

- www.ag.ohio-state.edu/~flight/
Ohio State University presents "Science Fun With Airplanes," a detailed site with pages discussing the science behind flight, how to control an airplane and instructions on how to build an experimental glider.
- sln.fi.edu/flights/own2/forces.html
This site developed by the Franklin Institute contains hands-on activities that convey the scientific principles of flight as well as historical information about aviation.

Suggested Print Resources

- Dalton, Steven. *The Miracle of Flight*. Firefly Books, Toronto, ON, Canada; 1999.
- Dispezio, Michael. *Flying Things: Simple Experiments in the Science of Flight*. Dale Seymour Publications, Parsippany, NJ; 2000.
- Farndon, John. *Flight (Science Experiments)*. Benchmark Books, New Canaan, CT; 2001.
- Macaulay, David. *The New Way Things Work*. Houghton Mifflin Company, New York, NY; 1998.
- Richards, John. *Air and Flight*. Copper Beech Press, Brookfield, CT; 1999.

TEACHER'S GUIDE

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BASED ON THE BOOK BY
DAVID MACAULAY



Flight

Grades 3-6

Journey to Mammoth Island, a whimsical place where investigating scientific principles is always an adventure. Olive, a young girl, assisted by the Island's mammoth population and a visiting inventor helps the locals discover why and how machines work. Science facts are clearly demonstrated, giving kids an opportunity to see how important everyday machines are linked together by the science that drives them. Students come to see that science is a way of organizing information about the world, explaining why things work the way they do and allowing us to predict what might happen in new situations.

This guide provides a brief synopsis of the program, background on the science concepts presented, discussion topics, additional activities, vocabulary and suggested print and Internet resources.



Program Summary

In *Flight*, inhabitants of Mammoth Island attempt to use a trusty mammoth to deliver canvas awnings when a gust of wind forces the mammoth and his oddly shaped parcel up into the air! Islanders soon discover that the power of the wind is able to overcome the considerable weight of the mammoth, lifting it and the awning into the sky like a kite. As soon as the wind dies down, however, the mammoth returns to the earth with a crash.

The Islanders begin experimenting, wrapping the awning and returning it to the delivery mammoth to create a shape called an airfoil with a round top and a flat bottom. The wing of an aircraft also has this special shape. The air traveling over the curved top of the airfoil travels faster than the air passing under the wing. This lowers the air pressure above the airfoil, forcing it upwards. The force is called lift and opposes the force of gravity. Gravity is the force that pulls everything down towards the Earth.

The mammoth flies like a glider, which is the simplest kind of winged aircraft. A glider is pulled along the ground until it is moving fast enough for the force of lift generated by the wings to exceed the opposing force of its weight. The glider then rises into the air and flies.

Airplanes are able to get off the ground and fly because we know how to control the four forces involved in flight — gravity, lift, thrust and drag. 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. Thrust is the force that moves the airplane forward. Thrust has to overcome the force of drag, which is also called air resistance. The force of drag is caused by air rubbing against the plane, slowing it down. Balancing these forces allows us to harness the power of the air and take to the skies!

Glossary

The following words are included for teacher reference and for use with students to extend the subject matter in the show.

air pressure — The force of the air pushing on all things on Earth. Air pressure decreases with height because there are fewer air molecules pressing down from above.

air resistance — The force that slows down objects as they move through the air.

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

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.

elevator — The part on the tail of the plane that controls the airplane's nose, tilting it upward or downward.

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

friction — The force that opposes motion and slows things down.

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

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

power — A measure of how quickly work is done.

rudder — The movable part of a plane's tail that helps steer the plane to the right or left.

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

weight — A measurement of the force of gravity pulling down on an object.

Pre-viewing Discussion

- Ask students to explain how heavy metal airplanes fly.
- Explain that a force is a push or a pull on an object that causes a change in motion. Ask students to identify the forces involved in the flight of an airplane.
- How is an airplane's wing shaped? How does it help the airplane fly?
- What parts of an airplane allow it to fly?

Follow-up Questions & Activities

- How does the force of lift battle against the force of gravity to get an aircraft into the air?
- What is the difference between a glider and a jet airplane?
- What force opposes thrust?
- How does a pilot control the direction of an airplane?
- 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 possible subjects are: Orville and Wilbur Wright, Amelia Earhart, Charles Lindbergh, Samuel Langley and Leonardo da Vinci.
- Challenge students to design and build paper gliders and test them to determine which design flies the fastest and longest. Have them experimentally test a number of variables that may affect the flight. Some examples are: type or weight of paper, airplane design, placement of paper clips on the planes fuselage, amount of thrust, flap folds, etcetera.
- Encourage students to come up with ways to prove that air is a substance that has weight, and that changes in air pressure make flight possible.

Suggested 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. *(Continued)*