Bernoulli's Principle

Teacher Copy

Grade Levels

K-12

Demonstration 1: Tent With a Straw

1. Fold a notecard into a tent, flat like a "mound" not tall like a "mountain."
2. Have students predict what will happen if you blow through the tent with a straw.
3. Using a straw, blow air through the opening in the tent.

Predictions

- Notecard will move in the direction of the air blowing underneath it.
- Notecard will not do anything because the air is not touching it.
- Notecard will push down.

Observation

- Notecard crease is pushed toward the table.

Explanation

- When the experiment is performed correctly, the top of the card will pull toward the table. The reason for this outcome is that the faster-moving air under the card creates relatively lower pressure compared to the air over the card. As a result, the card will bend toward the table or desk because, according to Bernoulli's principle, pressure decreases as the speed of a fluid (in this case, air) increases.
- Troubleshooting: If the experiment does not work as expected, students may have the end of their straw too close to or too far away from the paper tent or they may not be blowing hard enough. Also, the paper tent may be too high.

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Demonstration 2: Hair Dryer and Pingpong Ball

1. Set a hair dryer upright on a table. You can use a towel to make a cradle for it to sit in, but **do not** block the air intake.
2. Turn the dryer on high and balance a pingpong ball in the stream of air.
3. Depending on how strong your hair dryer is, you should be able to lift the handle and aim the stream of air at an angle, with the pingpong ball remaining suspended in midair.

Explanation

- The faster-moving air of the hair dryer creates a low-pressure area. The higher-pressure air around the stream of air pushes toward it and provides enough force to keep the pingpong ball from falling out of the stream. As the hair dryer tips sideways, the higher-pressure air has enough force to hold the pingpong ball in, until the force of gravity overcomes the force of the air.
- Troubleshooting: Some hair dryers do not have enough force to hold the ball up against gravity, especially travel-size hair dryers.

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Demonstration 3: Magic Moving Ball

1. Place two small cups about 6 inches apart.
2. Place a pingpong ball in one of the cups.
3. Ask the students to predict how to get the ball from one cup to the other without touching either the ball or cup.
4. Have the students try a few of their ideas.
5. Tell the students to blow across the top of the cup with the ball in it.
6. The ball should jump from one cup to the next.
7. Have the students experiment with how far apart they can place the cups and still get the pingpong ball to jump from one to the other.

Explanation

- This works because the air pressure moving across the top of the cup (faster-moving air) is less than the pressure inside the cup (slower-moving air). The higher pressure inside the cup forces the pingpong ball to jump out of the cup.
- Troubleshooting: This can take practice. The students should blow with an initial puff or burst of air to get the ball out of the cup, but then to get it to travel to the next cup, the breath of air needs to continue more gently. Also, the cups should be just slightly larger than the ball itself — too large and it takes too much air, too small and the balls get stuck.

So what about airplanes? Airplane wings are specifically shaped so that the air on the top of the wing travels faster than the air on the bottom. This results in lower pressure on top and higher pressure on the bottom. The high-pressure air, in effect, pushes the wing up, generating lift.