

1. Explain how the shape of airplanes, cars and boats can affect their speed.
2. Discuss the forces involved in the investigations with the ping-pong ball and hair dryer.
3. Discuss how a pilot controls the direction of an airplane by using flaps and rudders.

Follow-up Activities

- Ask students to draw an airplane. Using arrows, diagram the four forces involved in flight and how they pull or push on the plane.
- Have students replicate the investigations with the paper and the ping-pong ball and discuss why the ball stays afloat.
- Using patterns available on the Internet or in print, construct paper airplanes and refine them through flight tests. Challenge students to create a plane that is capable of the longest flight.
- In small groups, have students research the history of flight throughout the last one hundred years. Each student can choose a famous person involved in flight and write a biographical report to share with the class. Some possibilities are: Orville and Wilbur Wright, Amelia Earhart, Charles Lindbergh, Samuel Langley and Leonardo da Vinci.

Internet Resources

Periodically, Internet Resources are updated on our Web site at www.libraryvideo.com

www.aero.hq.nasa.gov/edu/

How Things Fly is a colorful, interactive site designed by NASA to help children understand the fundamentals of flight.

educate.si.edu/resources/lessons/siyc/flight/start.html

This Smithsonian Institution site contains a number of lessons and activities that do a great job of getting younger students to think about the basics of flight.

wings.avkids.com/Curriculum/Aerodynamics/drag_lift_summary.html

This site details an activity for younger elementary students that involves hands-on exploration of the aeronautic concepts of lift and drag. Many other "flight" lessons are described in detail as well.

Suggested Print Resources

- Cole, Joanna. *The Magic School Bus Taking Flight*. Scholastic Inc., New York, NY; 1997.
- Farndon, John. *Flight*. Marshall Cavendish Inc., Tarrytown, NY; 2001.
- Nahum, Andrew. *Eyewitness: Flying Machine*. DK Publishing, Inc., New York, NY; 2000.

TEACHER'S GUIDE CONSULTANT

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Physical Science

for Children™



All About Flight

Grades K-4

This guide is a supplement, designed for educators to use when presenting this program in an instructional setting.

Before Viewing: Research in learning suggests that it is important for the teacher to discover what the students know — or think they know — about a topic, at the start of a new unit, so that their accurate conceptions can be validated and reinforced, and their misconceptions identified and corrected. Therefore, after reviewing the pre-viewing discussion questions provided for your class, create a "Everything We Know About..." list. Preview key vocabulary words and have students raise additional questions they hope will be answered by this program. Most importantly, students should be told that as "science detectives" they must listen closely, so that after viewing the program, they will be able to tell whether or not the facts/beliefs they put on their list were scientifically accurate.

After Viewing: After a brief discussion about the program, challenge your "science detectives" to prove or disprove the accuracy of the facts they put on their "Everything We Know About..." list. Discuss what else they learned and use the follow-up questions and activities to inspire further discussion. Encourage students to research the topic further with the Internet and reading resources provided.

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Program Summary

People have always wanted to fly like birds and in the last one hundred years, we have discovered how to take to the skies. Airplanes are able to get off the ground and fly because we now know how to control the four forces involved in flight — gravity, lift, thrust and drag.

Gravity is the force that pulls everything down towards the Earth. In the 1600s, Sir Isaac Newton, an English scientist, was able to explain how this force pulls on everything. In order for an aircraft to get off the ground, it must first find a way to overcome the downward pull of gravity.

Lift is the force that can overcome gravity. Believe it or not, moving air is the key to lift. The wing of an aircraft, called an airfoil, is specially shaped with a round top and a flat bottom. The air traveling over the curved top of the airfoil travels faster than the air passing under the wing. Because faster-moving air does not push as hard against objects as slower-moving air does, the air under the wing pushes the plane up into the air. An investigation using a hair dryer and ping-pong ball demonstrates the force of lift.

In order to have enough lift to overcome gravity, planes must be able to move very quickly. Thrust is the force that pushes the aircraft forward. Propellers and jet engines are used to create thrust, which moves the aircraft at great speed so that lift can win the battle against gravity.

Of course, there is a force which battles against forward thrust. This force is called drag, and if you have ever put your hand out the window of a moving car, you have felt the force of drag. Also called wind resistance, drag pushes against the surfaces of the moving aircraft, slowing it down. The sleek shape of the aircraft helps to reduce the amount of wind resistance, so that thrust can win the battle against drag. Because we know how to balance all four forces involved in flight, people can fly!

Vocabulary

The following words are included for teacher reference or for use with students. They are listed in the order in which they appear in the show.

force — A push or a pull on an object, causing a change in motion.

gravity — The fundamental force of attraction between all objects. The more mass an object has, the greater the force of its gravity.

(Continued)

Sir Isaac Newton (1642–1727) — English scientist who studied gravity & other forces, and developed the Theory of Gravity.

lift — The force that opposes gravity, pushing or lifting an object upward and away from the Earth's surface.

airfoil — The special shape of an aircraft wing, with a rounded top surface and a flattened bottom surface.

thrust — The force from an airplane's engine that pushes the airplane forward and opposes the force of drag.

turbine — The spinning fan in the front of a jet engine which sucks air into the engine. When the air is pushed out the back at high speed, it creates thrust and the plane moves forward.

drag — Also called wind resistance, drag is the force of the air that presses against a moving object and slows it down. Drag opposes thrust.

rudder — The movable part of a plane's tail that helps steer the plane to the right or left. The force of drag air presses against the rudder and the plane turns in the direction the rudder is facing.

Pre-viewing Discussion

Before students generate their list of "Everything We Know About..." for this topic, stimulate and focus their thinking by raising these questions so that their list will better reflect the key ideas in this show:

1. How do heavy metal airplanes get off the ground?
2. Do birds and airplanes fly in the same way?

After the class has completed their "Everything We Know About..." list, and before watching the show, ask them what other questions they have that they hope will be answered during this program. Have students listen closely to learn if everything on their class list is accurate and to hear if any of their own questions are answered.

Focus Questions

You may wish to ask your class the following questions to assess their comprehension of key points presented in the program:

1. What is a force?
2. How is gravity a pulling force in your life? Give examples.
3. What did Sir Isaac Newton discover?

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4. How does the force of air affect us in the sky and on the ground?
5. How is an airfoil shaped?
6. How does the force of lift battle against the force of gravity to get an aircraft into the air?
7. Why does an airfoil's shape help create lift?
8. What force is needed for the air to move fast enough over the wings of the plane to cause lift?
9. What causes the force of thrust?
10. What kinds of things are used to create thrust?
11. How does the sail on a sailboat act like the wing on a plane?
12. What does the turbine in a jet engine do?
13. What are two names for the force which battles against the force of thrust?
14. How does the force of drag slow down planes, cars and boats?
15. How do we control the force of drag with an airplane's rudder?
16. How does a helicopter create lift without moving forward at a fast pace?
17. What controls the direction of a hot-air balloon?

Follow-up Discussion

The most important part of this segment is to examine both the facts and beliefs generated by the class in their "Everything We Know About..." list. Research indicates that students will retain their previous misconceptions — in preference to the new information — until they actively recognize and correct their own errors. Because of this, it is important to lead students to the correct ideas while identifying and correcting any misconceptions from the class list. After reviewing the list, encourage students to share the answers they got to the questions raised before viewing the program.

Raising a thought-provoking question is a good way to assess the overall depth of understanding. A couple of suggestions are listed below:

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