

- spacelink.nasa.gov/products/Rockets
This online guide developed by NASA contains a number of great activities, including "3, 2, 1 Pop," an excellent demonstration of how a rocket works.
- www.howstuffworks.com/engine.htm
Students can use the topical index on this site to find many answers to their questions about different engines and how they work.
- www.scitoys.com/scitoys/scitoys/thermo/thermo.html#thermodynamics
This online science text contains directions for making a number of simple engines with adult supervision.

Suggested Print Resources

- Brain, Marshall. *How Stuff Works*. John Wiley & Sons, Hoboken, NJ; 2001.
- 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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Engines

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

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 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 *Engines*, inhabitants of Mammoth Island try to speed up pizza delivery by experimenting with heat engines. There are many kinds of heat engines. The rocket is the simplest one. It burns solid fuel in a combustion chamber, and the hot gases produced expand greatly and rush from an opening at the bottom, driving the rocket up into the air. Sir Isaac Newton described the principles of rocket science in three laws of motion. His third law of motion states that every action has an equal and opposite reaction.

Turbofan jet engines, which power big airliners, basically suck air into the front and shoot it out the back. A large rotating fan drives air into a compressor, which squeezes the air. This compressed air is forced into the combustion chamber. Burning fuel in the combustion chamber heats the air, which expands and rushes towards the exhaust. A great volume of air speeds from the engine, driving the aircraft forward with tremendous force. The advantage of a jet engine over a rocket is that it does not need to carry its own oxygen supply — thus saving weight. Its disadvantage is that it will not work in space, where there is no atmosphere.

The gasoline engine is another type of (internal) combustion engine that converts heat into power to move the wheels of a car. Here, a series of pistons are attached to a single crankshaft. Another liquid fuel, gasoline, is mixed with air, sprayed into the cylinder and compressed by the piston. The air/gasoline mixture is ignited by a spark and the resulting explosion pushes a piston down. The exhaust is cleared as the piston rises again, and the cycle repeats itself, over and over again.

Glossary

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

combustion chamber — The part of the engine where air is mixed with fuel and ignited, producing a stream of hot gas that releases its energy to the turbine and nozzle sections of the engine.

compressor — A fan or a pump that squeezes air and pushes it forward to the combustion chamber. The compressor is the first component in an engine core.

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.

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

Newton's Third Law of Motion — The physical law that states that for every action, there is an equal and opposite reaction. When a rocket expels fuel or propellant out of its engine, the rocket moves in the opposite direction. The propellant comes out of the engine. This is the action. The rocket lifts off the launch pad in the opposite direction. This is the reaction.

power — A measure of how quickly work is done.

turbine — A spinning section of the engine that is usually made with a series of curved blades on a central rotating spindle. The air rushes through the turbine and provides power.

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 types of energy can be used to do work?
- What is the difference between a simple machine and a complex machine?
- What are some uses for engines?
- How does a rocket work?

Follow-up Questions & Activities

- Have students construct and launch paper rockets, and use graphs and non-standard measurement to show how far the rockets travel. Talk about safety rules during a real rocket launch. Have interested students research model rockets and build their own.
- Discuss the differences between a solid and a liquid. Encourage students to generate a list of the characteristics of a solid and a separate list of the characteristics of a liquid.

Suggested Internet Resources

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

- kids.msfc.nasa.gov/Rockets/Shuttle-Pics.asp
The NASA Kids Website contains images of recent shuttle launches along with a wealth of information about the space program.
- www.fi.edu/wright/again/wings.avkids.com/wings.avkids.com/Tours/Engine/
The Franklin Institute Online lets students see inside a jet engine.

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