Flight – Understanding Air Pressure and Air Flow
Lesson Plan

Grade Level: 6-8	**Curriculum Focus:** Forces and Gravity; Motion	**Lesson Duration:** Two class periods

Student Objectives

- An increased speed of airflow over a surface results in a decrease in air pressure over that surface.
- Air moves faster over a *cambered*, or arched, surface than over a flat surface.
- Together, these two facts explain how an airplane lifts into the air and stays in the air.

Materials

- Discovery School video on *unitedstreaming*: *Understanding Flight*
  Search for this video by using the video title (or a portion of it) as the keyword.

  Selected clips that support this lesson plan:
  - Getting up in the Air
  - Characteristics of Our Atmosphere
    - Air: The Substance We Fly In
    - Air Pressure
    - Air Flow

- Research materials on flight
- Computer with Internet access

For each group:

- Two sheets of paper
- Two empty soda cans
- Transparent drinking straw
- Scissors
- A cup of water

Procedures

1. Review with your students what they have learned about the principles of flight. Then let them know that they are about to perform a series of simple experiments that will demonstrate the principles that make it possible for an airplane to lift into the air and remain aloft.
2. Divide the class into groups, providing each group with the materials listed above.
3. Instruct the groups to perform the following brief experiments. Before each experiment, have group members predict the results.
    a) Hold two sheets of paper so that they are hanging vertically with their surfaces facing each other, close together in front of your mouth. Now blow in between the papers, and observe the result. (The sheets of paper will move closer together.)
    b) Lay two empty soda cans on their sides, parallel to each other, and fairly close together on a table or desk. Holding a drinking straw between the cans and parallel to them, blow through the straw. What happens to the cans? (They will move closer together.)
    c) Cut a transparent drinking straw into thirds and hold one segment upright in a cup of water, with the top of the straw segment above the surface of the water. Blow across the top of the straw and observe what happens to the water in the straw. (The water level will rise.)
4. Discuss with the class what they can infer from their experiments. Encourage them to offer reasons for their results. If necessary, explain that increased speed of airflow over a surface causes a decrease in air pressure over that surface. By blowing in between the sheets of paper, you decreased the air pressure between them. The same thing happened when you blew through the straw – the air pressure between the soda cans decreased. In both cases, the objects moved closer together; less pressure was pushing them apart. Likewise, because less pressure was holding the water down in the straw, the water level went up.
5. Continue the discussion by asking students to relate what they have learned to an explanation for how a plane lifts into the air. Remind students that a plane first gathers speed on the ground before it takes off. The speed of airflow increases *over* the wings, and this causes a decrease in pressure over the wings. This decrease in air pressure allows the plane to rise.
6. Finally, pose the following questions: "Why doesn't the increased speed of airflow *under* the wings cause an equal decrease in air pressure?" and, "Wouldn't the speed of airflow have to be faster *over* the wings than under to make the plane take off?" To help students answer this question, have them visualize the shape of an airplane wing. You might also ask them to visualize the shape of a bird's wing. They are both *cambered*, or arched upward.
7. Ask each group to write a brief explanation to the questions you have posed, accompanied by a labeled diagram. Provide them with the necessary research materials about flight. They should discover that air moves more quickly over an arched surface than over a flat surface. The speed of airflow is therefore faster over the wings of a plane (or bird) than under, causing a decrease in pressure over the wings, but not under them.

8. Challenge students with one more question: "What would happen if a plane stopped moving in midair?" Students should be able to infer that it would crash; a constant airflow over the wing is necessary to keep the plane aloft.

Discussion Questions

1. Discuss the impact flight has had on history and global development. Consider such areas as travel, defense, commerce, and information.
2. Discuss why humans have been obsessed with flight since our earliest history. Are aircraft today good enough to satisfy this obsession or do you think we will continue to try to fly like the birds do?
3. Discuss the idea of millions of people boarding aircraft and flying without having any idea of why the plane stays in the air. Does this seem reasonable? Are there other activities we take part in on a regular basis that we don't understand completely?
4. Discuss the idea of flying with almost total reliance on a computer system. Can you see advantages to this? Can you see any drawbacks? Describe how activities such as driving a car are becoming more and more automated. Are you willing to turn control over to a computer?
5. Discuss the importance of using experimental aircraft such as the Pathfinder to study our atmosphere, especially the stratosphere.
6. Discuss whether or not we can continue to push the envelope with technology and reduce the time of travel between different areas of our globe. How would our world be different without the ability to go long distances in very short periods of time?

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- 3 points: Student's explanation and diagram reflect accurate information clear wording; logical organization.
- 2 points: Student's explanation and diagram reflect adequate information; wording sometimes unclear; satisfactory organization.
- 1 point: Student's explanation and diagram some inaccurate information; some unclear wording; organization unsatisfactory.

Vocabulary

aerobatics

Definition: Spectacular stunts, such as rolls and loops, performed in an airplane or glider.

Context: Aerobatic planes are designed to fly upside down.

attitude

Definition: The orientation of an aircraft's axes relative to a reference line or plane, such as the horizon.

Context: You can fly the plane inverted almost in the same attitude with the same nose position as you can when you are upright.

camber

Definition: A slightly arched surface.

Context: By cambering the wing, like a bird's wing, you can create even more lift.

stratosphere

Definition: The region of the atmosphere above the troposphere and below the mesosphere.

Context: It flew five miles high on its first altitude test and in future flights it will climb even higher into the stratosphere.

Academic Standards

National Academy of Sciences

The National Science Education Standards provide guidelines for teaching science as well as a coherent vision of what it means to be scientifically literate for students in grades K-12. To view the standards, visit http://books.nap.edu.

This lesson plan addresses the following science standards:

- Physical Science: Motion and forces

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit http://www.mcrel.org/compendium/browse.asp.

This lesson plan addresses the following national standards:

- Science—Physical Science: Understands forces and motion.
- Science—Nature of Science: Understands the nature of scientific inquiry.
- Technology: Understands the nature of technological design.
- Technology: Understands the relationships among science, technology, society, and the individual.

Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- http://school.discovery.com/teachingtools/teachingtools.html