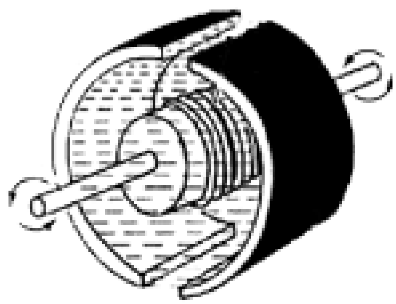
GENERATING ELECTRICITY

From

Electricity and Magnetism
A Unit of Study

Produced by
Colgren Communications

Written by
John Colgren



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GENERATING ELECTRICITY

from

Electricity and Magnetism A Unit of Study

Grade Levels: 5-8

Viewing Time: 15 minutes

INTRODUCTION

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

This program is about how electricity is generated at power plants. It begins with a discussion of the 2003 blackout that affected eight states in the United States and two provinces in Canada. The program presents information about how power plants are organized and the principles behind generating a flow of electricity. Various forms of energy are used to turn the turbines and spin the generators. The program presents information about hydroelectric power, fossil fuel plants, nuclear facilities, wind turbines, solar cells, and geothermal plants.

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.
- Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced.

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 program and participating in the lesson activities, the students should be able to do the following:

• Identify and describe how various fuels and energy sources are used to generate electricity at power plants.

• Describe how a power plant is set up. Identify parts of the plant, including the fuel-fired furnace, heat exchanger, turbine, generator, condenser, transformers, and high tension wires.

• Describe how we have become dependent on electricity over the years and how this key energy source is such a vital part of our society.

ASSESSMENT TOOLS

This lesson provides you with three different assessment tools. Together they make it possible to closely follow 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 **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.

The **Post-Test** (**Blackline Master 10**) can be used as a final test for the lesson.

UNIT TEST

An optional Unit Test has been provided with this lesson. It can be used as a final test to gauge student comprehension of the material presented in all five lessons of this Unit of Study. Answers to the Unit Test are provided in the Answer Key of this instructor's guide.

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

Develop a list on the chalkboard with the help of your students that includes different uses of electricity. Have the class think about uses at home as well as at school. Remind students that dry cells used in toys, flashlights, and remote controls are also producers of electricity. Once the list is on the chalkboard, ask the students to image what their world would be like without electricity. You may want them to describe how things would be different as a written assignment, as a class discussion, or first as a small group discussion and then a class discussion.

VIEW THE PROGRAM

Viewing time for this program is 15 minutes. The program quiz that follows the presentation will take about three minutes when you build in pauses for recording answers.

DISCUSSION QUESTIONS

After viewing the program, you may wish to conduct a discussion based on the following:

1. What images do the students remember from the blackout of August, 2003? Was anyone in an area that was affected by the blackout? What do they remember seeing on television newscasts?
2. Discuss the various energy sources used at power plants to generate electricity. Which sources do class members consider to be the most worthwhile and valuable?

DESCRIPTION OF BLACKLINE MASTERS

This program contains ten 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. Students' scores on the **Pre-Test** can be compared with their scores on the final Post-Test (Blackline Master 10).

• **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, Generators and Electric Motors**, are very similar and yet they have completely different uses. This sheet gives information about each and asks students to find out more.

• **Blackline Master 4, Power Plant**, contains a diagram of a fuel-fired power plant. Students are asked to describe what happens at each of the main parts of the plant. At the bottom of the page, students are to list other energy sources used to generate electricity.

• **Blackline Master 5, Lemon Juice**, is an experiment for building a wet cell from a lemon.

• **Blackline Master 6, Wet Cell**, is an experiment for building a wet cell from strips of copper and zinc and copper sulfate.

• **Blackline Master 7, Voltaic Pile**, is an experiment to demonstrate how a voltaic pile can be constructed.

• **Blackline Master 8, Safety Check**, asks the students to conduct a safety check of their home. They should look for situations where possible problems could occur.

• **Blackline Master 9, Write a Story**, is a writing exercise. Students should imagine a world without electricity.

• **Blackline Master 10, Post-Test**, is an evaluation tool for this unit.

ENRICHMENT ACTIVITIES

1. Have interested students research the construction of the Hoover Dam and give a presentation to the class.

2. Bring in some old electric motors from washing machines, power tools, toys, etc. Allow the students to take them apart and find things like a coil of wire, magnets, and armatures.

ANSWER KEY

• **Blackline Master 1, Pre-Test**

A. Matching

1. c	4. e
2. f	5. d
3. a	6. b

B. Short Answer

1. coal, oil, natural gas
2. Steam is used to spin the blades of a turbine at the power plant. The turbine is connected to a drive shaft that spins the magnet, or coil of wire, in a generator.
3. A generator uses coiled wire and a magnet to produce electricity. Either the wire is spun in a magnetic field or the magnet is spun in a coil of wire.

4. Electricity can be produced chemically or physically. Some of the methods for producing electricity is through solar cells, geothermal energy, fossil fuels, nuclear reactions, wind power, and hydroelectric plants.

• **Blackline Master 2, Program Quiz**

1. coal, natural gas, oil
2. falling water
3. sunlight
4. A step-up transformer increases the voltage, or push, behind electricity so that it can travel great distances to users many miles away.
5. Voltage is the push behind an electric current.

• **Blackline Master 3, Generators and Electric Motors**

1. An electric motor is designed so that electricity coming into a coil of water creates a magnetic field. Because there is a magnet surrounding the coiled wire, the two magnetic fields interact. The coil of wire has a metal armature running through it and there is a method for having the electricity to the armature turn on and off like an electromagnet.
2. A generator produces electricity when either a coil of wire is spun in a magnetic field or a magnet is spun in a coil of wire.

• **Blackline Master 4, Power Plant**

A fuel is burned in a furnace. A pipe going through the furnace carries water that will change to steam from the heat of the burning fuel. The steam is directed through pipes into a heat exchanger, where the pipe is in contact with water and that water turns to steam. The steam from the exchanger is piped past the blades of a turbine, which works like a pinwheel and spins. The turbine is connected to a drive shaft that runs into the generator. The drive shaft spins a magnet in a coil of wire or a coil of wire in a magnetic field. This creates a flow of electrons that are moved into a step-up transformer, which increases the voltage of the electricity so that the current can travel across high tension wires for great distances. When the electricity gets close to a user, the wires go into a substation and step-down transformers that lower the voltage. Eventually, the electricity gets to a house or business where the voltage is lowered even more to 220 and 120 volts.

Other energy sources used to generate electricity include chemicals, solar energy from the sun, heat from the earth called geothermal energy, and wind energy from wind turbines.

• **Blackline Master 5, Lemon Juice**
Observations: The needle on the compass should spin or move.

• **Blackline Master 6, Wet Cell**
Observations:
The voltameter should show an electric current was produced.

• **Blackline Master 7, Voltaic Pile**
Observations:
1. The voltameter should indicate a flow of electrons.
2. It should show a greater movement on the voltameter.

• **Blackline Master 8, Safety Check**
1. Sticking something, especially something made of metal, which is a good conductor of electricity, into a toaster is a very dangerous thing. The knife could touch an electrical contact in the toaster and cause electricity to go into the knife and you.
2. Water is a good conductor of electricity. If a radio or television were to fall into the water, it would cause a short circuit and electrocute the person in the tub.
3. Pulling on a power cord to remove it from a wall outlet is a very bad idea. This could damage the outlet or the cord. The cord could become torn and cause a short. The outlet might be damaged and that damage may remain hidden behind the face plate. Wires inside the outlet could come loose and cause a short or a fire.
4. Water is a good conductor of electricity, so wet hands is a dangerous thing to be bringing near an outlet.

• **Blackline Master 9, Write a Story**
Answers will vary.

• **Blackline Master 10, Post-Test**
<u>I. Definitions</u>
1. <u>transformer</u> - Used to step-up or step-down the voltage of an electric current.

2. generator - Produces electricity when a coil of wire spins in a magnetic field or a magnet spins in a coil of wire.
3. turbine - An engine or motor which looks like a pinwheel and spins when steam is forced past the blades.
4. cell or battery - There are wet and dry cells which use chemical reactions to generate electricity.
5. high tension wires - Used to carry electricity over great distances from the power plant to end users.
6. fossil fuels - Remains of prehistoric plants and animals, which formed over millions of years of being buried underground. Coal, natural gas, and oil are fossil fuels.
7. hydroelectric dam - A power plant that uses falling water to turn the turbines and spin the generators.
8. solar cell - Uses the energy of sunlight to create electricity.

II. Short Answer
1. A nuclear power plant uses the energy from radioactive decay to heat water and change it to steam. Everything else stays the same.
2. The turbine is like a pinwheel. It uses steam energy to spin the blades of the turbine and causes a drive shaft that runs into the generator to turn.
3. A generator is either made of a coil of wire in a magnetic field or a magnet spinning in a coil of wire.
4. A nuclear power plant uses radioactive material to heat the water and change it to steam. There are radioactive wastes created from the used uranium pellets and these must be buried or stored safely some place.
5. Answers will vary.

• Unit Test
I. Matching

1. d	6. g
2. h	7. c
3. f	8. e
4. a	9. b
5. i	

II. Short Answer
1. copper, silver, gold
2. wood, glass, rubber, cloth, plastic

3. Insulators are used to stop the flow of electricity. In-sulators around a wire will stop the electricity from moving out of the wire and into another conductor.
4. A generator produces electricity. It is made of either a coil of wire spinning in a magnetic field or a magnet spinning in a coil of wire. In either case, a flow of electrons is created.
5. An electromagnet can be made with a source of electrons, some wire, and an iron nail. Wrap the wire around the nail. Connect the wire ends to the terminals of the battery and you have an electromagnet.
6. An electromagnet can be turned on and off, but a regular bar magnet can't.
7. A source of electrons, a path for the electrons to flow along, and something to use the electrons.
8.

9. A series circuit has one path on which electricity flows. If a bulb in a series circuit burns out, all the lights go out. A paral-lel circuit has two paths on which the electricity flows. If one bulb burns out, there is still a path for the electricity to flow along, so other bulbs in the circuit stay lit.
10. Fuses and circuit breakers will automatically trip, or stop, the flow of electricity if the circuit becomes overloaded by the flow of current.
11. Answers will vary.
12. The sun's energy through the use of solar cells, wind tur-bines, geothermal energy, chemical energy.
13. They would move apart because they would be repel-led.
14. They would come together because they are attracted.
15. a. 4 amps b. 8 amps c. 6 amps

INTERNET RESOURCES

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

1. "What Is Electricity?" by Energy Information Admin-istration.
http://www.eia.doe.gov/kids/electricity.html

2. Clark County Public Utilities in the state of Washington has a wonderful site with excellent pages on topics related to electricity.
http://clarkpud.apogee.net/kids/

3. Energy Story at the Energy Quest Site.
http://www.energyquest.ca.gov/story/index.html

SCRIPT OF NARRATION

We have become so used to having electricity that if for some reason we are without it for even a short period of time, it becomes a real hardship.

No lights, no television, no computer, and spoiled food in the refrigerator. Electricity is very important to our lives.

On August 14, 2003, eight states and two Canadian provinces experienced the worst blackout and power failure in history. Fifty million people were affected. More than one hundred power plants, 22 of which were nuclear power plants, were involved. Here is a satellite image of the area affected on the night of August 14.

The strength and reliability of the power grid, which allows power stations to share electrical energy, has been cast into doubt. This grid ties power stations through a huge network of transmission lines, so that if one area needs more electricity, power can be transferred from one station to another.

In the United States, there are more than 6,000 power generating plants that use coal, oil, gas, falling water, wind, or nuclear fission to generate the electricity used throughout the country.

There are more than a half-million miles of high-tension transmission wires that carry the electricity.

If there is a problem, such as a transmission line fails, that part of the grid is suppose to be disconnected, or shut off.

Monitors, computers, and safety switches are all designed to assure that if a problem takes place in one area, it won't spread to other parts of the grid.

For electricity to be useful, it must be flowing in what is called an electric current. We generate electricity in various ways.

We can get it from the chemical reactions in a battery. Or we power our homes with electricity from a power plant that uses giant generators.

We can even get electricity from the sun. Solar cells can take the energy from sunlight and turn it into electrical energy. Here is a solar panel made up of solar cells. When the panel is brought into the sunlight, it generates electricity to run this small electric motor and spin the propeller.

A wind turbine is another way to generate electricity. Let's look at these different methods for generating electricity.

CELLS AND BATTERIES

Chemical energy can be turned into electrical energy. A cell, like the dry cells used in this flashlight, are examples of a device that can change chemical energy into electrical. There are two different types of cells, dry cells and wet cells. Both are made up of chemicals, called electrolytes, that conduct electricity. There are also two electrodes, which are made of two different conducting materials.

Here is an example of a wet cell. It is made with the electrolyte copper sulfate and two electrodes zinc and copper. A chemical reaction between the copper sulfate and the zinc rod leaves extra electrons on the zinc. The copper rod loses electrons and takes on a positive charge. If we provide a path for the electric current to travel along by connecting the two electrodes, then electrons will travel from the zinc to the copper. We can connect a voltameter to see that electrons are flowing.

You can make a wet cell from a lemon and a piece of zinc and a piece of copper. We cut two small slices into the lemon skin. The two metal plates are inserted into the lemon. Wires attach the copper and zinc strips to this voltameter and we can see the dial move indicating a flow of electrons. The acidic juice of the lemon is acting like an electrolyte.

Dry cells are like wet cells but the electrolyte in a dry cell is a paste or a solid. The paste produces the chemical reaction in the two electrodes. A battery is one or more cells connected together as a single unit.

This twelve-volt battery is used to power a car.

A flashlight uses two 1-½ volt batteries to power a 3-volt light.

GENERATING AT THE POWER PLANT

The electricity used at home, stores, offices and schools, and throughout our towns and cities is produced in power plants.

At a power plant, giant generators made of coiled wire and magnetic fields produce the electric current used so commonly throughout our daily lives.

Michael Faraday discovered a long time ago that a magnet moving in and out of a coil of wire produces an electric current. A generator is composed of a coil of wire spinning inside a magnetic field or a magnet spinning in a coil of wire. Either way a flow of electricity is produced.

This hand generator demonstrates that idea. As you can see, it takes a lot of effort to turn the handle that spins the shaft of coiled wire inside the magnets. The person turning the handle will work hard to keep the bulb lit, even for a short period of time. The person is using chemical energy from the food they ate to turn the shaft with mechanical energy. The mechanical energy of the spinning coil of wire in the magnetic field is changed to electrical energy as a current begins to flow.

At a power plant, the generators are huge and require some other form of energy to spin the drive shaft. Power plants use different energy sources to power their generators.

Many plants use nonrenewable resources called fossil fuels. Coal, petroleum, and natural gas are fossil fuels. These resources have been produced over millions of years.

They were made from the plants and animals that lived during prehistoric times. These animals and plants stored energy from the sun as the plants used photosynthesis for food production and animals ate the plants.

Now, millions of years later, when these remains are burned, the energy from the sun is released.

So a power plant using fossil fuels has a giant furnace where the fuel is burned. A pipe with water flowing through it is sent through the furnace. The water is heated and changes to steam.

The steam is directed to giant turbines. These turbines are like a pinwheel. The blades of the pinwheel spin in the wind.

The turbine blades will spin when the steam quickly travels past them. The turbine's drive shaft is attached to the generator shaft to spin a large magnet in a coil of wire.

After the steam moves through the turbine, it is then directed to a condenser that cools the steam and turns it back to water. The water can then be sent back through the furnace to turn to steam and start the process again.

A nuclear power plant also uses steam and turbines to power the generators, but instead of burning fossil fuels, at the nuclear plant a controlled nuclear reaction is used to heat the water.

Uranium atoms are radioactive, which means that the atoms split into two different atoms. In the process, energy is released. This splitting of atoms is called nuclear fission. The amount of fission can be controlled inside the nuclear reactor.

Pellets of uranium are put into hollow rods. These rods are lowered into the power plant core, which is surrounded in water. A chain reaction occurs as uranium atoms split and change into smaller elements. Free neutrons are released into the core to start the reaction. If a neutron hits the nucleus of a uranium atom, the atom splits. When this happens, two neutrons are released and they go on to collide with other uranium atoms, causing additional atoms to split. Each time an atom splits, energy is released as well. This energy is used to heat water to steam. And the steam is sent past turbine blades to spin the generators. The steam then passes into the condenser where a different water source is used to cool the steam and change it back to water to be reused. The water that is used in the condenser has turned hot, so it is sent to cooling towers. This white smoke coming from the cooling towers contains no pollutants, which is a real advantage over fossil burning plants. However, the nuclear waste material is radioactive and must be stored for thousands of years. Fuel pellets are stored in huge vats of water.

To control the reaction, control rods made of elements that absorb, or collect, neutrons are lowered into the core. These control rods collect extra neutrons and stop them from splitting atoms, so this slows down the reaction.

One fuel pellet of uranium releases as much energy as the burning of about 1,000 kilograms, or 2,000 pounds, of coal.

We can demonstrate the idea behind a chain reaction by setting a bunch of mouse traps with ping pong balls as shown here. When a single ping pong ball is released into this environment, it starts the chain reaction. Let's look at that once again in slow motion.

Sunlight can be used to power a solar cell and produce an electric current. This solar panel is made up of photocells. The photocell changes light energy into electrical energy. You can see that it is generating a flow of electricity when we connect the solar panel to a voltmeter. Notice that if the solar panel is covered, the voltage drops off.

This calculator is powered by a photocell.

This fire station signal is powered by solar cells. If there is a need for the signal to operate, it always has power.

Along the side of the road on this stretch of interstate in Ohio, solar cells are used to power an animal detection system. To help warn travelers that deer are present, this system sends an infrared light from pole to pole. If a deer walks through this beam of light, it sets off a warning signal for drivers. Hopefully this automatic system will help to protect wildlife.

A wind turbine is powered by the wind. Placed in an area where there is often a wind, this turbine can produce an ample supply of electricity. The blades of the turbine spin. The turbine shaft is connected to a generator. It spins copper wire in a magnetic field and electricity is produced.

Here is a scaled down model of a wind turbine. Notice that when we place the turbine in a stream of air, an electric current is produced to light this small bulb.

At a hydroelectric dam, the energy for the generators is produced by falling water. This is a very clean way to generate electricity. Water is held behind the dam and then valves are opened to let the water flow through pipes and past the turbine blades.

Geothermal energy is being used in some parts of the world to produce electricity. The word geothermal comes from the Greek words *geo* which means earth and *therme* which means heat. Geothermal energy is energy from within the earth.

The areas with greatest geothermal potential are found around plate boundaries and in areas of volcanic and seismic activity. This plant is located in northern California. It is one of the plants at the Geysers. First developed in1960, this is the largest geothermal energy complex in the world. Wells are drilled one or two miles into the earth to tap into this energy. These wells can bring either steam or hot water to the surface to be used in the power plant. Steam from a dry steam geothermal well can be sent directly to the turbines. In a hot water plant, hot water brought to the surface is changed to steam and sent to the turbines. After the steam cools and turns back to water, it is sent back through a different pipe into the ground to be used again.

Geothermal plants have many advantages such as they are environmentally clean, they can produce power 24 hours a day all year long, and there is an endless supply of this kind of energy.

There is another way to make an electric current, but it is not used to generate large amounts of electricity. Instead it is used to record the temperatures inside ovens, car engines, or furnaces. It is called a thermocouple. Two wires made of different materials, such as iron and copper, are twisted together at two different ends. One end is put into a cold environment while the other end is in a hot environment. The greater the difference between these two temperatures, the greater the flow of electricity as demonstrated by this set up.

DISTRIBUTION

Once the power plant has produced the electricity, there needs to be a way to send it to users. So at the power plant, they use step up transformers to boost the push behind the electricity. Voltage is a measure of the push behind electricity.

In our homes, the voltage from an outlet is 120 volts. That's powerful enough to run our refrigerator, or an electric stove, or a vacuum cleaner.

In contrast, this 1-1/2 volt battery is used to light a very small bulb.

The voltage at the power plant is about 26,000 volts. A substation at the power plant will be used to step up the voltage.

To move the electricity over these high tension wires across hundreds of miles, the voltage must be pushed up to anywhere from 138,000 to 765,000 volts. This reduces the power loss during a long distance transmission.

When the electricity gets close to a destination, a step down transformer is used to lower the voltage.

There are transformers on power poles to lower the voltage even more for use in households. Factories usually need higher voltage for equipment they use. Often the voltage needed at the factory is twice that used at home.

Electric poles are commonly seen running along streets and across neighborhoods. These poles often carry not only the power lines but also telephone and even cable television lines. However, there are places where power lines, telephone lines, and television cables are buried underground. This is common in cities or suburban areas. Workers have to work underground to repair cables in these situations. This worker is using hot solder to connect some wires.

TRANSFORMER

A transformer increases or decreases the voltage, or strength, of an alternating current.

A transformer is made of an iron ring with two different coils of wire. The primary coil is the one that receives the electric current. A second coil is called the secondary coil. If this coil has more loops than the primary coil, the voltage is increased. This is called a step up transformer. It increases the voltage from an alternating current source.

A step down transformer decreases the voltage. The secondary coil has fewer loops than the primary coil. A transformer like this might be used to change the 120 volts of a household outlet into a safer 9 or 12 volts to use with electric toys.

ELECTRICAL SAFETY

Electricity can be very dangerous if misused, so you must always be careful around outlets and power lines. Obviously, the power lines used to transmit electricity over great distances carry huge amounts of electrical power and voltage. That's why the lines are held so high in the air away from people and animals. Never go near these huge towers.

The power lines you see around your home are also dangerous. They carry high voltage, so never go near a fallen power line.

Outlets can also be dangerous. Many parents put child proof safety caps on home outlets to stop the little fingers of infants from going where they don't belong. Don't stick anything into an outlet because you may receive a huge electric shock or start a fire.

Maybe you have seen an outlet that looks like this? This is like a miniature circuit breaker. It is called a ground fault circuit interrupter. These devices are usually found in kitchens or bathrooms to protect against electrical shock.

When using electrical devices, you must be cautious. Don't pull on a cord to free the plug from the outlet.

Also, be careful with worn or torn power cords. These shouldn't be used. Report the damaged cord to an adult. Remember, humans are good conductors of electricity.

Water is also a good conductor of electricity, so never bring anything that runs on electricity near water. Be careful around the bathroom. Don't bring a radio, hair dryer, or other electrical devices near sinks and tubs of water. This is very dangerous.

Don't use octopus plugs in outlets. This kind of behavior can overload a circuit. With many things plugged into the same outlet, there is a great demand for current. As too much current goes into the circuit, it could cause a build up of heat and start a fire.

Electricity might be considered our most important source of power. We must remember to use it carefully.

Now it is time for the program quiz. There will be five short-answer questions.

1. Some power plants use fossil fuels to heat the water needed to generate electricity. What are some fossil fuels?

2. What does a hydroelectric power plant use to turn the turbines, which are connected, to the generators that make electricity?

3. What does a solar cell or photoelectric cell need to produce electricity?

4. What does a step-up transformer do at a power plant?

5. What is voltage?