Understanding: Electricity: Teacher's Guide

Grade Level: 9-12	**Curriculum Focus:** Physical Science	**Lesson Duration:** One or two class periods

Program Description

Electricity has dramatically changed lifestyles in much of the world—but how does it work? In segments that cover television technology, the harnessing of electricity, and electromagnetic power, students examine the physical force that powers a vast array of modern devices and technologies. This program includes two feature segments and two short segments.

Onscreen Questions

- How does a television signal travel?
- What is the difference between a conductor and an insulator?
- How do doctors use electrical signals to treat heart patients?
- How is mechanical energy converted into electrical energy?

Lesson Plan

Student Objectives

- Research one of three professions related to electricity.
- Write a story about performing this job.
- Share their ideas with their classmates.

Materials

- *Understanding: Electricity* video and VCR, or DVD and DVD player
- Paper and pencils
- Computer with Internet access

Procedures

1. Show students the "Electricity's Power" segment, having them focus on the professions—lightning researcher, scientist specializing in electricity in space, and a lineman.
2. Next, have students choose one profession to research. Their task is to learn about the profession and write a story as if they worked in that field.
3. Give students time in class to work on their stories. The following Web sites are good starting points for their research.

   Lightning Researcher

   - http://www.floridaenvironment.com/programs/fe00703.htm
   - http://home.att.net/~amcnet3/fulgurites/uman_conleynajafi.html
   - http://www.pr.ufl.edu/we_said.htm
   - http://www.usatoday.com/weather/resources/askjack/walightn.htm

   NASA Research on Electricity

   - http://www.space.com/businesstechnology/technology/space_tether_020306-1.html
   - http://www.spaceflightnow.com/news/n0202/05proseds/
   - http://www.mufor.org/rch3.htm
   - http://www.padrak.com/ine/BLOWSNASA.html

   Lineman

   - http://www.ci.edmond.ok.us/Electric/elec_crews.html
   - http://www.dailyitem.com/archive/2003/0901/local/stories/05local.htm
   - http://www.wapa.gov/media/cct/2003/july3/25no141.htm
   - http://www.trainingtechnology.com/safetytrng/SFTY470.htm
4. As students write their stories, make sure they include the following:
   - an individual worker's tasks
   - safety precautions
   - accomplishments
   - high points of the profession
5. Encourage students to be as creative as possible. Have them incorporate details about the profession to make the piece exciting or suspenseful.
6. Ask volunteers to share their stories. Try to have all three professions covered in the student presentations.
7. Conclude the lesson by asking students if they realized how many professions involved electricity. Discuss whether the activity broadened their ideas about career options.

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students participated actively in class discussions; researched a profession thoroughly; wrote an interesting, informative, and creative story.
- **2 points:** Students participated in class discussions; researched a profession; wrote a competent story.
- **1 point:** Students did not participate in class discussions; did not complete research about a profession; did not write a complete story.

Vocabulary

current

Definition: The flow of electricity

Context: A circuit provides a path along which an electrical current can flow.

electrical energy

Definition: Energy associated with the movement of electrical charges

Context: The power of running water can move turbines in a generator, resulting in the production of electrical energy.

electrician

Definition: An individual who has knowledge of electrical systems and who can build and fix electrical systems

Context: During power outages, people often turn to an electrician for help.

lightning

Definition: The dramatic collision of a positively charged object and a negatively charged object that produces an electrical spark

Context: Lightning, or the discharge of an electrical spark, occurs when electrons move from areas of negative charge to areas of positive charge.

lineman

Definition: A specialized worker who sets up and repairs power lines

Context: The lineman, whose job requires climbing on power lines to inspect or repair them, has a difficult and dangerous job.

static electricity

Definition: The type of electricity associated with the accumulation of excess electrical charges on objects

Context: Lightning is the most dramatic example of static electricity, but we usually experience it after walking on a carpet and then touching something containing metal.

Academic Standards

National Academy of Sciences

The National Science Education Standards provide guidelines for teaching science as well as a coherent vision of what it means to be scientifically literate for students in grades K-12. To view the standards, visit http://books.nap.edu.

This lesson plan addresses the following science standards:

- Physical Science: Motions and forces; Interactions of energy and matter

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit http://www.mcrel.org/.

This lesson plan addresses the following national standards:

- Science—Physical Sciences: Understands the sources and properties of energy
- Language Arts—Viewing: Uses viewing skills and strategies to understand and interpret visual media; Writing: Uses the general skills and strategies of the writing process, Uses the stylistic and rhetorical aspects of writing, Gathers and uses information for research purposes

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Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- http://school.discovery.com/teachingtools/teachingtools.html

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DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How To Use the DVD

The DVD starting screen has the following options:

Play Video—This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index—Here the video is divided into four parts (see below), indicated by video thumbnail icons. Watching all parts in sequence is similar to watching the video from start to finish. Brief

descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

***Curriculum Units*—**These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. Total running times for these segments are noted. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

***Standards Link*—**Selecting this option displays a single screen that lists the national academic standards the video addresses.

***Teacher Resources*—**This screen gives the technical support number and Web site address.

Video Index

I. Tune In to TV (5 min.)

Television has come a long way since its introduction in 1939. Explore TV's history and how images travel from the camera to your screen.

II. Generating Electricity (18 min.)

In our daily lives, we depend on electricity. Discover how this energy is generated and then transmitted from power plants to our cities and homes.

III. Bright Lights, Big Benefits (19 min.)

Travel to Las Vegas, the brightest city in the world. Then see how electricity is improving the lives of heart patients and amputees.

IV. Energy From the Earth (5 min.)

Dig deep for a look at geothermal energy, one of the cleanest and most-efficient ways to generate electricity.

Curriculum Units

1. Transmitting Waves

Pre-viewing question
Q: How has television transformed our society?
A: Answers will vary.

Post-viewing question
Q: What would life be like without TV?
A: Answers will vary.

2. Digital Technology

Pre-viewing question
Q: How has television technology changed?
A: Answers will vary.

Post-viewing question
Q: In what ways does digital technology enhance TV?
A: Its pictures and sounds are clearer. Because analog signals vary in strength, transmissions can be distorted easily. Digital also takes up less "room" within the cables that carry the signals to your home, creating space for hundreds of new channels.

3. Studying Lightning

Pre-viewing question
Q: What would it be like to be struck by lightning?
A: Answers will vary.

Post-viewing question
Q: How does the lightning rocket work?
A: This high-power lightning rod, of sorts, is shot up into the air. When lightning hits the wire attached to it, electric current moves down the wire and disintegrates into a green vapor in an instant.

4. Electromagnetic Energy

Pre-viewing question
Q: What is electricity?
A: The flow of electrical charge

Post-viewing question
Q: What is electric current?
A: Electric current—anything from static electricity to lightning—is a group of electrons moving from negative to positive.

5. Generating Electricity in Space

Pre-viewing question
Q: Why might scientists look to space for generating electricity?
A: Answers will vary.

Post-viewing question
Q: On what principle was the space shuttle experiment based?
A: That when you move a conductor through a magnetic field, electrons start to flow, generating an electrical current that can flow through a circuit

6. Blackouts

Pre-viewing question
Q: Have you ever experienced a power outage?
A: Answers will vary.

Post-viewing question
Q: What is a power grid?
A: This vast electrical system is woven together with a web of power lines, live wires carrying half a million volts of electricity.

7. Hydroelectricity

Pre-viewing question
Q: What's the best way to produce large amounts of electricity?
A: Answers will vary.

Post-viewing question
Q: How is water used to produce electricity?
A: The power of falling water spins the blades of a turbine. The turbine's shaft spins a magnet inside a tightly wound wire coil. This motion causes electrons to move in the wires and produce an electrical current.

8. The Brightest City

Pre-viewing question
Q: Why are people drawn to Las Vegas?
A: Answers will vary.

Post-viewing question
Q: How does a light bulb work?
A: As the electrons try to crowd through a bulb's hair-thin tungsten wire, the energy spent overcoming resistance turns into heat, which in this case, is light. The filament reaches a temperature of about 4,500 degrees Fahrenheit.

9. Experiments and Discoveries

Pre-viewing question
Q: Could our bodies function without electricity?
A: Answers will vary.

Post-viewing question
Q: What makes a heart beat?
A: Every second, electrical impulses spread through the heart muscle, triggering and coordinating a movement.

10. Bionic Parts

Pre-viewing question
Q: Would it be difficult to use an electric prosthetic?
A: Answers will vary.

Post-viewing question
Q: How does the Utah Arm work?
A: The device uses the body's own electrical impulses to operate and control a prosthetic arm. When the brain sends an electrical signal to flex the arm muscles, the impulse is intercepted at the muscle site by electrodes, or skin sensors. This electric impulse is then amplified and used by the microcomputer to control the electrical motors in the arm.

11. Solar Powered Electricity

Pre-viewing question
Q: What are the benefits and drawbacks of solar power?
A: Answers will vary.

Post-viewing question
Q: How does a solar panel work?
A: Photovoltaic cells, or solar panels, convert energy radiated by the sun into electricity. When a solar panel is put out into the sun, the materials within it release electrons and produce electricity.

12. Natural Electricity

Pre-viewing question
Q: What problems come from burning fossil fuels?
A: Answers will vary.

Post-viewing question
Q: What is geothermal energy, and how is it produced?
A: Heat inside the Earth creates vast underground regions of hot rock. When these regions come into contact with underground water, they can form geothermal reservoirs that can reach temperatures three times the boiling point of water. Harnessing this energy is one of the cleanest ways to produce the steam needed by electric generators.