Exploring Energy

From
The Basics of Physics Series
Unit of Study

INSTRUCTOR'S GUIDE

EXPLORING ENERGY

From
The Basics of Physics Series
A Unit of Study

Instructor's Guide

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EXPLORING ENERGY
From The Basics of Physics Series
Grade Levels: 5-8

INTRODUCTION

This live-action program is designed for use with the intermediate grade levels (5-8).

This program is about energy. Energy can be observed all around us. Energy makes things happen. It is the ability to do work. There are two kinds of energy: potential and kinetic. Potential energy is the energy of position. Kinetic energy is the energy of motion or movement. The Law of Conservation of Energy says that energy can not be created or destroyed, only converted from one form to another. There are seven main forms of energy; mechanical energy, heat energy, chemical energy, radiant energy, electrical energy, sound energy, and nuclear energy. The sun is the main source of energy for our planet. The sources of energy are divided into two groups called renewable and nonrenewable resources. This program deals with all those topics as well as problems associated with a reliance on fossil fuels. In addition ideas for conserving energy are also presented.

INSTRUCTIONAL NOTES

Before presenting this lesson to your students, we suggest that you preview the program and review this guide and the accompanying blackline master activities in order to familiarize yourself with their content.

As you review the materials presented in this guide, you may find it necessary to make some changes, additions, or deletions to meet the specific needs of your class. We encourage you to do so, for only by tailoring this program to your class will they obtain the maximum instructional benefits afforded by the materials.

It is also suggested that the program presentation take place before the entire group under your supervision. The lesson activities grow out of the context of the program; therefore, the presentation should be a common experience for all students.

LINKS TO CURRICULUM STANDARDS

This Unit of Study addresses the following National Science Education Standards for grades 5-8:

Science as Inquiry

Content Standard A:

- Abilities necessary to do scientific inquiry
  Plan and conduct simple investigations.
  Employ simple equipment and tools to gather data.
  Use data to construct a reasonable explanation.
  Communicate investigations and explanations.
- Understanding about scientific inquiry

Physical Science

Content Standard B:

- Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.

Science and Technology

Content Standard E:

- Abilities of technological design
- Understanding about science and technology
  People have always had questions about their world. Science is one way of answering questions and explaining the natural world.
  People have always had problems and invented tools and techniques to solve problems.
  Scientists and engineers often work in teams.
  Tools help scientists make better observations, measurements, and equipment for investigations.

History and Nature of Science

Content Standard G:

- Science as a human endeavor

Science and technology have been practiced for a long time.
Men and women have made a variety of contributions throughout the history of science and technology.
Although men and women using scientific inquiry have learned much about the objects, events, and phenomena in nature, much more remains to be understood. Science will never be finished. Many people choose science as a career and devote their entire lives to studying it.

STUDENT OBJECTIVES

After viewing the video and participating in the lesson activities, the students should be able to do the following:

- Describe how potential and kinetic energy are related.
- Identify the main sources of energy.
- Identify renewable and nonrenewable resources.
- Describe the problems associated with a dependence on fossil fuels.
- Identify ways to conserve energy.

ASSESSMENT TOOLS

This lesson provides you with three different assessment tools. Together they make it possible to follow closely the progress of your students and to judge their mastery of the subject matter.

The **Pre-Test (Blackline Master 1)** can be used to get some idea of students' understanding of the topic before the program is presented.

The **Post-Test (Blackline Master 16)** can be used as a final test for the lesson.

The **Program Quiz** and its accompanying answer sheet **(Blackline Master 2)** can be used either as a way to introduce the topic prior to showing the program or to judge student mastery once the program has been presented.

TEACHER PREPARATION

View the program and review the accompanying activities. Duplicate any blackline masters you wish to distribute. If you plan to use the Program Quiz, which immediately follows the program presentation, you may wish to have copies of the quiz ready to distribute at the completion of the program. Also, plan to pause the tape between questions if students require more time.

INTRODUCING THE PROGRAM

Ask the students to help you list on the board examples of energy that they observe on a daily basis. What are some of the ways they depend on energy?

VIEW THE PROGRAM

Viewing time for this program is 30 minutes. The program quiz that follows the presentation will take about three minutes when you build in pauses for recording answers.

DISCUSSION QUESTIONS

You may wish to conduct a discussion after viewing the program based on the following:

1. How is the sun responsible for most of the energy on earth?
2. What is the difference between renewable and non-renewable resources?
3. What are fossil fuels and how are we dependant on their use?

BLACKLINE MASTER DESCRIPTIONS

This program contains sixteen blackline masters that can be used to reinforce ideas and information presented in the program.

- **Blackline Master 1, Pre-test,** provides a way of finding out how much students know about the material covered in this lesson before you present it. Student scores on the Pre-Test can be compared with their scores on the final Post-Test **(Blackline Master 16)**.
- **Blackline Master 2, Program Quiz,** is to be used at the end of the program. At the completion of the program, there is a short quiz. The narrator will read the questions which are displayed on the screen. Students can use **Blackline Master 2** to record their answers. Answers to the questions are provided in the Answer Key section of this instructor's guide.
- **Blackline Master 3, Photosynthesis,**is a worksheet that supplies the formula for photosynthesis. There are also three questions related to the importance of plants to life on earth.
- **Blackline Master 4, Consumption By Source,** provides a chart of the percentage of consumption of the main energy sources used in the United States. Students are asked to identify the sources as renewable or nonrenewable resources. A question at the bottom of the page asks students to analyze information from the chart.
- **Blackline Master 5, Examples of Energy,** asks students to locate pictures from newspapers and magazines that illustrate energy usage.
- **Blackline Master 6, The Height of a Dropped Weight,** is an experiment for determining how height effects the strength of a dropped weight.
- **Blackline Master 7, The Mass of a Dropped Weight,** is an experiment to demonstrate how mass relates to the energy of a dropped fish weight.
- **Blackline Masters 8 and 9, Pendulum,**is an experiment to determine some of the properties of a pendulum.
- **Blackline Master 10, Renewable and Nonrenewable Resources,** asks students to identify advantages and disadvantages of each of the energy resources.

- **Blackline Master 11, Energy Transformations,** asks students to identify the energy transformations that occur during some common everyday situations.
- **Blackline Master 12, Fossil Fuels,** is a worksheet that asks students to respond to five questions about fossil fuels and our dependence on them as an energy resource.
- **Blackline Master 13, Renewable Resources,** asks students to respond to questions about renewable energy resources.
- **Blackline Master 14, Conserving Energy,** asks students to respond to questions related to energy conservation.
- **Blackline Master 15, Public Service Announcement,** is an activity designed to help students plan and produce a radio or television public service announcement about topics related to energy.
- **Blackline Master 16, Quiz,** is an evaluation tool for this unit.

ENRICHMENT ACTIVITIES

1. Have some students find out about research being conducted on the prospects of fusion reaction. Fusion is what takes place on the sun. Tremendous amounts of energy are released from the combining of simple atomic fuels derived from seawater. There is no pollution and with three-fourths of our planet covered with ocean water we have an almost endless supply.
2. Have students find out about their communities recycling program. Is there a recycling program at school? If not why not have some students organize an effort to put one into place.

ANSWER KEY

- **Blackline Master 1, Pre-Test**

A. Definitions

1. Potential energy is stored energy or energy of position.
2. Kinetic energy is energy of motion.
3. Friction is a result of two objects rubbing together. Heat and wear and tear are products of friction.
4. Air resistance is a form of friction between an object as it moves through the air around it.
5. Mechanical energy is the total potential and kinetic energy of an object.

B. Short Answer

1. Nonrenewable resources are resources that can not be replaced. There is a limit to these resources. Nonrenewable resources include resources such as coal, oil, natural gas, and petroleum.
2. Renewable resources are resources that are replaced quickly or seem to be limitless. Examples include solar energy, hydropower, geothermal, wind, and biomass.
3. Potential energy is the energy of position. Potential energy can change to kinetic energy which is the energy of motion. An example is a skier at the top of a slope. Energy from the chair lift has moved the skier to the top of the slope. The skier has potential energy. Once the skier begins down the slope his or her potential energy changes to kinetic energy.
4. The roller coaster cars are pulled up the first hill of the ride. At the top of the hill the cars have their greatest potential energy. When the cars go over the crest of the hill and start down the other side the potential energy changes to kinetic energy. At the bottom of the hill the potential energy has all changed to kinetic energy. This kinetic energy powers the cars up the next hill. The kinetic energy has changed to potential energy again. This process continues until the end of the ride.

5. A. Solar energy is the energy of the sun.
   B. Wind energy is used to spin giant propellers which can be attached to generators to produce electricity.
   C. Geothermal energy is produced by super heated water or steam from the interior of the earth.
   D. Biomass is energy derived from the burning of such things as wood or plants.
   E. Hydropower is the power of moving water. Rivers or dams can create situations where water runs past turbine blades to spin generators to produce electricity.

- **Blackline Master 2, Program Quiz**
  1. Potential energy is the energy of position or stored energy waiting to be released. Kinetic energy is the energy of motion.
  2. Mechanical, electrical, heat, light, sound, chemical, and nuclear.
  3. Energy transforms from one form to another such as the mechanical energy of turning a generator handle makes electricity to light a bulb.
  4. Nonrenewable resources are limited and will eventually disappear. Fossil fuels such as oil, coal, natural gas, and petroleum are examples of nonrenewable resources.
  5. Renewable resources are easily replaced and in some cases seem to be limitless. Solar energy, wind, geothermal, biomass, and water power are all examples of renewable resources.
  6. Many fossil fuels when they are burned give off chemicals that are harmful to the environment. These chemicals create acid rain and smog which can damage plants and hurt animals and humans.
  7. Fossil fuels were given that name because they were produced after millions of years of having been buried underground. They are the remains of microscopic plant and animal life that lived millions of years ago during prehistoric times. These plants and animals absorbed and used the energy of the sun to live. When they died they sank to the

bottom of marshes and over millions of years the pressure of all the land above them changed the remains into fossil fuels.

8. Energy can't be created or destroyed. The careful use and conservation of energy is important because many of the fuels and resources we now depend upon are disappearing.
9. People can conserve energy by thinking about how they use energy and making adjustments. For instance, even simple things such as turning off appliances and lights when a room isn't being used are things that can help. Thinking about what you want from a refrigerator before opening the door is a good plan. Taking showers instead of bathes will conserve water and heat. Turning down the thermostat can help. Recycling can make a big difference in energy conservation.

- **Blackline Master 3, Photosynthesis**
  1. Everything is dependent upon plants because plants are the only living things that can make their own food. Some animals eat plants for their nourishment and some animals eat other animals but without plants the entire system would fall a part.
  2. Besides producing food plants give off oxygen as a by-product of their food making process. Oxygen is required by all living things.
  3. There are things that humans do that threaten plants. Humans pollute the air with gases from factories, power plants, and automobiles. Humans also threaten the environment by building houses and cities. Water becomes polluted and can't be used by plants.

- **Blackline Master 4, Consumption by Source**

  Petroleum nonrenewable
  Natural gas nonrenewable
  Coal nonrenewable
  Uranium nonrenewable
  Biomass renewable
  Hydropower renewable
  Propane nonrenwable

Geothermal renewable
Solar renewable
Wind renewable

The forms of energy we depend upon the most are all nonrenewable. This reliance on fossil fuels will cause real problems as those sources dry up and disappear.

- **Blackline Master 5, Examples of Energy**
  Students will find pictorial examples of various energy forms.

- **Blackline Master 6, The Height of a Dropped Weight**
  The drop from the highest position will cause the block of wood to travel the farthest when hit.

- **Blackline Master 7, The Mass of a Dropped Weight**
  The block should travel farther than the corresponding data from blackline master 6.

- **Blackline Master 8 and 9, Pendulums**
  After all this investigation students should discover that the only thing to effect the number of swings in a pendulum is the length of the pendulum arm or in this case string.

- **Blackline Master 10, Renewable and Nonrenewable Resources**
  Fossil fuels – advantages: cheap, easy to get and transport
  Disadvantages: pollutant, nonrenewable resource
  Nuclear – advantages: lots of energy for small amount of fuel
  Disadvantages: produces radioactive wastes
  Hydropower – advantages: renewable, no pollution
  Disadvantages: must have source of water
  Solar – advantages: doesn't produce pollution, limitless
  Disadvantages: costly to make solar panels and cells
  Wind – advantages: non-polluting, inexpensive, renewable
  Disadvantages: works well only in areas with a steady wind
  Biomass – advantages: renewable
  Disadvantages: produces smoke, need large farmland areas

Geothermal – advantages: renewable, non-polluting
Disadvantages: only works where there hot springs

- **Blackline Master 11, Energy Transformations**
  1. example
  2. chemical energy of the gasoline is transformed to mechanical energy of the car
  3. electrical energy is transformed into heat energy to cook the food
  4. solar energy is transformed into chemical energy by the tree
  5. chemical energy of the coal is transformed into heat energy to change water into steam. The steam is used to turn turbines and spin generators to make electricity.

- **Blackline Master 12, Fossil Fuels**
  1. Nonrenewable resources are energy sources that will disappear eventually. There is a limit to them.
  2. These resources are referred to as fossil fuels because they were formed from the remains of plants and animals that lived during prehistoric times millions of years ago.
  3. Coal is used as a fuel for furnaces at factories and power plants. Oil can be used to make petroleum and other fuels. Natural gas is burned and is often used in home stoves, ovens, and furnaces.
  4. Fossil fuels are nonrenewable which means they will disappear eventually. They also give off pollutants when they are burned which can cause problems for the environment.
  5. Currently we are dependent on fossil fuels for most of our energy needs. This causes problems because we will run out of these resources. Also they create problems for the environment because these fuels often give off pollutants.

- **Blackline Master 13, Renewable Resources**
  1. Renewable resources are resources that can be replenished quickly and easily. They may be limitless.

2. A. geothermal energy is non-polluting but requires an area such as a hot spring where geothermal activity is prevalent.
    b. wind energy is non-polluting but requires an area where there are steady winds.
    c. Solar energy is limitless but requires expensive equipment.
    d. Biomass energy is produced from the burning of plants, wood, and wastes.
    e. Hydropower energy is from running water such as in a river or as water held behind a dam. It is non-polluting but requires a water source.
3. Renewable resources will eventually have to replace our dependence on nonrenewable resources. Nonrenewable resources are running out.
4. Some of the most important advantages of renewable resources have to do with the fact that they are non-polluting.
5. Most of the factories and power plants are designed to use fossil fuels. Many of the nonrenewable resources are limited to use in certain areas. Some are still expensive to set up such as solar panels.

- **Blackline Master 14, Conserving Energy**
    1. It is important to conserve energy in an effort to save resources especially nonrenewable resources.
    2. Acid rain is produced when chemicals given off during the burning of certain fossil fuels combine with rain water.
    3. The greenhouse effect happens as the atmosphere becomes too thick with gases such as carbon dioxide which is released in car exhaust. Sunlight goes through the atmosphere and then instead of bouncing back into space it is trapped by this blanket of gases. This condition causes heat to increase. The Greenhouse effect causes global warming as more and more heat is trapped in the atmosphere.
    4. Fossil Fuels give off gases that are polluting to the atmosphere.

5. People can conserve energy by turning off electrical appliances and lights when a room is unoccupied. Recycling is an important method to help conserve energy. Turning down the thermostat on a furnace will help.

- **Blackline Master 15, Public Service Announcement**
  Students should produce an audio or video cassette of their public service announcement.

- **Blackline Master 16, Post Test**

Part A:

1. A 2. C 3. A 4. B 5. B

Part B:

1. Only plants are capable of making food. Plants use the energy of the sun to carry on their food making process called photosynthesis.
2. Nonrenewable resources include oil, coal, natural gas, and nuclear power.
3. Renewable resources include solar energy, geothermal, wind, hydropower, and biomass.
4. Fossil fuels release chemicals that can harm the environment.
5. People can conserve energy in a variety of ways. Some examples are to recycle paper, cans and glass. Another is to simply turn off appliances and lights when a room isn't in use.

INTERNET RESOURCES

The following websites may be valuable sources of additional information to reinforce the objectives of this lesson:

1. http://www.nrel.gov/ The site is sponsored by the National Renewable Energy Laboratory. It discusses solar, wind, biomass, geothermal, and other related areas of energy research and development.
2. http://solstice.crest.org Information about renewable energy resources. Site sponsored by the Center for Renewable Energy and Sustainable Technology.

3. http://zebu.uoregon.edu/energy.html Links to sites about energy and resources.
4. http://www.bydesign.com/fossilfuels/links/index.html A good starting point for information about the use of fossil fuels in America.

Script of Program Narration

Exploring Energy
EXAMPLES OF ENERGY

Examples of energy can be found all around us. Nature is full of energy, from the power of running and falling water,
to the electrical power of lightning. Our shorelines are battered by waves. New land forms as volcanoes release hot molten lava. Winds whip around mountaintops. Impressive rock formations are carved by a mixture of sand and wind. Mountains that were once as tall and majestic as the Rockies are worn down by millions of years of wind and water erosion. The surface of the planet is in constant change due to the energy of nature. Animals need energy to survive, to run, play, and hunt.

Energy is used by people to warm their homes, cook their food, light their way, and to make it through their busy days. But what is energy and where does it come from? That's what this program is all about. It's all about ENERGY.

WORK, FORCE, AND ENERGY
To a scientist, work is only accomplished when a force moves an object some distance. A force is defined as a push or a pull.
So even though someone may appear to be working hard to lift a weight, if the weight never moves no work has been done.
In contrast if someone picks up a pencil and moves it to a new location, work has been done. Scientists use the formula; work equals force times distance to calculate the amount of work

accomplished. Naturally, to do any work requires energy. Energy is defined as the ability to do work. In the metric system, the newton-meter, or joule (joul – rhymes with pool), is used as the unit of measurement for work or energy. So if someone moves something with a mass of 20 newtons one meter, he or she is doing 20 newton-meters of work. Remember, work equals force times distance, or 20 newton-meters.

ENERGY FROM THE SUN

Energy is the ability to make things happen. It's the ability to do work. It isn't difficult to look around and see all kinds of examples of energy. Bulldozers need energy to lift heavy loads. The fuel that the bulldozer burns provides the necessary energy. Animals need energy for just about everything they do. Their energy comes from the food they eat. All plants and animals need food to live. Plants are the only organisms that can make their own food; they need the sun to do that. So when we eat food, we are really using the energy from the sun that was stored in the plant. Almost all the energy on earth comes from the sun. The sun's energy travels 93 million miles or 149 million kilometers through the emptiness of space to reach our planet in the form of light, heat, and other forms of energy. The sun is important to all living things on earth. Plants use the sunlight, water, and minerals from the soil to make food in a process called photosynthesis. Animals depend on the plants: some animals eat them to get energy while other animals eat the plant-eaters to get energy. The process of energy transfer from the sun to plants to animals is called a food chain. Some animals, such as humans, eat both plants and animals for food. The food is used by the body to do things; such as exercise, work, and just move. Food is chemically broken down and mixed with oxygen to release the energy needed to do things. The amount of energy food contains is measured in calories and a special piece of equipment is used to determine this. A sample of the food is burned inside a sealed container, which captures the heat energy released, and uses it to heat a known amount of water. The temperature before and after burning the food is recorded and is then used to figure out how many calories of heat energy are released by the food. Our bodies need a certain

amount of these food calories to operate throughout the day. If you aren't active and just sit around, the extra food calories are changed to fat for use later. Remember that most of the energy of our planet actually comes from the sun. Food contains stored energy from the sun. Even the gasoline that cranes, trucks, and cars use has energy from the sun stored in it. These fuels come from fossil fuels that were formed over millions of years. During prehistoric times, the plants soaked up and used the energy of the sun. Then these plants died and were buried beneath huge layers of earth over a long period of time. These plants changed into natural gas and oil, which are then mined and made into fuels for our machines.

POTENTIAL AND KINETIC ENERGY

Energy changing from one form to another is behind everything that happens. Scientists refer to two kinds of energy: potential and kinetic. Potential energy is stored energy, or energy of position. If a book is lifted to the edge of a table, it has potential energy. Someone has used muscle energy to lift the book against gravity to the height of the table. The potential energy is stored energy waiting to be released. If the book falls, it will hit the floor with a force, causing a loud sound, and if someone's foot is in the wrong place, a great deal of pain. The book falling is an example of kinetic energy, or the energy of motion. On a roller coaster, the first hill is always the highest. A huge motor is used to pull the cars to the top of this hill. This represents a great deal of potential energy because the motor has used energy against gravity to lift the car and the people inside. When the coaster cars go over the top of the hill and head down, the potential, or stored energy, changes to kinetic, or energy of motion. The first hill has to be the highest so that the greatest amount of potential energy can be stored up in the cars.

A battery has chemical potential energy. The chemical energy is stored until the battery is attached in a circuit. Then the chemical energy is changed to electrical energy. In this circuit it is used to light a bulb. Wood has stored chemical energy as well. When the wood is set on fire, we see the release of this energy as light and

heat energy. The light and heat energy moves from one place to another, so they are examples of kinetic energy - energy of motion.

THE SEVEN FORMS OF ENERGY

Energy can appear in many forms and it can change from one form to another, just as the chemical energy of a battery can change to the electrical energy needed in the circuit to light the bulb. The bulb gives off light and heat energy. There are seven main forms of energy: mechanical, heat, chemical, radiant, electrical, sound, and nuclear. Sometimes energy can be made to change from one form to another instantly. Here is a solar cell panel. The solar cells on it can change sunlight into electricity. When we expose the panel to sunlight, electricity is produced immediately. Notice the needle on this voltmeter moves as sunlight strikes the panels. The voltmeter is indicating that electricity is produced.

At a fair we could find many examples of energy. The lights are examples of electrical energy changing to heat and light energy. We hear the sounds of the rides and that too is a form of energy - sound energy. The moving parts of the rides are all examples of what is called mechanical energy. The food sold at the fair is cooked with heat energy. When we eat the food, our bodies change the chemical energy stored in the food to other forms of energy to move our bodies or let us create our own sound energy.

<u>Mechanical Energy</u>

Mechanical energy is the energy of motion. Water rushing down a stream is an example of mechanical energy. The blowing wind and running people are examples of mechanical energy.

<u>Heat Energy</u>

Heat energy is related to the movement of the particles that make up matter. These particles are called atoms, and they are always moving. The movement of atoms causes heat energy; the faster the movement, the more heat energy is produced. You can feel heat energy if you rub your hands together quickly. The mechanical energy of rubbing your hands changes to heat energy.

Chemical Energy

Chemical energy is stored in fuels, such as charcoal, gasoline, and even food. When we burn charcoal in a grill, the stored energy is released as heat energy to cook our food. When we eat the food, the chemical energy stored in the food is used to power our muscles. In another example of chemical energy, a rocket burns fuel and uses it to launch off the ground.

Electrical Energy

Electricity is used everyday in our homes to power tools and equipment. Electricity is the movement of electrons. Electricity is considered a secondary energy resource because it is generated by using primary energy resources. At most power plants, steam is forced past turbines that will spin a drive shaft that turns coiled wire inside a magnetic field. When a coil of wire spins in a magnetic field or a magnet moves in a coil of wire, electricity is produced. Magnetism can be used to produce electricity. To make the steam to spin the drive shaft, a furnace burns fossil fuel to heat water. Or at a nuclear power plant a nuclear reaction is used to heat up water. In either case, electricity is one of our least expensive forms of energy.

Radiant Energy

Radiant energy includes light, x-rays, and radio waves. Radiant energy in the form of light is critical to life on earth. Green plants depend on light as a major ingredient in photosynthesis. Photosynthesis is the food making process upon which green plants depend. During photosynthesis, carbon dioxide, minerals, water, and sunlight are used to make food in the form of glucose, which is sugar, and to release oxygen. Plants are the food makers of our world. In addition, they release oxygen, which is critical to survival on our planet.

Nuclear Energy

Nuclear energy has to do with the nucleus, or center, of an atom. When this center splits, it releases a large amount of energy. This is

called fission and is what happens at a nuclear power plant. When atoms join together, or fuse, they also release energy. This is what happens on the sun as hydrogen atoms join to form helium atoms and tremendous energy is released. This process is called nuclear fusion.

THE LAW OF CONSERVATION OF ENERGY

The Law of Conservation of Energy states that energy cannot be created or destroyed, only converted from one form to another. Some energy may be lost to friction and air resistance, but the overall amount of energy stays the same. Most energy conversions are not very efficient. There is always a loss of useful or useable energy. A perfect energy conversion is impossible because this means that all the energy in the conversion would be turned to useful work. For example, a car is about 22% efficient, as much of the energy changes to heat and is used to overcome friction and inertia.

The human body uses food as its fuel source. The chemical energy is converted to energy to help us move, breathe, think, and carry on all the other important functions that keep us alive. However, the human body is not very efficient, and during this conversion, 95% of this chemical energy is converted to heat. Think of the last time you were very active and produced a lot of heat as a result.

Remember, energy cannot be created or destroyed as it is converted from one form to another. Here is an example. Look at this set-up of five metal balls hanging from strings of the same length. The balls are all exactly the same. What do you think will happen if we lift one ball and then release it? If you thought that only one ball from the end would pop out, you're correct. Notice that it goes up almost as high as the first ball and then swings back, hitting the group and sending the first ball flying again; each time the height that the two balls reach is lower until, eventually, they would stop this movement. This back-and-forth movement doesn't continue forever because energy is being changed to heat due to friction and air resistance.

Now let's change things a bit. This time, we will release two balls from one side. What do you think will happen? Pause the program

and make your prediction. As you can see, two balls from the other side bounce out. Scientists call this the Law of Conservation of Energy, which simply means energy is neither created nor destroyed. It is transferred, or changed, from one form to another.

Let's try another set up. This time, we will release three balls from one side. There are only two balls left hanging straight down. What do you think will happen this time? Pause the program and make your prediction. Were you surprised by what happened? One of the balls joins the two so that the amount of kinetic energy is equal.

Now let's change things by releasing one ball from each side at the same time. Pause the program and make your prediction. Did you expect the balls to bounce back out? As long as the strings don't get tangled, you could do this with different numbers of balls. When we lift a ball to a certain point before dropping it, we have given it potential energy. Someone has used his or her muscles against gravity to lift the ball to a certain height. When the ball is released, it begins to swing down. The potential, or stored, energy is changing to kinetic energy, or energy of motion. When the ball hits the group of balls, the energy is transferred, or moved, from one ball to the next until the ball on the end is pushed into the air against gravity. This ball reaches a certain height and stops; at that point, it has potential energy. Then it begins to swing down, which means its potential energy is changing to kinetic energy.

Look at this amusement park ride and think about how it might be another example of potential energy changing to kinetic energy, and then kinetic energy changing to potential energy, and so on and so on. How much kinetic energy an object has depends on two things: how much mass the object has and how fast the object is moving. Forms of energy are all around us.

NONRENEWABLE RESOURCES

There are many sources of the energy we use every day. These sources of energy fall into two groups called nonrenewable and renewable resources. Most of the energy used in the United States

comes from nonrenewable resources. These resources are called nonrenewable because once they are used, they cannot be replaced. Coal, petroleum, natural gas, propane, and uranium all take millions of years to form. Their supply is limited, and eventually they will run out.

Coal, natural gas, petroleum, and propane are referred to as fossil fuels because they have formed over the millions of years since prehistoric times. These resources formed from the tiny plants and animals that lived before the dinosaurs. These plants and animals got their energy from the sun. When they died, they sank to the bottom of swamps and oceans. Then, over millions of years, water and dirt piled up on these plants and animals. The pressure caused chemical and physical changes that transformed these decayed plants and animals into the fossil fuels, which have become so important to our life. However, once the supply of fossil fuels is used up, it will be gone forever.

Here is a chart that shows energy consumption by source in the United States. Notice how the nonrenewable resources dominate with 94 percent of energy consumption coming from their use.

<u>Coal</u>

Giant machines are used to remove coal from the ground. There are two methods for mining coal. Surface mining is currently the most widely used method. This method can be used when the coal is a few hundred feet below the surface. Giant machines are used to scrape the topsoil and dirt away and then the coal can be mined on the surface.

Underground mining is necessary when the coal vein is deep underground. In this situation, people and machines are transported underground to remove the coal. Ninety-one percent of the coal mined in the United States is used to produce electricity at power plants. Coal is also used in the manufacture of paper, cement, and bricks. Our coal reserves should last for the next 300 years at the current level of use.

Before any coal is mined from an area, the coal company plans, with the local community and other interested parties, how to reclaim the land. Coal companies make a great effort to treat the land in an environmentally proper fashion.

Sometimes coal contains sulfur, which is released when the coal is burned and this sulfur combines with oxygen to make acid rain. Acid rain can harm trees and other living things, so coal companies try to locate sources of coal that are low in sulfur. They also remove sulfur from the coal they mine. Power plants have installed scrubbers in their smoke stacks to remove the sulfur before it can get into the air.

Natural Gas

Natural gas is the cleanest burning fossil fuel. Natural gas is used mainly for heating. It is used primarily by industries as a fuel for heating in the manufacture of products. It is also an ingredient in products such as glue, fertilizer, and paint.

Natural gas, like other fossil fuels, was formed millions of years ago from dead plants and animals. Natural gas is found trapped in underground rock pockets. It is considered a nonrenewable resource, though some natural gas is generated and can be collected at landfills as garbage breaks down. The main gas associated with natural gas is methane, which is colorless and odorless. Natural gas companies add the odor of rotten eggs to natural gas so that if there is a leak people can tell there is a problem. Sixty percent of homes use natural gas for heating. It is estimated that the United States has about 50 years of natural gas left.

Petroleum

Petroleum is often referred to as oil or crude oil. It is a fossil fuel and is a very valuable energy resource. Petroleum is primarily used as fuel for vehicles used for transportation.

To bring petroleum to the surface of the earth, oil companies drill deep wells. One-fourth of the earth's petroleum reserves are from off-shore wells located in oceans. Most wells are about a mile or one point six kilometers deep. The oil that comes out of the ground must be cleaned up. It is sent to a refinery where it is separated into many fuels such as gasoline, diesel fuel, jet fuel, and heating oil.

The United States only produces enough oil to serve about one-third of its petroleum needs, so most of the petroleum used in the United States is imported from other countries.

Propane

Propane is a gas that can be found with natural gas and petroleum deposits. Propane is a very clean gas. In fact, it is used as the fuel in forklifts that must work inside warehouses. This fuel doesn't give off harmful or deadly fumes, so it can be used inside this closed area.

Propane is also used by home owners to power barbecues, and in rural areas it is often used as the fuel to heat homes.

RENEWABLE RESOURCES

There are many sources of the energy we use every day. These sources of energy fall into two groups called nonrenewable and renewable resources.

Renewable energy resources can be replaced and in some cases are considered to be limitless. Examples of renewable resources include solar, wind, geothermal, biomass, and hydropower.

Solar Energy

Solar energy, or the energy from the sun, is responsible for most of the energy on earth. The sun produces this tremendous energy as a result of nuclear fusion occurring in its interior. During nuclear fusion, hydrogen atoms combine to form helium atoms. Every time hydrogen atoms combine to form helium atoms, a great deal of energy is released. This energy radiates out from the sun in all

directions. Actually, only a very small part of that energy, about one-billionth of the radiant energy released from the sun, strikes our atmosphere and planet. Yet that solar energy is critical to the survival of all living things on our planet.

Solar energy drives the food-making process of green plants called photosynthesis. Green plants take carbon dioxide from the air, water and minerals from the ground, and the light of the sun, and, in the presence of chlorophyll in their leaves, produce food in the form of sugar, or glucose. In addition, the plant releases oxygen as a by-product of photosynthesis. So, in many respects all living things on earth owe everything to the light from our sun.

Many homes take advantage of solar energy by facing their windows in such a way as to take advantage of the thermal energy of sunlight to heat rooms naturally.

A solar cell can be used to convert sunlight directly into electricity. Solar panels on this experimental aircraft power the electric motors that enable it to fly.

Wind Energy

Wind turbines can be used to generate electricity. The wind turbine spins in the air and is connected to a generator, which produces electricity. This is a very clean method for generating electricity. There is no waste product and the only requirement is a steady movement of air, provided by the wind.

Geothermal Energy

Geothermal energy is the energy of the earth. "Geo" means earth and "thermal" means heat. This energy is created about 4,000 miles or about 6,400 kilometers beneath the earth's surface. Temperatures are extreme at this depth.

Wells can be drilled to pump water heated by this energy to the surface to be used at geothermal power plants. This hot water is used to change water into steam to spin turbines and generate

electricity. The active geothermal areas are found around plate boundaries. This is where earthquakes and volcanoes occur.

Geothermal energy is considered to be a renewable energy source because the interior of the earth is always hot and all that is needed is a supply of water so that steam can be formed.

Biomass Energy

Biomass is anything that was once alive. Wood, agricultural crops, and animal products are all examples of biomass. Biomass gets its energy from the sun. Through photosynthesis, plants make sugars; these sugars are used as fuel by living other things.

The energy stored in plants can be used as fuel. For instance, before 1850, wood burning was the main method of heating homes and cooking foods. Today, wood burning represents a small part of the energy sources in the United States.

Another biomass source of energy through burning is garbage. Garbage can be burned to generate electricity in a plant called a waste-to-energy plant. Garbage produces only about one-fourth the energy that an equal amount of coal produces, but there seems to be an endless supply of garbage, whereas coal is a nonrenewable resource.

When dead animals and plants decay, they give off a gas called methane. Bacteria are responsible for this decay. Methane is a good source of energy. At landfills, wells are drilled to capture the methane gas given off by the garbage and decaying waste.

If yeast, which is bacteria, is added to biomass, a fuel called ethanol can be made. This process is called fermentation. This fuel can be mixed with gasoline to power automobiles.

Hydropower

Hydropower is the use of running water to generate electricity. A hydropower dam can be built on a river; a reservoir can be used to

store the energy. Opening and closing gates can control the flow of water through the dam. Turbines in the dam turn when water rushes past them. The turbines are connected to the driveshafts of generators, which generate electricity when they spin.

This is the least expensive method for generating electricity. Throughout the world, it accounts for 25 percent of the electricity produced. In the United States, it accounts for between five and ten percent of the electricity produced.

It is non-polluting and, because our water is constantly replenished through the water cycle, there is no threat of it disappearing as an energy source.

PROBLEMS ASSOCIATED WITH OUR DEPENDENCE ON FOSSIL FUELS

Fossil Fuels Are Nonrenewable

One major problem with our dependence on fossil fuels has to do with the fact that, as nonrenewable resources, they will and disappear. There is a limit to these fuels and they will run out.

The Greenhouse Effect

Another problem is associated with the burning of fossil fuels. Fossil fuels are polluting to our atmosphere. When fossil fuels are burned, gases and chemicals are released that can harm the atmosphere.

The atmosphere is made up of a variety of gases including oxygen, nitrogen, and carbon dioxide. It is the carbon dioxide in the atmosphere that acts like a blanket, helping to keep the earth warm by trapping radiant energy from the sun. Radiant energy travels through the atmosphere, strikes the surface of the planet, and some of this energy is reflected back towards space. The carbon dioxide

in the atmosphere helps to reflect some of this heat energy back to keep the planet at the right temperature to maintain life.

However, when too much carbon dioxide gets into the atmosphere, the blanketing effect is increased, causing too much radiant energy to be trapped. This is called the Greenhouse Effect.

You have probably walked through a greenhouse at one time or another and thought that temperatures were much higher than those outside the greenhouse.

If we take two fish bowls outside and fill the bottoms with sand and then set them in the sunlight for a while, we can perform an experiment. Put a thermometer in each bowl and wait about a minute before taking its temperature. Then place a sheet of glass on top of one of the bowls and wait about fifteen minutes. Then compare the temperatures again. The bowl with the glass on top is helping to capture some of the radiant energy in the same fashion as the carbon dioxide in our atmosphere.

So, as cars, trucks, factories, and power plants release more and more carbon dioxide into the atmosphere this contributes to a build up of greenhouse gases and increases the Greenhouse Effect.

Global Warming

Another issue related to the use of fossil fuels is referred to as global warming. As the Greenhouse Effect has more and more of an effect on the atmosphere, the planet becomes warmer and warmer. Some scientists believe that this global warming could have far-reaching effects for the entire planet.

Farm areas may become too dry to produce plants.

Acid Rain

Chemicals released from factories, power plants, and automobile exhausts also combine with water vapor in the air to create acid rain.

Acid rain can travel in the atmosphere over great distances and then fall as precipitation.

Acid rain can harm plants, fish, and even buildings and statues made of limestone and marble.

Here is a demonstration to show the effects of acid rain. You will need two glasses, some vinegar, water, and a piece of chalk. Put some water in one glass, and some vinegar in the other. Break the chalk in half and put half in one glass and the other piece in the other glass. Now watch what happens. You should see the chalk dissolving away in the vinegar. Vinegar contains a lot of acid. Chalk contains calcium carbonate, which is found in limestone and marble. So this demonstrates the effects of acid on some common building materials, limestone and marble.

CONSERVING ENERGY

Currently, we depend primarily on fossil fuels for our energy needs. Fossil fuels are nonrenewable, which means they will be all used up at some point. Fossil fuels are polluting our atmosphere because of gases and chemicals released from burning these fuels in car engines, factory furnaces, and power plants. To help protect the environment and to help insure we have resources for the future, we must try to conserve energy. This means using less energy; it is something in which everyone can participate. Every little bit helps.

Here are some things we can do to conserve energy.

Turn off lights, televisions, radios, and other appliances when they are not in use.

Use the dishwasher only after it is completely filled.

Take showers instead of baths. Believe it or not, a shower typically uses less water than a bath.

Consider public transportation and car pooling.

Walk or ride a bike to the store instead of using the car.

During the winter, turn down the thermostat and wear sweaters if you get chilled.

Think about what you want from the refrigerator before you open the door.

Recycling can contribute a lot to conserving energy. Many communities have recycling programs in place and require you to simply separate cans, plastics, and paper from the other waste from your home.

SUMMARY: ENERGY

Energy is what keeps things moving. From forms of transportation to our own bodies, everything is dependent upon energy and the many forms it can take. Energy is the ability to do work.

There are two types of energy called potential and kinetic. Potential energy is stored energy or the energy of position. A skier is lifted by a ski lift to the top of a hill. This represents stored energy. When the skier turns and starts down the hill the potential energy changes to kinetic energy, the energy of motion.

There are seven main forms of energy: mechanical, heat, chemical, radiant, electrical, sound, and nuclear.

The Law of Conservation of Energy states that energy is neither created nor destroyed. It changes from one form to another. Some energy may be lost to friction or air resistance, but the overall amount of energy stays the same.

There are many sources of the energy we use every day. These sources of energy fall into two groups called nonrenewable and renewable resources.

Most of the energy used in the United States comes from nonrenewable resources. These resources are called nonrenewable because they are limited. They include coal, petroleum, natural gas, propane, and uranium.

Renewable energy resources can be replaced and, in some cases, are considered to be limitless. Examples of renewable resources include solar energy, wind energy, biomass, geothermal energy, and hydropower.

PROGRAM QUIZ

Now it is time for the program quiz. There will be ten questions that require short-answers.

Question One:

How are potential and kinetic energy different from each other?

Question Two:

What are the seven main forms of energy?

Question Three:

The Law of Conservation of Energy states that energy is neither created nor destroyed. What does this mean?

Question Four:

What are nonrenewable resources? Give some examples of nonrenewable resources.

Question Five:

What are renewable resources? Provide some examples.

Question Six:

What are some of the problems associated with burning fossil fuels?

Question Seven:

Why are nonrenewable resources also called fossil fuels?

Question Eight:

How were fossil fuels formed?

Question Nine:

Why is the Law of Conservation of Energy so important?

Question Ten:

What are some things people can do to conserve energy?