Balloon Racers

Overview: We're going to experiment with Newton's Third Law by blowing up balloons and letting them rocket, race, and zoom all over the place. When you first blow up a balloon, you're pressurizing the inside of the balloon by adding more air from your lungs into the balloon. Because the balloon is made of stretchy rubber, like a rubber band, it wants to snap back into the smallest shape possible as soon as it gets the chance, which usually happens when the air escapes through the nozzle area. When this happens, the air inside the balloon flows in one direction while the balloon zips off in the other.

What to Learn: The motion of objects can be observed and measured.

Materials

- balloons
- string
- wood skewer
- two straws
- caps (4, like the tops of milk jugs, film canisters, or anything else round and plastic about the size of a quarter)
- wooden clothespin
- stiff cardboard (or four popsicle sticks)
- hot glue gun
- meter or yardstick
- stopwatch

Lab Time

1. Blow up the balloon (don't tie it), then let it go. Wheee! Okay, so that step was to get the balloon ready for the experiment. Now…
2. Tie one end of the string to a chair.
3. Blow up the balloon (don't tie it).
4. Tape a straw to it so that one end of the straw is at the front of the balloon and the other is at the nozzle of the balloon.
5. Thread the string through the straw and pull the string tight across your room.
6. Let go. With a little bit of work (unless you got it the first time) you should be able to get the balloon to shoot about ten feet along the string.

Balloon Racer Data Table

Trial	Number of Breaths to Blow Up Balloon	How Far Did It Go? *(measure in feet or meters)*	How Long Did It Take? *(measure in seconds)*

Reading

When you first blow up a balloon, you're pressurizing the inside of the balloon by adding more air from your lungs into the balloon. Because the balloon is made of stretchy rubber, like a rubber band, it wants to snap back into the smallest shape possible as soon as it gets the chance, which usually happens when the air escapes through the nozzle area. When this happens, the air inside the balloon flows in one direction while the balloon zips off in the other.

Have you ever noticed how the balloon crazily zips all over the place when you let go? Why is that?

The balloon zigzags all over because of something called "thrust vectoring," which means the direction of the balloon changes depending on the angle that the nozzle makes at the end (the part you blew into).

Think of a fire hose. There's a lot of water rushing out of the end of a fire hose, right? A fire hose not only has high-speed water rushing out, but there's also a lot of volume in a fire hose. How easy do you think it would be to try to

change the direction of all that water? You'd actually feel a "kick" back from the water when you tried to angle around a fire hose operating at full blast. That "kick" is the same reaction force that propels both balloons and fighter aircraft into their aerobatic tricks.

Newton's Third Law of Motion states that for every action, there is an equal and opposite reaction. These experiments are a great demonstration of Newton's Third Law. The air inside the balloon shoots off in one direction, and the balloon itself rockets in the opposite direction.

It's also a good opportunity to bring up some science history. Many folks used to believe that it would be impossible for something to go to the moon, because once something got into space there would be no air for the rocket engine to push against and so the rocket could not "push" itself forward.

In other words, those folks would have said that a balloon shoots along the string because the air coming out of the balloon pushes against the air in the room. The balloon gets pushed forward. You now know that that's silly! What makes the balloon move forward is the mere action of the air moving backward. Every action has an equal and opposite reaction.

Exercises Answer the questions below:

1. What is Newton's Third Law of Motion?

2. Why does the balloon stop along the string?

Answers to Exercises: Balloon Racers

1. What is Newton's Third Law of Motion? (For every action, there is an equal and opposite reaction.)
2. Why does the balloon stop along the string? (Friction between the string and straw.)