

- [www.oms.edu/visit/physics/air/](http://www.oms.edu/visit/physics/air/)  
"Air Travelers" is an introduction to the basic principles of buoyancy, properties of gases, temperature, and the technology involved in hot air ballooning. It contains detailed instructions for building a hot air balloon out of common household materials.
- <http://plabpc.csustan.edu/energy&matter/Summer2000/Density/Buoyancy/Buoyancy.htm>  
This site contains lessons and investigations designed for students studying the principles of density and buoyancy.

### Suggested Print Resources

- Brain, Marshall. *How Stuff Works*. John Wiley & Sons, Hoboken, NJ; 2001.
- Macaulay, David. *The New Way Things Work*. Houghton Mifflin, New York, NY; 1998.
- Stille, Darlene. *Blimps*. Children's Press, New York, NY; 1997.
- Zaunders, Bo. *Feathers, Flaps, and Flops: Fabulous Early Fliers*. Dutton Books, Boston, MA; 2001.



## Ballooning

### 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.

#### TEACHER'S GUIDE

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## Program Summary

In *Ballooning*, some of the inhabitants of Mammoth Island decide to explore the far side of a distant mountain ridge on a breezy spring day. Half way up the steep mountain trail, their trusty mammoth becomes afraid and winds up trapped on the mountainside. In order to save their hairy pet, Olive and Troy enlist the aid of the inventor to build a hot air balloon. Their plan involves using the balloon to float up the mountain, where they will harness the mammoth and carry him back to the village.

In order to rise into the air, a balloon must become lighter than the air around it — the air that it is displacing. Air is made of molecules that are moving around at incredible speeds, and the higher the temperature, the faster the molecules are moving. When the air inside a balloon is heated, the molecules speed up, which means they push harder against their surroundings and take up more room. This is known as expansion. As the air expands, some of the molecules leak out of the bottom of the balloon and, because there's less air inside it, the overall weight of the balloon is less, too! A force called buoyant force is now pushing the balloon up. When the buoyant force is equal to the weight of the balloon and its occupants, the balloon stops rising.

An airship is like a hot air balloon in some ways, but very different from it in others. Balloons simply follow the direction of the winds. In contrast, airships are powered and have some means of controlling their direction, usually with rudders. Airships often use a lifting gas like helium to become lighter than air and are propelled forward by an engine.

## Glossary

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

**airship** — Also called a dirigible or blimp, an aircraft that derives its lift from helium or hot air while it is propelled forward by an engine.

**atmosphere** — All the air surrounding the earth, from the ground all the way up to the edge of deep space.

**ballonets** — Air bags inside the envelope of a dirigible which regulate the internal pressure. Air is squeezed out of the ballonets as the gas expands with increasing altitude, and is forced back in again as the helium contracts when the airship descends.

**buoyancy** — The tendency of a body or object to float or rise when placed in a liquid.

**buoyant force** — The upward force exerted by a fluid on an object in it, giving the object the ability to float.

**buoyancy** — The ability to float.

**density** — The relationship between a material's mass and its volume.

**effort** — The force applied to get work done.

**energy** — The ability to do work.

**envelope** — The primary structure of an airship containing the helium gas and the ballonets.

**float** — To sit at or above the surface of a liquid. When buoyant force overcomes gravity, an object will float.

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**floatation** — The act of resting on the surface of a liquid or being suspended in it.

**force** — A push or a pull on an object that causes 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.

**helium** — An extremely light gas that is often used to provide lift for balloons and airships.

**lift** — The force that gives a balloon the ability to rise in the air.

**mass** — The amount of matter that is contained in an object. The more mass an object has, the greater its weight.

**work** — To move or change something. Doing work takes energy. When you use force to make something move, you are doing work.

**volume** — The amount of space taken up by a given mass.

## Pre-viewing Discussion

- Discuss the fact that air is made of particles that are moving and that adding heat energy makes the particles move faster.
- Why is it that some things float and others do not?
- How do you steer hot air balloons?
- What is a blimp? How does it fly?
- What does density have to do with the ability to float?

## Follow-up Questions & Activities

- Have students observe as you put a balloon around the neck of the bottle and heat the bottle. Ask them to explain what happens to the balloon. Then cool the balloon and have them explain their observations.
- Ask students to describe how the force of buoyancy allows a hot air balloon to rise into the air and how its descent is controlled.
- Challenge small groups of students to design and build hot air balloons using common items like hairdryers and plastic bags of different sizes. Then have an outdoor rally!
- Have students research the history of ballooning, from the first flight in 1783 through the most recent record-setting journeys.

## Suggested Internet Resources

Periodically, Internet Resources are updated on our Web site at [www.LibraryVideo.com](http://www.LibraryVideo.com)

- [www.fi.edu/wright/again/wings.avkids.com/wings.avkids.com/Book/History/beginner/balloon-01.html](http://www.fi.edu/wright/again/wings.avkids.com/wings.avkids.com/Book/History/beginner/balloon-01.html)  
The Franklin Institute Online lets students see some of the pioneers involved in ballooning.
- [www.balloonzone.com/](http://www.balloonzone.com/)  
Balloon Zone is a place for kids to read the history of modern ballooning and unravel the mysteries behind balloon construction.

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