

## 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.
- Tocci, Salvatore. *Experiments With Heat*. Scholastic Library Publishing, New York, NY; 2003.
- Sproule, Anna. *James Watt: Master of the Steam Engine (Giants of Science)*. Blackbirch Press, Woodbridge, CT; 2001.
- White, Larry. *Energy: Simple Experiments for Young Scientists*. Millbrook Press, Brookfield, CT; 1996.
- Wood, Robert W. *Heat FUNDamentals: FUNtastic Science Experiments for Kids*. McGraw Hill, New York, NY; 1997.



## Steam Power

### 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 *Steam Power*, two young Islanders, Olive and Troy, enlist the help of a visiting inventor to build a machine that will make the rides at the amusement park much more exciting. They decide to build a steam engine! A steam engine is a device that converts heat energy to mechanical energy.

In Olive's first design, fuel was used to heat water. As the water turned to steam, it expanded and the pressure increased, creating a force that pushed a piston along a hollowed out cylinder. Then cold water was splashed on the cylinder, condensing the steam and lowering the pressure, so the air pressure outside pushed the piston down again. Finally, a crankshaft was attached to the piston, making the engine a source of continuous rotating force. This early model was very inefficient. The cylinder (where the piston was) had to be heated when steam was admitted, and then gradually cooled again to condense the steam. This wasted a lot of time and fuel. While this machine successfully provided some power to turn the amusement rides, Olive realized all this heating and cooling was far from efficient.

Olive hit upon the idea of condensing the steam in a separate vessel. This removed the need for heating and cooling, making the engine faster, safer, and more fuel-efficient. The Islanders worked hard and built a double-acting steam engine in which the steam would be shot onto alternate sides of the piston, pushing the piston one way, and then pushing it back the other. This engine wasted much less heat and got much more power out of the fuel it used. There was just one fatal flaw in Olive's new engine, and that was the strength of the boiling tank itself. It just couldn't stand the high pressure that the expanding steam exerted on it. After a minor disaster, Olive devised some major improvements that made her steam engine much safer. The Islanders soon discovered that their steam engines were useful in many ways — like powering locomotives, water pumps and a brand new roller coaster!

## Glossary

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

**condensation** — The process of a gas changing to its liquid form when heat energy is removed.

**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.

**machine** — Any device that helps you do work. Machines do not increase the amount of force applied, they just use the force in a way to get the job done more easily.

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

**power** — A measure of how quickly work is done.

**pressure** — The force of molecules pushing on every surface area they come in contact with.

**steam** — Heated water often used for energy in machines. When molecules are heated, they gain a higher energy of motion and are able to push out with more force.

*(Continued)*

**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. How do machines make work easier?
- What kinds of machines use steam power?
- What is energy? How do machines use energy?
- Describe heat energy in terms of atoms and molecules. What happens as atoms move or vibrate at a faster pace?

## Follow-up Questions & Activities

- In small groups, have students brainstorm a list of the many ways we use energy in our everyday lives. Using a roll of adding machine paper, have your class create a running list of different examples of energy use. Challenge each group to see how long a roll they can create. Post them.
- Have students research and report on one of the many inventors involved in the design and improvement of steam engines. Some possible subjects include Hero of Alexandria, James Watt, Elijah McCoy, Thomas Newcomen, and Robert Fulton. A good Web resource for younger students interested in inventors is [www.enchantedlearning.com/inventors](http://www.enchantedlearning.com/inventors).
- Challenge students to design new steam-powered machines to make a particular job easier. Ask them to make sketches of their inventions and write short summaries of what their machines will use for energy and how they will work.

## Suggested Internet Resources

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

- [www.energyquest.ca.gov/projects/steamboat.html](http://www.energyquest.ca.gov/projects/steamboat.html)  
This page from Energy Quest contains detailed instructions for building a steam-powered model boat and quickly explains the science behind what's happening.
- [www.energy.gov/kidz/](http://www.energy.gov/kidz/)  
The “Energy Smart” site contains teacher guides, worksheets and other downloadable resources for teaching energy concepts in elementary school classrooms.
- [www.scitoys.com/scitoys/thermo/thermo.html](http://www.scitoys.com/scitoys/thermo/thermo.html)  
This site contains clear explanations of why heat engines are so useful, along with detailed instructions for educators on how to build simple engines.
- [www.howstuffworks.com/steam.htm](http://www.howstuffworks.com/steam.htm)  
Students can use the topical index on this site to find many answers to their questions about steam engines and how they work.