- **www.mos.org/sln/Leonardo/InventorsToolbox.html**
  This site includes pages about simple machines along with illustrations.
- **howthingswork.virginia.edu/**
  Students can use the topical index on this site to find many answers to their questions about simple machines and how they work.

Suggested Print Resources

- Farndon, John. *Science Experiments: Levers, Wheels, and Pulleys.* Benchmark Books, Tarrytown, NY; 2001.
- Kassinger, Ruth. *Reinvent the Wheel.* John Wiley & Sons, New York, NY; 2001.
- Macaulay, David. *The New Way Things Work.* Houghton Mifflin, New York, NY; 1998.
- Sylvester, Doug. *Magnificent Machines: Levers, Pulleys, Wheels And Other Stuff.* Rainbow Horizons Publishing, San Diego, CA; 1999.
- Walker, Sally. *Wheels and Axles.* Lerner Publications, Minneapolis, MN; 2001.
- Wilson, Anthony. *Visual Timeline of Transportation: From the First Wheeled Chariots to Helicopters and Hovercraft.* Dorling Kindersley, New York, NY; 1995.

TEACHER'S GUIDE

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TEACHER'S GUIDE

BASED ON THE BOOK BY
DAVID MACAULAY

THE WAY THINGS WORK

Wheels & Axles

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.

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Program Summary

Most tools of today look different from those of the past, but they are just modifications and combinations of very ancient tools called simple machines. We are surrounded by simple machines that make our lives easier by helping to get a job done with less effort. Simple machines have very few moving parts, or no moving parts at all. They enable us to use less effort to push or pull an object, and they can be found almost anywhere work is being done. Machines do not increase the amount of force applied, they just use the force in a way to get the job done more easily. When simple machines are combined they create useful compound machines.

In *Wheels and Axles*, inhabitants of Mammoth Island have decided to use the concept of a wheel and axle to create a machine that will help them dry their mammoths. The wheel and axle is a simple machine that makes work easier by changing the effort force needed to move an object. Slightly turning the axle of the mammoth dryer makes the feather wheel spin a greater distance, causing the generation of a breeze.

There are many examples of how a wheel and axle can be used to make all kinds of work easier. A screwdriver functions as a force multiplier because the handle (the wheel) is much larger than the blade (the axle). When you apply force to turn the handle, the distance and speed traveled by the blade is decreased, but the force is increased, making it easier to drive a screw. Steering wheels and doorknobs are other examples of this type of simple machine. On the other hand, a wheel and axle can also be a speed multiplier if you apply a force to the smaller axle instead of to the wheel. The force of the axle translates to a much faster movement of the wheel rim. This is the basis of the Islanders' feather wheel created to dry their bathed mammoths.

The wheel is one of the greatest inventions of all time, making work much easier for humans over the centuries. It is hard to look around and not see examples of this simple machine in our lives! Waterwheels, windmills, turbines and doorknobs are all based on the wheel and axle.

Glossary

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

effort — The force applied to get work done.

energy — The ability to do work.

force — A push or a pull on an object that causes a change in motion.

wheel and axle — A simple machine consisting of a small circle (the axle) within a larger circle (the wheel). The wheel and axle acts as a rotating lever, changing the amount of force. As it rotates, the wheel moves a greater distance than the axle but with less force.

machine — Any device that helps you do work.

mechanical advantage — The number of times a simple machine multiplies the effort force.

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power — A measure of how quickly work is done.

simple machines — Devices with few moving parts that can be used to reduce the amont of effort needed to do work. The six basic simple machines are the lever, the wheel and axle, the pulley, the inclined plane, the wedge and the screw.

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

Pre-viewing Discussion

- Ask students to define "work" and explain how work gets done.
- Explain that force is a push or a pull on an object. Use a small force to push open the classroom door, then illustrate that a larger force would push the door open even more. Ask students to come up with other examples of forces (pushes or pulls) that will move objects in the classroom.
- What is the difference between a simple machine and a complex machine?
- What are some uses for wheels?
- What do you think the first simple machine was?
- How does a wheel and axle work as a simple machine?

Follow-up Questions & Activities

- What kinds of tasks involve the use of simple machines? Have the class make a list of all the inventions that they encounter in the course of a week. After going over the list, have students write a story describing a day without the help of simple machines. Ask them what invention they would miss the most if it disappeared.
- Challenge small groups of students to research and report on the history of inventions such as windmills and waterwheels.
- Ask students to predict the effect of wheel size on the speed of a vehicle, and then design an investigation to determine if their prediction was correct.
- Create a "Simple Machine Museum." Ask students to bring in toys, tools, devices or photographs of things that demonstrate simple machines in action. Ask them to be ready to explain the way these simple machines work. When appropriate, have them disassemble some common tools or toys and list all the different components in an "Inventor's Journal".

Suggested Internet Resources

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

- **www.energyquest.ca.gov/projects/waterenergy.html**
  This site contains information about the power of water as well as plans to create a turbine and a water wheel.
- **www.fi.edu/qa97/spotlight3/spotlight3.html**
  The Franklin Institute Online presents information on simple machines.

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