



Principles of Flight



Lesson Plan: An Uplifting Experience

Grade Level: 5

Subject Area: Science

Time Required: *Preparation:* 1 hour
Activity: 2 hours

National Standards Correlation:

Science (grades 5-8)

- Science as Inquiry Standard: Abilities necessary to do scientific inquiry.
- Science in Personal and Social Perspectives Standard: Science and technology in society.
- Physical Science Standard: Motion and forces.
- Unifying Concepts and Processes Standard: Change, constancy, and measurement.
- Unifying Concepts and Processes Standard: Evidence, models, and explanation.

Summary: Students will conduct four activities using simple materials to demonstrate Bernoulli's Principle, the concept of lift as a force in flight, and angle of attack. Students will make predictions and record results. During this lesson, students will learn about Bernoulli's Principle and lift.

Objectives: Students will:

- Build an airfoil
- Explain and demonstrate Bernoulli's Principle
- Explore the action of lift as a force in flight

Materials:

Activity I:

- Each student will need a paper strip (4" x 11")

Activity II:

- 25 or more drinking straws
- 2 empty soda cans

Activity III:

- Index cards (4" x 6")
- Duct tape
- One drinking straw
- Fishing line
- Hair dryer
- Table

Safety Instructions: Use caution when operating the hair dryer — it can get very HOT!

Procedure

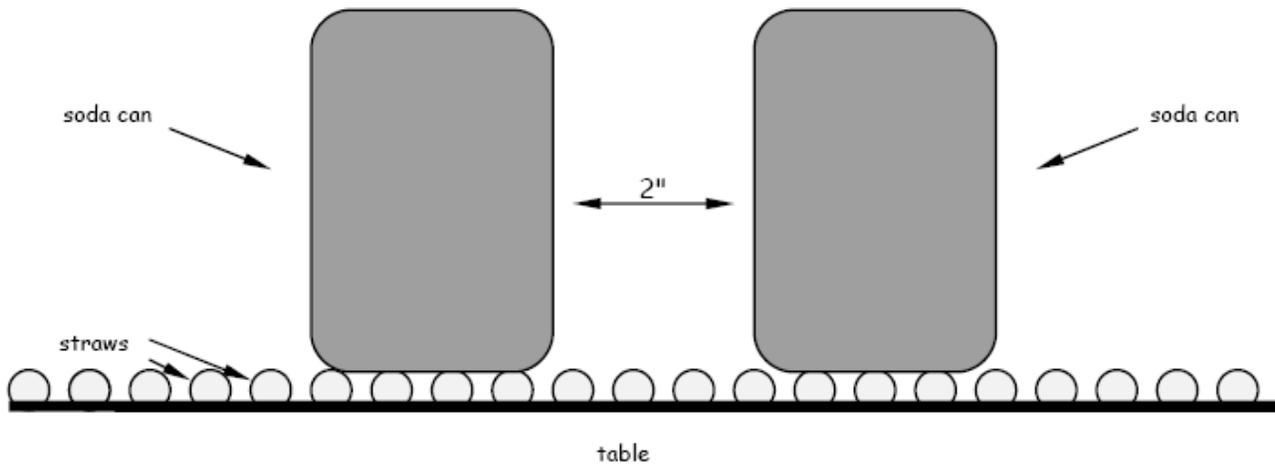
A. Warm-up

Review Bernoulli's Principle. Have students hold the short end of a strip of paper (4" x 11") at both corners. Students will hold the paper close to their mouths and blow forcefully across the top of the paper. The paper should lift.



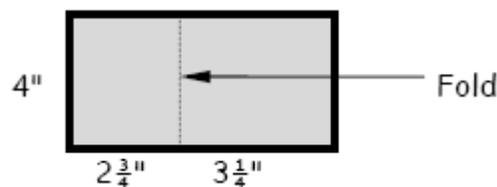
B. Activity I

1. Place 25 straws in a row on a tabletop, making sure the straws are very close together ($\frac{1}{4}$ " apart).
2. Place two soda cans on top of the straws approximately 2" apart. The cans will be free to roll.
3. Predict what will happen when air is blown between the cans.
4. Blow between the cans, using a straw to blow air through. Bernoulli's Principle should be demonstrated when the cans move closer together.
5. Record results.
6. Experiment changing the distances of straws and cans. Predict and record results.



C. Activity II: Making an Airfoil

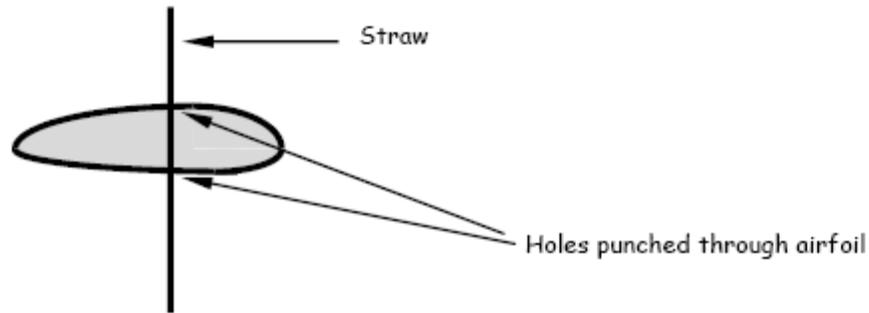
1. Review the concept of an airfoil (using information in background).
2. Fold a 4" x 6" index card in two, leaving an overlap of about $\frac{1}{2}$ ".



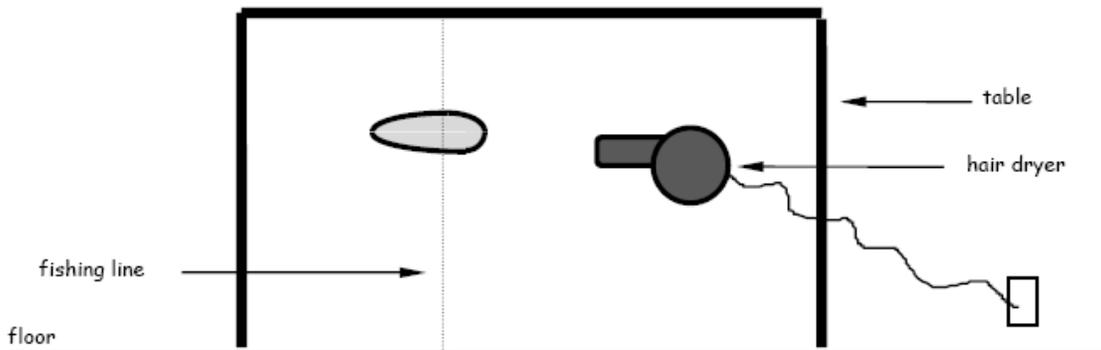
3. Push the overlapping ends together. One side of the folded index card will curve up.
4. Tape the ends together.



- Use a pen to punch 2 holes through the middle of the airfoil (one hole on the top and one on the bottom).
- Carefully push a drinking straw through the holes.



- Pull a piece of fishing line through the straw. Cut the fishing line long enough to fit between the underside of a table and the floor. Hold the fishing line in place, making sure it is perpendicular (90°) to the floor and table.
- Tape the fishing line in place between the table and floor. The airfoil should be able to slide freely up and down the line.
- Lift the wing up slightly and aim the hair dryer at the folded edge.
- Turn the dryer on. The wing should lift. Point the dryer straight for the best lift.



D. Activity III: Angle of Attack

- Using the airfoil set-up from Activity II, experiment with angle of attack by moving the string to an 80° angle rather than 90° angle. Turn hair dryer on. Observe results.
- Move string to 70° and 60° . Observe results.

Assessment/ Evaluation:

Students should be evaluated based on recordings of predictions and results of activities where applicable.



Extensions:

1. Change the size and shape of the airfoils in Activity II.
2. Turn the airfoil upside down and test it again in Activity II.
3. Try to move the hair dryer further away in Activity II.
4. Research Daniel Bernoulli's life and present a report to the class.

**Resources/
References:**

Hetzel, June, and Wyma, Brenda. *Flight*. Cypress, California: Creative Teaching Press, Inc., 1995.

Hixson, B.K. *Bernoulli's Book*. Salt Lake City: The Wild Goose Company, 1991.

Johnstone, Hugh. *Aircraft and Space Rockets*. New York: Gloucester Press, 1989.

Robson, Pam. *Air, Wind, & Flight*. New York: Gloucester Press, 1992.

Taylor, Kim. *Flight*. New York: John Wiley & Sons, Inc., 1992.

