- **www.glenbrook.k12.il.us/gbssci/phys/Class/energy/u5l1d.html**
  This physics tutorial site may be useful for some middle-school students. Energy concepts are defined clearly with understandable examples.

Suggested Print Resources

- Brain, Marshall. *How Stuff Works.* John Wiley & Sons, Hoboken, NJ; 2001.
- Doherty, Paul, Dan Rathjen and the Exploratorium Teacher Institute. *The Spinning Blackboard and Other Dynamic Experiments on Force and Motion.* Wiley, New York, NY; 1996.
- Eichelberger, Barbara. *Constructions for Children.* Dale Seymour Publications, Upper Saddle River, NJ; 2001.
- Lafferty, Peter. *Eyewitness Books: Force & Motion.* DK Publishing, New York, NY; 2000.
- Macaulay, David. *The New Way Things Work.* Houghton Mifflin, New York, NY; 1998.

TEACHER'S GUIDE

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TEACHER'S GUIDE

Springs

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 simply modifications and combinations of very ancient tools called simple machines. We are surrounded by machines that make our lives easier by helping to get a job done with less effort. They enable us to use less effort to push or pull an object, and they can be found almost anywhere work is being done.

In *Springs*, a visiting inventor observes a family working together to harvest coconuts on Mammoth Island. They are using a number of devices called springs. Springs come in two shapes. There are coil springs, and there are bending bars — called "leaf springs" — which is what Troy uses. When a spring is bent, the molecules on one side are pushed together while the molecules on the other side are pulled apart. So once the bending force is removed, the molecules rapidly spring back into their natural places. Springs store potential energy when they are stretched or compressed. This stored energy is transferred to the energy of motion when coconuts go flying through the air!

Potential energy is stored energy, or energy waiting to be transferred into kinetic energy, also called the energy of motion. If work is done on an object without any outside force involved, the total mechanical energy — the sum of the kinetic and gravitational potential energy — remains constant. When using a bow and arrow, the more you pull back on the bow, the greater the potential energy. When the arrow is released, the distance it travels will depend upon the amount of work that was done on the bowstring; in other words, the potential energy it was given by your pull. The greater the pull on the bow, the greater the kinetic energy of the moving arrow and the distance the arrow can travel.

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 make things happen or to do work.

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

kinetic energy — Energy that is active or moving.

matter — Any substance that takes up space. Matter is made of small particles called atoms, and can be in the form of a solid, liquid, gas or plasma.

potential energy — Energy that is stored or waiting to be used.

power — A measure of how quickly work is done.

spring — A device that stores potential energy when compressed or stretched. This energy can the be converted to kinetic energy.

machine — Any device that helps you do work.

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

work — To move or change something. Work is force acting over distance to move an object. Work involves the transfer of energy from one place to another.

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.
- Explain how energy can be stored in a spring or a rubber band, and how this energy can change form.

Follow-up Questions & Activities

- Ask students to give an example of an energy transfer from potential to kinetic energy.
- Challenge students to design a device that will demonstrate an energy-transfer system chain reaction. They may work in small groups or individually and be given size specifications. Participants may use string, pulleys, weights, rings, rulers, springs, elastic bands and any variety of building materials for their "chain-reaction" inventions.
- Using a variety of supplies, have students create "kinetic" three-dimensional sculptures. One part of each sculpture must move as a result of putting energy to work.
- Understanding the relationship between potential and kinetic energy helps us to gather information about the world around us. Using marbles and ramps of differing sizes, have students discover the fact that the higher and heavier an object is, the greater its potential energy. (This is called gravitational potential energy, calculated by multiplying an object's weight by its height of position.) If two objects of different weights are about to be dropped from the same height, the heavier one has greater potential energy. Accordingly, when they are dropped, the heavier one has greater kinetic energy. If two marbles are rolled down a ramp from the same height toward a container, the heavier marble will move the container farther than the lighter one. However, raise the lighter marble higher on the ramp, and it will move the container just as far.

Suggested Internet Resources

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

- **www.fi.edu/guide/hughes/10types/typesspring.html**
  This site elaborates on the energy stored in springs. It also has a link to some interesting information on trampolines.
- **askeric.org/cgi-bin/printlessons.cgi/Virtual/Lessons/Science/Physical/PHY0067.html**
  This page provides a fun, hands-on activity that reflects inquiry-based learning strategies. Students create "spool racers" to investigate the relationship between potential and kinetic energy.

(Continued)