

INSTRUCTIONAL GUIDE

Contents

- Vortex Tube
- Instructional Guide

Recommended for activities:

- Two 2-liter plastic soda bottles



Introduction

An initial small rotation causes the water to move in a circle near the tube opening. The water is forced downward and toward the lower bottle by gravity. As water approaches the small opening in the tube, they move in a gradually smaller circle. Each water molecule's angular momentum* is conserved, so as its rotational radius decreases, its speed increases. (The same thing happens when a spinning ice skater pulls in her arms.)

The hole that develops in the center of the vortex allows air to move from the lower bottle to the upper one, making room for the water.

Directions

1. Remove the labels from two 2-liter soda bottles.
2. Fill one bottle 2/3 full with water and attach the Vortex Tube to the top.
3. Attach another (empty) bottle to the top of the Vortex Tube.
4. Quickly invert the assembly.
5. Rest the bottom bottle securely on a flat surface, and briefly rotate the top bottle in a circular motion.
6. Observe the vortex that forms as the water moves through the Vortex Tube!

Activities

1. Add visual interest by putting food coloring or glitter in the water. The glitter works particularly well because each particle can represent a "unit" of water whose angular momentum is conserved.
2. Relate the bottle vortex to vortices in nature, such as tornadoes, hurricanes and smoke rings.
3. Notice that the vortex can easily rotate either way, and does not start without an initial rotation. The vortex is not influenced by the Coriolis Effect, and neither is the vortex that forms when you empty a sink. These systems are far too small to be affected by the earth's rotation.

4. Introduce the topic by challenging a student to a race. Fill two bottles 2/3 with water and cap each with a Vortex Tube. Ask the student to empty the bottle as fast as possible (without removing the Vortex Tube). Surface tension at the hole will make it quite difficult to do quickly. Students may have to shake or squeeze the bottle to get the water out. Record the student's time. To empty your bottle, invert it, hold the Vortex Tube steady in one hand, and rotate the top of the bottle in the other hand. This will create a vortex at the tube opening, allowing the water to quickly escape. This "trick" has been used to quickly empty large glass bottles that would "glug" and release water slowly. Note: This works best with smaller or more rigid bottles, whose sides are not likely to collapse when a partial vacuum forms in the bottle.

Related Products

Airzooka Air Cannon (P8-5700) A takeoff from the old Trashcan Air Cannon; this amazing new vortex launcher sends a strong blast of air all the way across the room! No batteries or fuel needed. Just point and shoot! Powerful and accurate!

Fountain Connection (P8-6000) Hero of Alexandria described his compressed-air fountain principle in the first century A.D., but it took the invention of the two-liter soda bottle to make it this easy to demonstrate.

Bernoulli Bag 4 pack (P6-7350) How many breathes would it take to inflate an 8-foot long, 10-inch diameter bag? Just ONE using Bernoulli's principle! Commonly called the Wind Tube or Wind Bag.