Rocketball Launcher

Overview: One of the basic laws of the universe is the conservation of momentum. When objects smack into each other, the momentum that both objects have after the collision is equal to the amount of momentum the objects had before the impact.

What to Learn: Today you'll get introduced to the ideas about mass, velocity, impact, and momentum as well as see firsthand how momentum is conserved as it's transferred from one object to another.

Materials

- Two balls of very different sizes, like a bouncy ball and a tennis ball, or a tennis ball and a basketball

Lab Time

1. First, hold out the larger ball at arm's length in front of you. You'll want to do this over a flat surface – something without any rugs or carpet. Drop (don't throw and don't bounce) your larger ball on the floor. Do you see how high it bounces on its own?
2. Now drop your smaller ball (this can be a bouncy ball or a tennis ball if you're using a basketball) on the ground and notice how far it bounces back up.
3. Now place the smaller ball on top of the larger ball like it shows here in the picture and let them BOTH drop at the same time so that they fall together and hit the ground with the smaller ball still on top. You've got to make sure that the smaller ball stays on top when it hits the ground. If it falls off, you've got to do it again.
4. Try this with different-sized balls and record what you see.
5. What happens if you try THREE?

Rocketball Laucher Data Table

Top Ball (Smaller)	Bottom Ball (Larger)	Observations

Reading

Momentum can be defined as "inertia in motion." Something must be moving to have momentum. Momentum is how hard it is to get something to stop or to change directions. A moving train has a whole lot of momentum. A moving ping pong ball does not. You can easily stop a ping pong ball, even at high speeds. It is difficult, however, to stop a train even at low speeds.

Mathematically, momentum (p) is mass (m) times velocity (v), or: p=mv

In today's experiment, we're going to have two balls, one much larger than the other, collide and transfer energy. Once the two balls hit the ground, all of the larger ball's momentum transferred to the smaller ball (plus the smaller ball had its own momentum, too!) and thus the smaller ball goes zooming to the sky.

Do you see how using a massive object as the lower ball works to your advantage here? What if you shrink the smaller ball even more, say to bouncy-ball size? Momentum is mass times by velocity, and since you aren't going to change the velocity much (unless you try this from the roof, which has its own issues), it's the mass that you can

really play around with to get the biggest change in your results. So for momentum to be conserved, after impact, the top ball had to have a much greater velocity to compensate for the lower ball's velocity going to zero.

You can also try a small bouncy ball (about the size of a quarter) and a larger bouncy ball (tennis-ball size) and rest the small one on top of the large one. Hold upright as high as you can, then release. If the balls stay put (the small one stays on top of the larger) at impact, the energy transfer will create a SUPER high bounce for the small ball. (Note how high the larger ball bounces when dropped.)

Exercises Answer the questions below:

1. What is the mathematical formula for momentum?

2. Explain momentum in words.

3. What happens to the momentum of the bottom ball in this experiment?

Answers to Exercises: Rocketball Launcer

1. What is the mathematical formula for momentum? (momentum = mv)
2. Explain momentum in words (It's mass times velocity; it's inertia in motion.)
3. What happens to the momentum of the bottom ball in this experiment? (It's transferred to the small ball.)