

# Bernoulli's Principle

This is one of our most commonly performed demonstrations. It is easy to perform, easy to understand, and the topic matter is easily adjusted for all grades and age levels.

## Materials

- Shop Vacuum/Blower with Hose
- Ribbon Wand
- Beach Ball
- Round-bottom Plastic Bottle
- Optional: Roll of Toilet Paper

## Safety Precautions

Please read the Physical Demonstration section of the [Demonstration Safety](#) page before performing this demonstration.

## Demonstration

Preparation: Blow up the beach ball. Make sure the hose is in the blower side, and plug it in. Make sure that there is a small amount of water in the soda bottle.

1. Choose a volunteer from the audience and have them hold the ribbon wand. Explain to the audience that you will be making the beach ball fly by using the blower, but you want them to guess if the air will be blowing over or under the beach ball. Take a vote to see how many think the air should blow over or under.
2. Turn on the blower on the "LOW" setting. Hold the hose at an angle slightly above 45 degrees, and lift the ball into the air stream. It will lift off into the air, and it will float! Have the volunteer hold the ribbons first under the ball, and see that the air isn't blowing

underneath! Then, have them hold the ribbon wand over the ball to see the ribbons move, and show that the air blows over the ball!

3. Let the volunteer return to their seat. Turn off the blower, and explain the demonstration.
4. Call on a new volunteer, and have them hold the soda bottle in one hand. Turn on the blower on the "HIGH" setting. Holding the hose at about a 70 degree angle, have the volunteer place the rounded side of the bottle into the air stream. It should float in the air! After showing this for a minute, turn off the blower and explain.
5. Optional: To end the show, call up one more volunteer. give them the ribbon wand, and have them hold it sideways, turned towards the audience. put the toilet paper roll on the wand, with the roll over side towards the audience. Turn on the blower on the "HIGH" setting, and aim above the roll a little above a 45 degree angle. The roll will unravel into the audience!</li>

## Why This Works

Bernoulli's Principle states that if you have an object inside of a fluid, then the object will move to the part of the fluid that exerts the least amount of pressure upon it. To understand what this means, first look at the beach ball. Before we use the blower, the air is still around the ball. This means that the Air Pressure, or the force the air exerts across all sides of the ball, is equal on all sides. Because it is equal on all sides, the net force will cancel out, leaving the force of gravity as the only force on the ball and pulling it down. When the blower is used, the air above the ball is now moving. The moving air above the ball no longer pushes equally in all directions, and instead pushes mostly in one direction (forward) and weakly in the direction of the ball (downward). The air under the ball is not moving, and so the force it applies on the ball (upward) is now much stronger than the downward force of air from above and the force of gravity. The Lift, or the net upward force, holds the ball up into the moving air stream and keeps it suspended.

The bottle helps to get across how useful this knowledge is. Even though it has more mass to it, we can still get it to hover in the air by using this concept. The curve of the bottle's base allows it to float, much like the curve on a plane's wing will allow it to fly. A plane is able to fly thanks to utilization of this concept, along with a lot of important engineering to make the plane able to ascend, descend and turn in the air.

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