- Students can create a "Mechanical Energy Museum" by bringing in a number of toys and simple tools or devices (wind-up and battery-operated) for display in the classroom. Have pairs of students analyze how a toy/device uses mechanical energy (both kinetic and/or potential). They should then present their ideas to the group.
- Have interested students research the concept of "mechanical advantage" in machines. Ask them to explain to the other students how the amount of required mechanical energy can be decreased with the use of simple machines.
- Using different-sized marbles and ramps of varying heights, have students investigate the relationship between kinetic and potential energy. (See ericir.syr.edu/Virtual/Lessons/Science/Physical/PHY0036.html for guidelines for this activity.)

## Suggested Internet Resources

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

- **sln.fi.edu/tfi/units/energy/windguide.html**
  These pages titled "Investigating Wind Energy" from The Franklin Institute Science Museum focus on building machines that harness the mechanical energy of the wind in order to do work.
- **www.glenbrook.k12.il.us/gbssci/phys/Class/energy/u5l1d.html**
  This high school physics tutorial site may be useful for older middle-school students. Energy concepts are defined clearly with understandable examples.
- **www.miamisci.org/af/sln/mummy/raceways.html**
  The Miami Museum of Science presents "The Atoms Family" energy Web site. "The Mummy's Tomb" pages feature a number of activities that explore mechanical energy.

## Suggested Print Resources


- Macaulay, D. *The New Way Things Work.* Houghton Mifflin Co., New York, NY: 1998.
- Morgan, Sally. *Using Energy: Designs in Science.* Facts on File, New York, NY; 1994.
- St. Andre, Ralph. *Simple Machines Made Simple.* Teacher Ideas Press, Englewood, CO; 1994.
- Weise, Jim. *Roller Coaster Science.* John Wiley & Sons, New York; NY; 1994.




TEACHER'S GUIDE


**TEACHER'S GUIDE CONSULTANT**

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**TITLES**

- ELECTROMAGNETIC ENERGY
- ENERGY: POTENTIAL & KINETIC
- ENERGY RESOURCES: USE & CONSERVATION
- HEAT & CHEMICAL ENERGY
- MECHANICAL ENERGY
- NUCLEAR ENERGY
- THE TRANSFER OF ENERGY



TEACHER'S GUIDE

ENERGY IN ACTION™

# Mechanical Energy

## Grades 5–8

Students in grade 5-8 classrooms possess a wide range of background knowledge. Student response to this video program is sure to be varied, so the teachers at these grades need all the help they can get! This guide has been designed to help the 5-8 science teacher by providing a brief synopsis of the program, previewing and follow-up questions, activities, vocabulary and additional resources.

**Before Viewing:** Extensive research tells how important it is for the teacher to discover what the students know — or think they know — about a topic, before actually starting a new unit. Therefore, after prompting discussion with the pre-viewing questions, lead your class to create an "Everything We Think We Know About…" list. You may also wish to preview key vocabulary words, and have students raise additional questions they hope will be answered.

**After Viewing:** Have your students share video excerpts that fascinated or surprised them, then challenge your students to prove or disprove the accuracy of the facts they put on their "Everything We Think We Know About…" list. Discuss what else they learned and use the follow-up questions and activities to inspire further discussion. Encourage students to research the topic further with the Internet and reading resources provided.

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## Program Summary

Everything in the universe is made up of matter. Energy is what allows us to move or change matter. Whenever energy is used to move or change things, work is done. Work can be done with mechanical energy, which is energy possessed by an object because of its motion or the stored energy of its position. When that mechanical energy is moving, it is called kinetic energy. Everything that is in motion has kinetic energy and has the ability to move or change other things.

When energy is stored in an object because of its position, it is called potential energy. A stretched rubber band has potential energy and can spring into action when released. A roller coaster at the top of the track has the potential to go roaring down the tracks at a high speed. As an object's kinetic energy increases, its potential energy decreases and vice-versa. A swing, at its highest point, has the greatest potential energy, while its kinetic energy is at its lowest. As it moves to its lowest point, kinetic energy increases while potential energy decreases. Energy is continually passing back and forth between these two states.

One of the most useful facts about energy is that it can also change from one form to another. These changes are happening all the time. Sound is a form of mechanical energy that moves in waves through matter. Most machines transfer energy from one form into another in order to do work. At a wind farm, the blades of a windmill are moved by the mechanical energy of the wind and generate electrical energy. Chemical energy from the food we eat is transferred to mechanical energy for action. Similarly, the chemical energy in gasoline is converted to mechanical energy to operate vehicles and tools. Simple machines, such as the lever and the inclined plane, help make work easier. When two or more simple machines are combined, they make complex machines that are able to transfer mechanical energy and make doing work a lot easier!

## Vocabulary

The following words are included for teacher reference or for use with students. They are listed in the order in which they appear in the video.

**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.

**energy —** The ability to make things happen or to do work. Energy may exist in potential, kinetic, thermal, electrical, chemical, nuclear or other various forms.

**work —** To move or change something. Doing work takes energy.

**mechanical energy —** The total energy of an object due to its motion and its position.

**kinetic energy —** Energy possessed by an object due to its motion.

**motion —** A change in the speed or position of an object relative to the things around them.

*(Continued)*



**force —** A push or a pull on an object, causing a change in motion.

**potential energy —** Stored energy that is due to an object's position. Potential energy can be stored in an object due to its position as well as in the chemical bonds of the molecules that make up the object.

**sound —** Mechanical energy that travels from one object to another as a vibration.

**chemical energy —** The energy that is stored in the molecules of a substance.

**internal combustion engine —** The form of engine invented for cars and other vehicles, run by gasoline, which contains potential chemical energy.

**Gottlieb Daimler —** (1834-1900) The German inventor and mechanical engineer who developed an engine that could be fueled with gasoline.

## Pre-viewing Discussion

Before students generate their list of "Everything We Think We Know About…" for this topic, stimulate and focus their thinking by raising these questions so that their list will better reflect the key ideas in this show:

- What is energy?
- What things require energy?
- Where does energy come from?
- How does energy travel from one object to another?

After the class has completed their "Everything We Think We Know About…" list, ask them what other questions they have that they hope will be answered during this program. Have students listen closely to learn if everything on their class list is accurate and to hear if any of their own questions are answered.

## Focus Questions

1. What are matter, energy and work? How are they related?
2. What is mechanical energy?
3. What is kinetic energy? When does matter possess kinetic energy?
4. If something is not in motion, can it still possess mechanical energy? Justify your answer.
5. Define potential energy and provide several examples.
6. Give an example of a transfer of potential energy to kinetic energy.
7. When does a wrecking ball used to smash buildings have the greatest potential energy? When does it have the greatest kinetic energy?
8. Does energy ever disappear? Explain your answer.
9. A basic law of science is that energy cannot be created or destroyed; it just changes form. Using the example of a pendulum, explain what that means.

*(Continued)*



10. Explain how sound can be considered to be mechanical energy.
11. In what ways is mechanical energy used to generate other forms of energy?
12. How is mechanical energy generated by other forms of energy?
13. How does food generate mechanical energy?
14. How did Gottlieb Daimler influence the way that the world uses energy?
15. How does an engine transfer energy to do work?
16. What forms of energy are involved in a moving automobile going uphill?
17. What are some examples of simple machines?
18. How do simple machines, such as the inclined plane, the lever and the wheel and axle make work easier?

## Follow-up Discussion

Research indicates that students will retain their previous misconceptions about a topic, in preference to new information, until they actively recognize and correct their own errors. Therefore, it is important to have your students re-examine the facts/beliefs they put on their "Everything We Think We Know About…" list. It might also be helpful to review the list by marking each entry with a "+" or "-" to show which facts were correct and which were incorrect.

Discussions that ensue from thought-provoking discussions provide a good way to assess the overall depth of student understanding. The following are some suggested discussion topics.

- Give examples of how mechanical energy is harnessed to do work.
- Explain what kind of energy is possessed by a drawn bow, a book resting high on a shelf and a moving car.
- Describe how the kinetic energy of a moving ball is changed into other forms of energy when it hits a surface and bounces.
- Discuss why it takes more energy to stop a rolling boulder than a rolling basketball.

## Follow-up Activities

- 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.

*(Continued)*