Newton’s Third Law Simulated Lab

Newton’s third law is often considered the most confusing of the three laws. This is often due to the fact that people cannot readily see where the reaction force comes from, or even see it at all! When the law tells you that your chair is indeed pushing up on you as you sit in it, it may be hard to believe since you are not moving anywhere. With some important thought experiments, it is this confusing law that can explain so many of our most common daily experiences with motion or the lack of apparent motion even with applied forces. In this activity you will examine Newton’s third law by observing the effects when balls of different masses bounce into each other.

Procedure

1. Start Virtual Physics and select Newton’s Third Law from the list of assignments. The lab will open in the Mechanics laboratory.

2. The laboratory will be set up with two balls of the same mass on a table. The balls will move towards each other. As they collide, they will exert forces on each other which are equal and opposite.

3. The initial velocity of all of the balls will be the same for each trial, but the masses of the balls will change. You will observe what happens in the collisions and record the final velocities of each ball.

4. Click the Start button to start the balls in motion. After the balls bounce off each other and move a short distance away from each other, click the Pause button to stop the experiment. Note the velocity of each ball in the display panel below the table. You can display the velocity of the second ball by clicking on the ball, or by clicking on the Tracking arrows to change the display. Record the velocities in the table. Describe what happened to each ball in the reaction box.

5. Click the Reset button to reset the experiment before trying new masses. Use the table to keep track of what mass to use for

each trial. Use the Parameters Palette to change the mass of the balls. Uncheck the Balls Same Mass and Diameter box to be able to change each mass separately.

6. Find the final velocities of each ball for trials one through three and write them in the table below. Create your own scenarios for trials 4 and 5 in which the balls are initially moving in the same direction. Ensure that one of the balls will catch up to the other and cause a collision.

Trail 1	Mass (kg)	Velocity Before (m/s)	Velocity After (m/s)	Reaction
Ball 1	10	-10	10	
Ball 2	10	10	-10	
Trail 2	Mass (kg)	Velocity Before (m/s)	Velocity After (m/s)	Reaction
Ball 1	20	-10	3.333	
Ball 2	10	10	-16.667	
Trail 3	Mass (kg)	Velocity Before (m/s)	Velocity After (m/s)	Reaction
Ball 1	50	-10	-9.216	
Ball 2	1	10	-29.216	
Trail 4	Mass (kg)	Velocity Before (m/s)	Velocity After (m/s)	Reaction
Ball 1	10	-10	-1.000	
Ball 2	10	-1	-10.000	
Trail 5	Mass (kg)	Velocity Before (m/s)	Velocity After (m/s)	Reaction
Ball 1	10	-10	8.164	
Ball 2	100	-0.01	-1.826	

Questions

1. Describe what happened when the masses of the balls were the same, and when they were very different.

When the mass was same the balls exchange their velocities after impact. In case they were very different the final velocity of the balls would be fairly different.

2. Explain why a lighter ball has more velocity after a collision with a heavy ball than it had before? Where did that velocity come from? Hint: Think about Newton's second law.

On impact the two balls experience the same magnitude of Force(third law) but the lighter ball experiences a larger acceleration(second law) and thereby gains a larger velocity.

3. Does the data prove your earlier prediction? Explain.

Yes it does, but the changes are a bit more complex when both are travelling in the same direction.

4. Why don't the forces of action and reaction cancel each other? I.e. why isn't the velocity of both objects zero if they exert forces on each other that is equal in magnitude but opposite in direction as dictated by Newton's Third law?

The action and reaction forces act on different bodies therefore they don't cancel each other.

5. Comment on trials 4 and 5 and determine the direction of the reaction forces on each ball.

For trial 4, the balls switch velocities after collision. Ball 1 experiences a force in positive x direction and ball 2 in negative x direction.

For trial 5, the lighter ball (1) bounces back with almost the same speed. Ball 1 experiences a force in positive x direction and ball 2 in negative x direction.