17. Why do we say that convection is responsible for Earth's weather patterns? Explain the process.
18. What is chemical energy?
19. How is chemical energy stored?
20. Explain how the sun provides heat and chemical energy to people on Earth.

## 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 what might happen to life on Earth if photosynthesis did not exist.
- Have students brainstorm a list of insulators and conductors used in everyday life (i.e., clothing, building supplies, heating and cooling devices, cooking supplies).

## Follow-up Activities

- Have students design experiments to investigate the influence of temperature on different types of batteries (i.e., zinc, alkaline and lithium). Students can control variables like the length of time exposed to cold and intensity of cold (freezer, refrigerator, outside on cold day). Students can extend this activity by investigating methods for reviving cold batteries, based upon the information they have learned.
- Disposable chemical hotpacks can be passed around to students in order to demonstrate a chemical reaction that gives off heat (an exothermic reaction). Ask students to come up with explanations for the source of the heat energy. In groups of two, students can then measure the heat given off in a chemical reaction with a large cup containing 20 milliliters of vinegar and a thermometer. Making sure they are equipped with goggles and gloves, have them take the temperature of the vinegar and record it. Then have each group add different amounts of baking soda to their cup (from .5 grams to 3 grams) and take periodic temperature readings over the course of five minutes. Ask students to compare their observations and present their data in a large classroom graph.





## Suggested Internet Resources

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

- **www.miamisci.org/af/sln/mummy/**
  "The Atoms Family" Web site sponsored by the Miami Museum of Science contains two activities exploring heat and insulation called "Building a Better Pyramid" and "Cooling the Mummy's Tomb."
- **www.energy.ca.gov/education/projects/projects-html/peanut.html**
  This site, hosted by the California Energy Commission, presents "Peanut Power," an activity that demonstrates the links between heat and chemical energy by releasing the chemical energy stored in the peanut by burning it. Suggestions are also offered for expanding the activity.

## Suggested Print Resources


- Friedhoffer, Robert. *Molecules and Heat.* Watts, Danbury, CT; 1993.
- Gardner, Robert and Eric Kemer. *Science Projects About Temperature and Heat.* Enslow Publishers, Hillside, NJ; 1994.
- Wood, Robert W. *Heat FUNdamentals: FUNtastic Science Experiments for Kids.* McGraw-Hill, New York, NY; 1997.



**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**



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ENERGY IN ACTION™

# Heat & Chemical Energy

## Grades 5–8

Students in grade 5-8 dassrooms 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

Heat and chemical energy are two interrelated forms of energy that affect the world around us. Heat energy is defined as the movement of atoms and molecules. The faster molecules move, the greater the heat. Chemical energy is energy that is stored and can be unleashed by heat energy. Once chemical energy is released, it can be converted into heat energy.

Temperature is a measurement of heat energy. Three different scales are commonly used to measure temperature. On the Fahrenheit scale, water freezes at 32° and boils at 212°. On the Celsius scale, the freezing point of water is 0° and its boiling point is 100°. The Kelvin scale is used by scientists to study extremely cold temperatures.

Heat energy always flows from hot to cold surfaces. An ice cube will melt in your hand because the heat energy travels from your warm hand to the cold ice cube. This is called a heat energy transfer. There are three different ways that heat can be transferred: convection, conduction and radiation. Convection occurs when hotter or faster-moving molecules of liquids and gases expand and rise as colder molecules contract and sink. Convection is the basis of the Earth's weather patterns, in which warm air rises and cold air sinks. The transfer of heat in solid objects is called conduction. When two solid surfaces are touching, heat moves from the warmer surface to the cooler one. The third form of heat energy transfer is radiation. Earth's greatest source of heat comes from the sun. The sun's radiant or heat energy travels through the emptiness of space to reach Earth by radiation. If you have ever sat close to a campfire or a radiator, you have felt the effects of heat transfer by radiation.

Plants are able to transfer energy from the sun into stored chemical energy through a process called photosynthesis. Chemical energy is released and transferred to heat energy when plants are eaten and digested by animals. Eating food, which directly or indirectly contains energy from the sun, helps our bodies to stay warm, to move and to grow. Fossil fuels such as coal, oil and natural gas also store chemical energy, and release heat energy when burned. Heat and chemical energy are essential for life on Earth!

## 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.

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

**heat —** The energy produced by the movement of the tiny atoms and molecules of an object. The more they move around, the more heat is produced.

**atoms —** Tiny particles that make up everything around us. These particles are constantly moving.

*(Continued)*



**molecules —** The smallest units of a substance, made of one or more atoms.

**kinetic energy —** Energy that is active or moving.

**expand —** To get bigger; most substances expand when heated.

**temperature —** A measurement of how fast the atoms and molecules of a substance are moving. Three scales are commonly used to measure temperature: Celsius, Fahrenheit and Kelvin.

**Celsius scale —** A scale used to measure temperature that was invented by Anders Celsius, a Swedish scientist. On the Celsius scale, 0° is the freezing point of water and 100° is the boiling point.

**Fahrenheit scale —** A scale used to measure temperature that was invented by Gabriel Fahrenheit, a German scientist. On the Fahrenheit scale, 32° is the freezing point of water and 212° is its boiling point.

**Kelvin scale —** A temperature scale having a measurement of absolute zero, below which temperature does not exist.

**absolute zero —** The coldest possible temperature, measured on the Kelvin scale as 0° K and corresponding to -273.15° Celsius and -459.67° Fahrenheit. At absolute zero, molecules are absolutely still. Absolute zero cannot be reached.

**cold —** A condition of low temperature, or the absence of heat.

**energy transfer —** The flow of energy from one object to another. Heat energy always flows from hot to cold items.

**conduction —** The way heat energy travels through objects that are touching one another. If you stir a pan of hot soup with a cold spoon, heat energy from the hot soup 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.

**conductor —** A substance that allows heat to flow through it easily. Metals are good conductors of heat.

**insulator —** A substance that does not allow heat to flow through it easily. Air, wood and plastic are examples of insulators.

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

**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 obtained from releasing energy that is contained or stored in a substance. The sun's energy is released to our bodies when we eat plants. Our bodies use this energy to live. Batteries and burning fuels release chemical energy as well.

**calorie —** A measurement of the amount of energy contained in food. A calorie is defined as how much heat is required to raise one gram of water one degree Celsius.

*(Continued)*



**kilocalorie (Calorie) —** The energy required to raise the temperature of a thousand grams of water one degree Celsius. One Calorie is actually equal to 1,000 calories.

**calorimeter —** A device used to determine how many calories foods contain.

**fossil fuels —** Energy resources such as coal, oil and natural gas that are created within the Earth from the remains of plants and animals that lived millions of years ago.

## 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?
- Where does heat energy come from?
- How do we obtain energy from the food we eat?
- What are some examples of chemical energy?

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 kinds of things are made of matter?
2. How are energy and work connected?
3. Describe heat energy in terms of atoms and molecules.
4. What is kinetic energy?
5. How is kinetic energy related to heat?
6. Are atoms always in motion? Justify your answer.
7. What happens as atoms move or vibrate at a faster pace?
8. How is temperature different from heat?
9. How does the Fahrenheit scale measure the freezing point of water? The boiling point?
10. How is the Celsius scale used to measure temperature?
11. How are the Kelvin scale and the Celsius scale similar and different?
12. What is absolute zero?
13. Why does winter clothing help you stay warm on a cold day?
14. What is an energy transfer?
15. What are three ways that heat travels?
16. What is conduction? Name some good conductors.

*(Continued)*