and its velocity (m/s).** The unit for momentum, p, is kg·m/s. When two objects collide each will experience the same size force, caused by the other object (Third Law). If the force experienced is the only force on the object, it will be unbalanced, resulting in a net force on the object and will cause and impulse (change in momentum). This happens for both objects involved in the collision. In this activity you will explore how momentum can be transferred between objects, resulting in the law of conservation of momentum. There are two different types of collisions: (1) elastic, objects bounce off of each other and (2) inelastic, objects stick together.

Where: Go to the pHet Collision Lab simulation website. Stay on the Introduction tab.

What: You will be observing various 1D collisions. Please note that a positive motion is to the right and a negative motion is to the left.

- Take some time to familiarize yourself with the simulation and collisions. (No more than 5 minutes)
- Use the simulation to complete the data tables on the back of this paper:
  1. Click the "More Data" button…Set the given mass and velocity values
  2. Before collision: Record the individual momenta and calculate the total momentum by adding the individual momenta (note the +/- values)
  3. After collision: Record the individual velocities and momenta
  4. Calculate the total momentum by adding the individual momenta (note the +/- values)

Conclusions: Based on the results answer the following

1. Did the momentum of each ball change due to the collisions? If not which did not and which collisions?

2. Was the total momentum (ball 1 and 2 together) after each collision the same as it was before each collision?

3. Write what you think the "Law of Conservation of Momentum" would say:

Part 1			Elastic collisions (move the elasticity slider all the way to the right, 100%) Objects will bounce after the collision								
	Ball 1 Before collision			**Ball 2 Before collision**			**Before collision**	**Ball 1 After collision**		**Ball 2 After collision**		**After collision**
	m	$\vec{v}$	$\vec{p}$	m	$\vec{v}$	$\vec{p}$	$\vec{p}_{total}$	$\vec{v'}$	$\vec{p'}$	$\vec{v'}$	$\vec{p'}$	$\vec{p}_{total}$
1	3 kg	+2 m/s		3 kg	0 m/s							
2	3 kg	+2 m/s		1 kg	0 m/s							
3	1 kg	+2 m/s		3 kg	0 m/s							
4	3 kg	+2 m/s		3 kg	-2 m/s							
5	5 kg	+2 m/s		3 kg	-2 m/s							

Part 2			Inelastic collisions (move the elasticity slider all the way to the left, 0%) Objects will stick after the collision								
	Ball 1 Before collision			**Ball 2 Before collision**			**Before collision**	**Ball 1 After collision**		**Ball 2 After collision**		**After collision**
	m	$\vec{v}$	$\vec{p}$	m	$\vec{v}$	$\vec{p}$	$\vec{p}_{total}$	$\vec{v'}$	$\vec{p'}$	$\vec{v'}$	$\vec{p'}$	$\vec{p}_{total}$
6	3 kg	+2 m/s		3 kg	0 m/s							
7	3 kg	+2 m/s		6 kg	0 m/s							
8	6 kg	+2 m/s		3 kg	0 m/s							