University of Maryland

Department of Physics Education and Outreach

Physics at Home Activities

Introduction to Aerodynamics Activity #2: Bernoulli's Principle

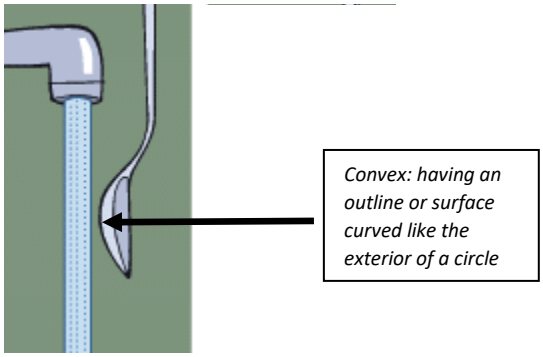
Learning Objective: The following fun activity is the second in a series of three lessons: the law of Gravity, Bernoulli's principle, and the Coanda effect. The trio is designed to introduce upper elementary school students to physics concepts related to aerodynamics.

Activity #2: Bernoulli's Principle

Part A- Basics of Bernoulli's Principle

*Make sure to check out Part B (coming soon!) to take **flight** with Bernoulli!*

1. **Materials and Set up:**
    a. 1 soup spoon
    b. Kitchen sink faucet
2. **Instructions:**
    a. Turn on the faucet. Run the water at a steady medium rate. The temperature does not matter.
    b. Hold the top of the spoon handle using your thumb and pointer finger with the convex side parallel to the stream of water. See image below.



c. **What will happen when you slowly move the spoon into the stream of water and then slowly remove it from the water?**

NOW, do the experiment! Slowly move the spoon into the stream of water. Wait 5 seconds and remove the spoon from the stream. Repeat and carefully observe the dynamics of the system.

3. **What happened.**

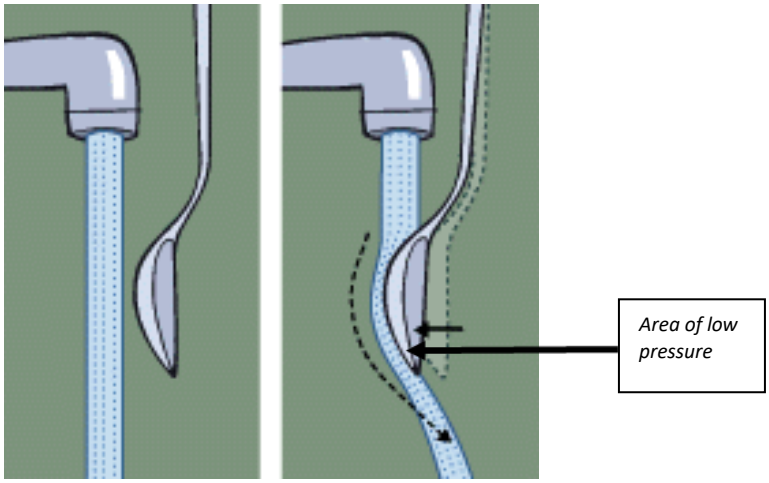
Was your prediction correct?

The spoon was pulled into the stream of water and was stuck there! *Did you feel the attraction?* To release the spoon from the stream, you actually needed to apply force to the spoon to free it from the stream!

What's going on?

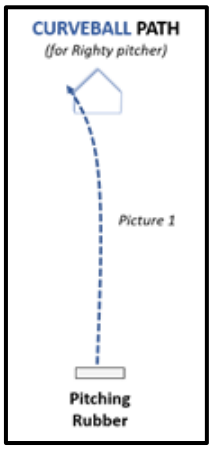
The Bernoulli's Principle explains why this occurs. As the water rushes over the convex side of the spoon, an area of low pressure occurs beneath it on the bottom of the convex side. Instead of the water splashing away, it maintains contact with the spoon and flows down the curve, holding it in place. Bernoulli's principle states that an increase in the speed of moving air or flowing fluid is accompanied by a decrease in the air or fluid's pressure.

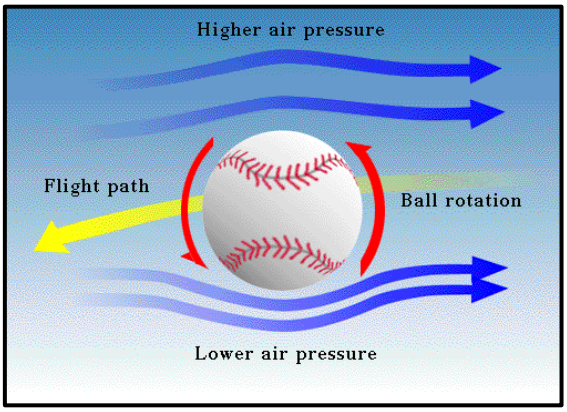
Extension: Try this experiment again, this time making the stream of water stronger and then weaker. Does this change the result?



More on Bernoulli's Principle!

Another example of Bernoulli's Principle in action is the path, and more importantly the physics, of the famous curve ball! A curve ball occurs when a pitcher throws the baseball with an incredible amount of spin. The pitch starts by traveling in a straight path after leaving the pitcher's fingers. Almost immediately, however, the path of the ball begins to curve and cut to the left (for a right-handed pitcher). This is due to Bernoulli's Principle! The bottom of the ball immediately starts to accelerate downward faster than the top of the ball. At the same time, due to the spin of the ball, an area of high pressure occurs on the top of the ball. This creates the downward and inward motion of the pitch, which confuses batters and makes the pitch look almost magical!





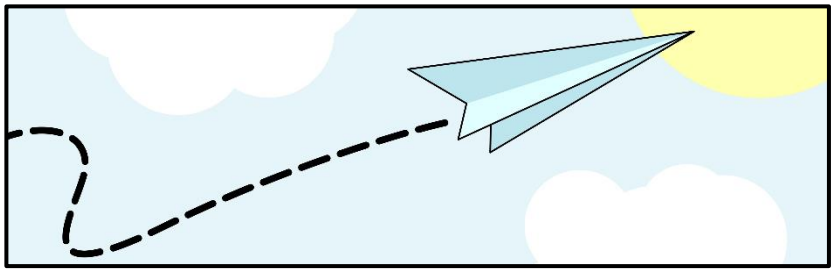
Part B- Bernoulli's Principle and Flight!

Objective: In Part A, you learned how Bernoulli's Principle effects a spoon in water. Now using air instead of water, we will explore Bernoulli's Principle in flight!

1. **Materials:**
    a. Sheet(s) of paper (we suggest 8.5x11")
    b. Tape measure
    c. Sidewalk chalk or ball of string
    d. Crayons or markers for decoration

2. **Instructions:**
    a. Head outside to create your flight course! We recommend using the driveway, patio, lawn, or sidewalk. Using your tape measure and sidewalk chalk (or string), make marks every 5ft. The outside will be our lab setting for this activity!
    b. Now, using the paper and decorating supplies, make a paper airplane! Personalize your plane however you like! *If you need help constructing your plane, see instructions on the last page for help!*

NOW… Head to your flight course and test your paper airplane!

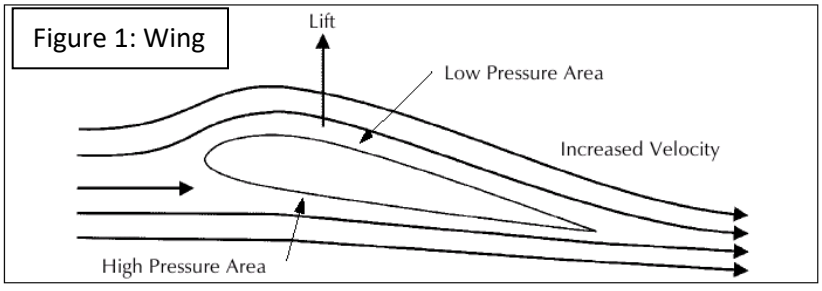


3. **What Happened?**

How did Bernoulli's Principle affect your paper airplane?

In Part A, we learned that Bernoulli's Principle explains why the convex side of a spoon sticks to the stream of water. In Part B, we examine the wing of a paper airplane traveling through the air to see Bernoulli's Principle in action. A typical airplane wing has a convex side (on top) and a flat side (on bottom) as shown in Figure 1 below. When you throw your airplane, air flows over the wing, creating an area of low pressure on top of the wing, and an area with higher pressure underneath the wing. This difference in pressures creates lift! When you throw your paper airplane, this pressure dynamic allows your plane to fly.

Figure 1: Wing



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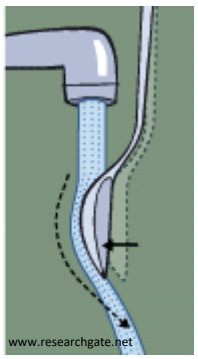

Extension: Create a paper airplane that flies the furthest! Use what you have learned about the shape of an airplane wing and design more paper airplanes! ***Connect with friends and family (via text message, Zoom or any socially distanced form of communication) and see who can set the record distance!*** *Use the table below to track your distances and circle the longest flight.*

Distance Travled (ft.)				
	Throw 1	Throw 2	Throw 3	Throw 4
Plane 1				
Plane 2				
Plane 3				
Plane 4				

My furthest distance: _____ft.!!

Basic Paper Airplane Design: