Follow-up Activities

- Have students investigate potential and kinetic energy as they relate to a moving pendulum. Ask them to find ways to increase the kinetic energy of the bob at the end of the pendulum. Is it possible to increase the kinetic energy without increasing the potential energy? Ask them to determine when the pendulum has the most potential energy and the most kinetic energy.
- Have students work in groups to develop their own energy transfer machines using common supplies.
- Assign each student a specific type of energy to research (chemical, electrical, wind, water, light, sound, etc.) and have them discover how it is transformed to other forms of energy.
- Ask students to research how the transfer of energy throughout the atmosphere is responsible for our weather.
- Have students create an "Energy Web" that illustrates the transfer of energy from organism to organism throughout a natural ecosystem.

Suggested Internet Resources

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

- **www.energy.ca.gov/education/story/story-html/chapter01.html**
  "The Energy Story" from the Energy Quest Web site defines energy and offers many concrete examples of how energy changes from one form to another.
- **www.eia.doe.gov/kids/renew/solar.html**
  This site from the Department of Energy gives a detailed overview of how the sun's energy can be converted into other forms of energy.
- **www.learner.org/exhibits/parkphysics/index.html**
  This "Amusement Park Physics" page explains how roller coasters use kinetic and potential energy. On this site, students are able to use this information to investigate energy transfers and design their own roller coaster.

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Suggested Print Resources

- Charman, Andrew. *Energy*. Watts, Danbury, CT; 1993.
- DiSpezio, Michael. *Awesome Experiments in Force and Motion.* Sterling, New York, NY; 1999.
- Gutnik, Martin and Natalie Browne-Gutnik. *Projects That Explore Energy*. Millbrook Press, Brookfield, CT; 1994.
- Ward, Alan. *Forces and Energy*. Watts Publishing, Danbury, CT; 1992.

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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**

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TEACHER'S GUIDE

ENERGY IN ACTION™

The Transfer of 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

We need energy to live and move around, and machines need energy in order to function. Whenever work is done, energy is transferred from one object to another. But what exactly is energy? Energy takes a lot of different forms, like heat, light and sound, as well as the chemical energy stored in food and the mechanical energy of moving objects.

In 1905, physicist Dr. Albert Einstein formulated the Law of Conservation of Mass and Energy, which basically states that energy cannot be created or destroyed — it just changes form. In other words, whenever the amount of energy in one place decreases, the energy in another place increases by an equal amount. This energy is transferred continually from one object to another and can be converted from one form to another along the way.

When an object like a bowling ball is moving down a lane, it possesses kinetic energy that can be transferred to the bowling pins, knocking them down. Where does this moving energy come from? It is transferred from the person rolling the ball. Stored chemical energy from food eaten by the bowler is converted into moving mechanical energy, enabling a bowler to do the work of lifting and swinging the bowling ball. Any stored energy waiting to be used is called potential energy. A boulder resting on top of a cliff has potential energy. The moment the boulder starts to fall, the potential energy in that rock decreases and the amount of kinetic energy increases. Though the energy is changed or transferred, the total amount of energy stays the same.

Light energy from the sun is transferred in a variety of ways, providing the Earth with light, heat and other forms of energy. Plants are able to store energy from the sun through photosynthesis, the process of using the sunlight to make sugar. The sugar that is made is stored as chemical energy in the leaves, stems and roots of plants. When humans and other animals eat plants, the potential energy is released and absorbed by their cells. Some of the chemical energy from food sources is converted to heat energy to help us warm our bodies and some is converted to mechanical energy that helps us get work done when we transfer that energy to other objects.

The burning of fossil fuels is another example of energy transfer. Fossil fuels contain chemical energy from ancient plants and animals. When burned, fossil fuels release that potential energy, turning it into heat and light energy. This energy is sometimes transferred in power plants to create electrical energy. When we turn on a light bulb, electrical energy is transferred and released as both heat and light. Heat energy can be transferred in a number of ways; through conduction, convection and radiation.

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.

energy transfer — The flow of energy through matter. Energy can be transferred in many ways.

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

potential energy — Stored energy that is due to an object's position.

The Law of Conservation of Mass and Energy — A law of physics, formulated in 1905 by Albert Einstein, which states that whenever the amount of energy in one place decreases, the energy in another place increases by an equal amount. According to this law, energy cannot be created or destroyed; it can only be changed into different forms.

Albert Einstein — (1879-1955) A scientist who developed the Law of Conservation of Mass and Energy, and many other theories of physics.

photosynthesis — The process through which plants capture energy from the sun and convert it into sugars. Photosynthesis provides the stored chemical energy for the food we eat as well as the eventual development of fossil fuels.

chemical energy — The energy that is stored in the molecules of a substance. Plants store the sun's energy in chemical bonds when they produce sugars. This energy is transferred to our bodies when we eat the plants. Batteries and burning fuels release chemical energy as well.

conduction — The way heat energy is transferred through objects that are touching one another. If you stir a pan of hot soup with a cold spoon, heat energy will be conducted to the spoon, warming it up.

convection — The process by which heat is transferred through the movement of liquids and gases from a warm spot to a cooler spot. An example of convection is the wind formed when cold air sinks and warm air rises.

radiation — The movement of energy in a direct line away from its source. The sun transfers energy through space by radiation — even though we do not touch the sun, we can still feel its heat.

James Watt — (1736-1819) A Scottish inventor famous for building a powerful steam engine.

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 are some different forms of 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. Describe matter, work and energy. How are they related?
2. Define potential and kinetic energy. Provide examples of each.
3. Why is the transfer of energy important?
4. Give an example of a transfer of potential to kinetic energy.
5. Does energy ever disappear? Explain your answer.
6. Albert Einstein formulated the Law of Conservation of Mass and Energy. What does that law suggest?
7. What does photosynthesis in plants have to do with the transfer of energy?
8. When we burn a log, a lump of coal or gasoline, what is really happening from an energy standpoint?
9. How is heat energy transferred from one object to another?
10. How have humans harnessed energy to do work?

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.

Thought-provoking discussions provide a good way to assess the overall depth of student understanding. The following are some suggested discussion topics.

- Discuss why it can be said that fruits and vegetables are nothing more than edible forms of light energy.
- Ask small groups of students to brainstorm examples of energy in action (toys, vehicles, amusement rides, tools, machines, things in nature, human activities) and then have them describe where the energy came from and where the energy goes.