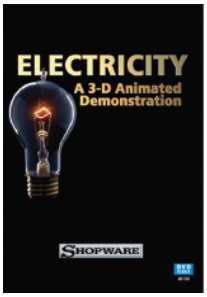


Instructor's Guide

Electricity: A 3-D Animated Demonstration

ELECTRIC CURRENT

Introduction

This instructor's guide provides information to help you get the most out of *Electric Current,* part of the eight-part series *Electricity: A 3-D Animated Demonstration.* The series makes the principles of electricity easier to understand and discuss. The series includes *Electrostatics; Electric Current; Ohm's Law; Circuits; Power and Efficiency; Electricity and Magnetism; Electric Motors;* and *Electric Generators*.

Electric Current examines the physics concepts and processes at play in the creation and function of electric currents, as well as applies equations to measure (and calculate) various electric current operations and elements.

Learning Objectives

After watching the video program, students will be able to:

- Explain the significance of the battery's creation
- Explain how conductors and insulators are related to electric current
- Diagram the electron flow in an electric current
- Demonstrate how to measure voltage and current
- Describe what causes alternating current and how it differs from DC current
- Describe and diagram the wiring systems associated with AC voltage
- Demonstrate select physics principles associated with electric current

Educational Standards

National Science Standards

This program correlates with the National Science Education Standards from the National Academies of Science, and Project 2061, from the American Association for the Advancement of Science.

Science as Inquiry

Content Standard A: As a result of activities in grades 9-12, all students should develop:

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Physical Science

Content Standard B: As a result of their activities in grades 9-12, all students should develop an understanding of:

- Structure of atoms
- Motions and forces
- Conservation of energy and increase in disorder
- Interactions of energy and matter

Science and Technology

Content Standard E: As a result of activities in grades 9-12, all students should develop understanding of:

- Abilities of technological design
- Understandings about science and technology

History and Nature of Science

Content Standard G: As a result of activities in grades 9-12, all students should develop understanding of

- Nature of scientific knowledge
- Historical perspectives

National Science Education Standards, from the National Academies of Science, and Project 2061 come from the American Association for the Advancement of Science. Copyright 1996 by the National Research Council of the National Academy of Sciences. Reprinted with permission.

English Language Arts Standards

The activities in this instructor's guide were created in compliance with the following National Standards for the English Language Arts from the National Council of Teachers of English.

- Standard 7: Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.

- Standard 8: Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

Standards for the English Language Arts, by the International Reading Association and the National Council of Teachers of English. Copyright 1996 by the International Reading Association and the National Council of Teachers of English. Reprinted with permission.

Mathematics Standards

This program correlates with the Principles and Standards for School Mathematics by the National Council of Teachers of Mathematics.

Problem Solving

Instructional programs from pre-kindergarten through grade 12 should enable all students to:

- Build new mathematical knowledge through problem solving
- Solve problems that arise in mathematics and in other contexts
- Apply and adapt a variety of appropriate strategies to solve problems

Reasoning and Proof

Instructional programs from pre-kindergarten through grade 12 should enable all students to:

- Select and use various types of reasoning and methods of proof

Principles and Standards for School Mathematics by the National Council of Teachers of Mathematics. Published 4/12/2000. Reprinted with permission.

Technology Standards

The activities in this Teacher's Guide were created in compliance with the following National Education Technology Standards from the National Education Technology Standards Project.

Standard 2: Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.

Standard 3: Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information.

Standard 4: Critical Thinking, Problem-Solving & Decision-Making

Students use critical thinking skills to plan and conduct research, manage projects, solve problems and make informed decisions using appropriate digital tools and resources.

The National Education Technology Standards reprinted with permission from the International Society for Technology Education. Copyright 2007.

Program Summary

This program explores how electric energy became an essential tool with the advent of electricity storage, allowing the flow of current to do useful work. Conductors and insulators, voltage, and current are defined and examined, using a water flow model to help ensure understanding. The difference between electron flow and current flow models is explained, and the nature of direct and alternating current (both one- and two-phase) is developed.

Main Topics

Topic 1: Tapping a Source
This introductory section speaks to the work of the electric current from a historical perspective. It emphasizes the discovery of the battery, a device that allows for a steady supply of electric charge.

Topic 2: Conductors and Insulators
Here, students examine conductors and insulators, which are substances that respectively work to effectively or poorly conduct electricity.

Topic 3: Direction of Flow
In this section, students learn about electron flow theory (current flows from negative to positive) that overshadows the commonly accepted positive-to-negative concept.

Topic 4: Potential Difference
This segment introduces the concept of Electric Potential Difference, what is used to describe potential energy or the ability to do work, in this case the potential between a battery's charged poles.

Topic 5: Measuring Voltage
Students identify what voltage is (the electric potential difference between a pair of terminals) and how it is measured — in volts. They also learn how to measure "work done" or the change in potential energy.

Topic 6: Measuring Current
In this section, students learn what defines electric current or the flow of electric charge and how that current is measured. They also learn that electricity's destructive force depends on the strength of voltage and current.

Topic 7: Alternating Current
Here, the function and use of alternating current (AC) is discussed at length. AC current is also differentiated from DC current to note its energy-efficient value as a transporter of electricity. Finally, students learn what causes the current to alternate.

Topic 8: AC Voltage
This final portion describes the layout and types of wires associated with alternating current, as well as examines how voltage is measured. It also describes the differences between two-wire and three-wire systems to explain how volt service differs and can be heightened.

Fast Facts

- Italian physicist Alessandro Volta invented the electrochemical cell, leading to an early form of electric battery.
- English scientist Stephen Gray was the first to describe conductors, a class of substances in which electricity easily flows.
- Gray also identified insulators (such as glass and rubber), which are materials that conduct electricity poorly. Insulators are important tools for isolating conductors to prevent a loss of current.
- The planet Earth is a conductor of electricity. The human body can also conduct electricity because of impurities in the body's fluids.
- Benjamin Franklin's premise that flow of electricity was from positive to negative turned out to be not quite right (since he was basing it on an earlier, incorrect work). In fact, electron flow is the flow of negative elementary charges toward a positive charge.
- Charged battery poles connected by a conductor allow for the creation of a circuit.
- Three-wire systems can power devices like a stove, which require more voltage than the standard pair of wires that provide electricity in a home.
- In North America, alternating current shifts through 60 cycles (the flow of electrons from zero to positive, then negative and back to zero again) every second (the 60-cycle alternating current).
- A battery's voltage varies with age, use, and temperature.
- The amount of work that gets done in an electric circuit also depends on how much charge is flowing.

Vocabulary Terms

AC (alternating current) circuit: An electrical current with a magnitude and direction that vary cyclically, as opposed to direct current with a direction that remains constant.

AC voltage: This is the type of electricity that is typically found in a home. AC voltage in Americn homes is commonly 110 or 120 volts for most ordinary consumer electronic items.

ampere: A unit of electric current equal to one coulomb per second.

atom: The smallest unit of matter that still retains the properties of whichever element it is a part of. Atoms are composed of subatomic particles called protons, neutrons, and electrons.

battery: A collection, series, or a group of electrochemical cells.

circuit: A path between two or more points along which an electrical current can be carried.

conductor: A material (like a metal) through which electricity and heat flow easily.

coulomb: The amount of electricity transported by a current of one ampere flowing for one second; one coulomb is equal to 6.25×10^{18} elementary charges.

electric current: A flow of electrons in an electrical conductor. The strength or rate of movement of the electricity is measured in amperes.

electric potential difference: The electric potential difference is the work done per unit charge as a charge is moved between two points in an electric field.

electrochemical cell: A device that changes chemical energy into electrical energy.

electrochemistry: The study of the interchange of chemical and electrical energy.

electron: A negatively charged particle that is a very small part of an atom.

electroscope: An instrument for detecting the presence of static electricity.

gravitational potential energy: The energy stored in an object as the result of its vertical position or height. The energy is stored as the result of the gravitational attraction of the Earth for the object.

hydroelectric: Electricity produced by turbines that are turned by water flow.

insulator: Non-conductive resistant materials (rubber, plastic, etc.) that keep electricity on its path.

joule: A measurement of work or energy. One joule is equal to one watt times one second.

LED (Light Emitting Diode): A semiconductor light source that emits visible light or invisible infrared radiation.

proton: A positively charged subatomic particle usually found in the nucleus of an atom.

terminal: A connecting point in a circuit where a wire is attached to create an electrical connection.

volt: A unit of electromotive force or potential difference.

voltage: A measure of the pressure under which electricity flows.

voltmeter: Electronic meter used to measure voltage; used to measure the electric potential difference between two points in an electric circuit.

zinc: A metallic chemical element.

Pre-Program Discussion Questions

1. Describe what a battery does. Why is a battery so useful?
2. In terms of electricity, what is a conductor? What is an insulator?
3. In what direction do you think an electric current flows?
4. What makes AC current different from DC current?
5. What type of voltage do you use to run most of your appliances at home? How would you increase voltage, if you had to?

Post-Program Discussion Questions

1. Explain the relationship between a battery and conductors and insulators.

2. Describe the conventional current flow theory. What challenge does it pose in terms of the physics of the electric current?

3. What does a circuit enable a battery to do?

4. How are the behavior of water and the electric current flow similar (or analogous)?

5. What exactly is AC current? How does such a current occur?

Individual Student Projects

Measure Up!
Students apply physics equations to measure voltage and current. To jumpstart this activity visit www.sciencebuddies.org; click on "Project Guide," then scroll down and choose "How to Measure Voltage & Current."

Looking At AC Voltage
Students diagram two-wire and three-wire systems that demonstrate AC current and voltage in those configurations.

The Water Analogy
Students create visual representations of the water analogy (presented in the program) as it relates to the direction of the electron flow and/or electric potential difference (and thus also a demonstration of electron flow and/or electric potential difference).

Group Activities

Testing Concepts

Student groups can each conduct a different experiment that examines current electricity in the context of one of the physics properties and/or principles (electron flow, insulator, conductor, potential difference, batteries, etc.) discussed in the program. Have students keep process and observation journals that reflect their findings and how the physics principles the program explores are manifested. The following are some interesting experiments:

- Conductors and Insulators: www.iit.edu/~smile/ph9019.html
- Electron Current Flow: www.iit.edu/~smile/ph9118.html
- How Smart Are You About Electricity, Batteries And Conductors?: www.iit.edu/~smile/ph9306.html
- Physical Science Activity Manual (see Current Electricity): www.utm.edu/departments/cece/cesme/PSAM/PSAM.shtml
- The water circuit: modelling current and potential difference: http://practicalphysics.org/go/Experiment_666.html
- Use of a voltmeter:_http://practicalphysics.org/go/Experiment_688.html

Battery Building

Student groups can construct a battery not only to observe its function, but also to observe and document the concepts and actions of electric current. Several battery-building activities are found at:

- Experiments with Homemade Batteries: www.creative-science.org.uk/sea1.html
- Get a Job…Build a Battery: www.thirteen.org/edonline/nttidb/lessons/ma/battma.html
- Lemon Battery: http://pbskids.org/zoom/activities/sci/lemonbattery.html
- Making a Battery: http://seplessons.ucsf.edu/node/291
- Veggie Power! Making Batteries from Fruits and Vegetables: www.sciencebuddies.org; search on "Making Batteries from Fruits and Vegetables"

AC Current: A Visual Representation

Students create a diagram, a 3-D model, or, if possible, a virtual gizmo of AC current. The representation should include explanations, and might demonstrate how AC and DC currents differ.

Internet Activities

All About Volta and/or Gray

Students further explore the work and life of Alessandro Volta and/or Stephen Gray to create an annotated timeline or a biography of the experiments of either or both men, as well as other discoveries and related work.

What DO You Know about Electric Current?

Students can test their electric current knowledge by taking an online quiz. (Be sure to review the questions first and to remove those that students are not likely to understand in terms of content.)

- Alternating Current (AC) Electricity: www.school-for-champions.com/science/ac.htm
- Electric Current True/False Quiz: www.shs.d211.org/science/faculty/MJP/s432/reviewquizzes/2ndsemesterreview/p2quiz/truefalsecircuit.htm
- Electricity Knowledge Quiz: http://school.discoveryeducation.com/quizzes20/curriculumcenter/CC_Electricity.html
- Electric Power Quiz: www.batesville.k12.in.us/physics/PhyNet/e&m/current/power_quiz.htm

An Electric Current Slideshow

Students can review several electric current slideshows, designed to introduce and/or review the topic, and then create one that they feel best represents electric current basics.

- Electric Current: Concept Summary: www.batesville.k12.in.us/physics/PhyNet/e&m/current/ECurrent_Notes.htm
- Electricity Generation: www.physics.rutgers.edu/~kotliar/honors/honsem02/somalwar/HonSem02/Energy%20Generation.ppt

Assessment Questions

1: The rate at which electric charge flows in a current is measured in_____.
a) amperes b) joules c) coulombs

2: Which of the following does *not* represent electric current measurement?
a) $I = Q/\Delta t$ b) $A = C/S$ c) $V = \Delta E_Q/Q$

3: A _____ is a path that is made for an electric current.

4: How does conventional current compare to electron flow?
a) Conventional current moves in the same direction as electron flow.
b) Conventional current moves back and forth, while electron flow is only in one direction.
c) Conventional current moves in the opposite direction as electron flow.

5: A car headlamp takes a 3.5A current. How much charge in coulombs will be transferred if the headlamp is used for one hour?
a) 420 C b) 12,600 C c) 25,200 C

6: Which of the following is *not* an insulator?
a) rubber b) copper c) glass

7: Which statement is true?
a) The direction of flow of charge will change when a battery runs down, thus lowering voltage.
b) The electric potential difference between two battery terminals never changes.
c) The direction of flow of charge will not change as a battery runs down, thus lowering voltage.

8. What is significant about Volta's inventing the electrochemical cell?

9: The amount of work that gets done in an electric circuit also relies on how much _____ is flowing.

10: What behavior does AC current exhibit?

Assessment Questions Answer Key

1: The rate at which electric charge flows in a current is measured in_____.

a) amperes
b) joules
c) coulombs

A: amperes
Feedback: The flow of electric charge, or electric current, is defined as the quantity of charge passing a given point divided by the interval of time during which the charge is moving. Electric current is measured in amperes. At any given point in a circuit, if one coulomb or charge passes the point in one second, the electric current is one ampere: one ampere of current is a flow of one coulomb of charge in one second.

2: Which of the following does *not* represent electric current measurement?

a) $I = Q/\Delta t$
b) A = C/S
c) $V = \Delta E_Q/Q$

A: c
Feedback: (a) and (b) represent electric current measurement: (a) is the quantity of charge passing a given point divided by the interval of time during which the charge is moving; (b) represents that one ampere of current is a flow of one coulomb of charge in one second. (c) represents a voltage measurement equation.

3: A _____ is a path that is made for an electric current.
A: circuit
Feedback: In a battery, if poles are connected, using a conductor, what is known as a circuit is created. Work is done by the flowing electrons in the circuit. The simplest kind of work is the heating of the conductor. A fresh battery continues to pump charge up the imaginary hill to create a potential difference between the two poles. And so the battery, as long as it remains connected to a circuit, continues to do work.

4: How does conventional current compare to electron flow?

a) Conventional current moves in the same direction as electron flow.
b) Conventional current moves back and forth, while electron flow is only in one direction.
c) Conventional current moves in the opposite direction as electron flow.

A: c
Feedback: Electron flow is a flow of negative elementary charges towards a positive charge. Conventional current flow is from the surplus at the positive terminal to the scarcity at the negative terminal.

5: A car headlamp takes a 3.5A current. How much charge in coulombs will be transferred if the headlamp is used for one hour?

a) 420 C
b) 12,600 C
c) 25,200 C

A: b
Feedback: The physics equation that applies is A = C/S. In this problem, the hour must be turned into seconds: thus, one hour is 3,600 seconds x 3.5 = 12,600 coulombs.

6: Which of the following is *not* an insulator?

a) rubber
b) copper
c) glass

A: b
Feedback: Conductors are substances in which electricity easily flows: metals, such as copper, are good conductors. Insulators poorly conduct electricity.

7: Which statement is true?

a) The direction of flow of charge will change when a battery runs down, thus lowering voltage.
b) The electric potential difference between two battery terminals never changes.
c) The direction of flow of charge will not change as a battery runs down, thus lowering voltage.

A: c
Feedback: The electric potential difference between two battery terminals may change. As the battery runs down, the voltage will become lower. But the direction of flow of charge will not change. Electrons will always flow from negative to positive. Direct current, or DC, is the term given to this kind of current.

8. What is significant about Volta's inventing the electrochemical cell?
A: The invention of the electrochemical cell was the invention of the battery.
Feedback: Volta created a practical source of electric current; he created the first battery by inventing the electrochemical cell. The battery provides a steady supply of electric charge.

9: The amount of work that gets done in an electric circuit also relies on how much _____ is flowing.

A: charge
Feedback: Regardless of the electric potential difference between one point and another, the amount of work that gets done in an electric circuit also depends upon how much charge is flowing. Enough charge flows through a flashlight bulb to exhaust the battery in only a few hours. Much less charge flows through a high-intensity flashing LED light, which may run for hundreds of hours, using current from the same battery.

10: What behavior does AC current exhibit?
A: The current generated is constantly changed from positive to negative and back again.
Feedback: In a conducting wire, an electron flows first one way and then the other in an alternating current, or AC circuit. This change from full flow in a positive direction, through no flow on the way to full flow in a negative direction, produces a kind of sloshing effect on the electrons, so they appear to compress together and expand apart again.

Additional Resources

BOOKS

Electricity and Magnetism, by Kyle Kirkland, Ph.D. Facts on File, 2007. ISBN: 978-0-8160-6112-9

Awesome Experiments in Electricity & Magnetism, by Michael A. DiSpezio. Sterling, 1999. ISBN: 0806998199

Basic Electricity, by Nooger and Neville Van Valkenburgh. Prompt; 1st edition, 1995. ISBN: 0790610418

Basic Electricity: Reprint of the Bureau of Naval Personnel Training Manual, by Staff of the Bureau of Naval Personnel. Barnes & Noble Books, 2004. ISBN: 9780760752388

Electric Universe: The Shocking True Story of Electricity, by David Bodanis. Crown, 2005. ISBN: 1400045509

Flying Tinsel, by Grant Mellor, by Cuisinaire Company of America, Inc. White Plains, New York, 1993. 0938587331

Physics Demonstrations: A Sourcebook for Teachers of Physics, by Julien Clinton Sprott. University of Wisconsin Press; 1st edition, 2006. ISBN: 0299215806

Safe and Simple Electrical Experiments, by Rudolf F. Graf. Dover Publications, Inc., 1973. ISBN: 0486229505

Schaum's Outline of Basic Electricity, 2nd edition, by Milton Gussow. McGraw-Hill, 2006. ISBN: 0071474986

WEB SITES

All About Circuits: Voltage and Current
www.allaboutcircuits.com/vol_1/chpt_1/4.html

comPADRE: Digital Resources for Physics and Astronomy Education
www.compadre.org

How Stuff Works: How Electricity Works
http://science.howstuffworks.com/electricity4.htm

How Stuff Works: Direct Current vs. Alternating Current
http://science.howstuffworks.com/electricity5.htm

HyperPhysics: Electric Current
http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

IEEE: Insulators and Conductors
www.ieee.org/web/education/preuniversity/tispt/condinsul.html

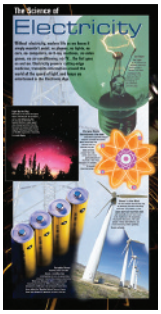
Learn Physics Today — Chapter 13: The Current
http://library.thinkquest.org/10796/ch13/ch13.htm

NDT Resource Center: Electrical Current
http://www.ndt-ed.org/EducationResources/HighSchool/Electricity/electricalcurrent.htm

Teacher Tube
www.teachertube.com

Try Engineering: Insulators and Conductors
www.tryengineering.org/lesson_detail.php?lesson=17

Additional Resources from www.films.com • 1-800-257-5126



The Science of Electricity Poster
- **17" x 32" Poster**
- **Correlates to National Science Education Standards**
- **Item # 36854**

Recommended for grades 7-12. © 2006

Newton's 3rd Law Poster
- **17" x 22" Poster**
- **Item # 39208**

This is poster 8 of the 8-part poster series *Physics of Fun*. Recommended for grades 6-12. ©2008

Current Electricity

- **DVD #3552**
- **Includes viewable/printable instructor's guide**

The program examines how a flow of electric charge is harnessed when an electrostatically charged object is grounded. A dry cell, or "battery," is introduced as a source of current electricity. The concepts of complete circuits, their energy conversions, electrical currents, and the ampere—the unit for currents—are also illustrated.

Investigations in Physics: Experiments and Observations

- **DVD/ VHS #6842**
- **Preview clip online**
- **Correlates to educational standards**
- **"Useful in secondary physics classes, especially where hands-on experimentation is limited."**
  —School Library Journal

Designed for basic physics labs, this 9-part series offers an extensive collection of demonstrations and experiments essential to any core physics curriculum. Each program features three related lessons that are supported by tabletop close-ups, computer graphics and animation, re-creations of famous experiments using replicas of original equipment, and simple, concise narration. Some lessons incorporate sophisticated equipment not normally found in schools. Selected demonstrations take viewers to exotic sites to dramatically illustrate fundamental physics principles. The series includes *Equilibrium of Forces • Motion of Bodies and Mechanical Energy • Pressure • Heat • Waves and Sound • Optics • Magnetism and Static Electricity • Electrical Energy • Electric Current* (30 minutes each)

Electric Power on the Move

- **DVD #34288**
- **Preview clip online**
- **Correlates to national science educational standards**
- **Includes viewable/printable instructor's guide**

This *Science Screen Report* examines the production, transportation, and consumption of electricity. Using the Hoover Dam as an example of efficient hydroelectric power generation, the program illustrates how transformers raise or lower voltage to manageable levels and how electricity is specifically channeled to illuminate buildings, power devices, and propel vehicles. Vital electrical concepts are discussed, including the difference between alternating and direct current, the advantages of neon over filament bulbs, and the definitions and significance of ohms, volts, and amperes. Produced in association with the Accreditation Board for Engineering and Technology and the Junior Engineering Technical Society. (18 minutes) © 2004

Electricity and Magnetism

- **CD-ROM #10267 (Windows/Macintosh)**
- **Preview clip online**
- **Correlates to the National Science Education Standards developed by the National Academies of Science and Project 2061 Benchmarks for Science Literacy from the American Association for the Advancement of Science.**
- **Includes activity sheets**

Since the early experiments with electricity over two hundred years ago, scientists have made many discoveries that help explain its nature. These discoveries have linked many areas of science including static electricity, electric current, magnetism, and materials. In all areas of our life at home and at school we rely on electricity, which has become a crucial part of modern society. Electricity and Magnetism examines the principles involved and gives students an insight into this fascinating topic, covering such subjects as: Static electricity; Attraction/repulsion; Current electricity and electrical circuits; Measuring electricity—current, voltage, meters; Electrical calculations; Magnetism—materials, fields, rules, Earth's field; Field around a current-carrying wire; Link between electricity and magnetism—induction. © 1999

Electronics and Electrical Engineering, Volume 1

- **DVD/ VHS #36072**
- **Preview clip online**
- **Close captioned**
- **Correlates to educational standards**
- **Includes viewable/printable instructor's guides**

This 20-part series covers everything from basic electrical theory, to electronics troubleshooting, to residential electrical wiring. The series includes • *Electrical Principles* • *Electric Circuits: Ohm's Law* • *Electrical Components, Part I: Resistors, Batteries, and Switches* • *Electrical Components, Part II: Capacitors, Fuses, Flashers, and Coils* • *Electrical Components, Part III: Transformers, Relays, and Motors* • *Electronic Components, Part I: Semiconductors, Transistors, and Diodes* • *Electronic Components, Part II: Operation—Transistors and Diodes* • *Electronic Components, Part III: Thyristors, Piezo Crystals, Solar Cells, and Fiber Optics* • *Electrical Troubleshooting* • *Electronic Troubleshooting* • *The Service Entrance* • *Panelboards* • *Wiring Methods* • *Grounding* • *GFCIs and AFCIs* • *Receptacles and Switches* • *Wiring Light Fixtures* • *Wiring for Appliances* • *Math in Electrical Technology* • *Electrical Safety.* Recommended for high school, technical or vocational school, and training programs. (18-24 minutes each) © 2006

Energy I Video Library

- **DVD #30960**
- **Close captioned**
- **Correlates to educational standards**
- **Includes user guides**

Contains 22 video clips on forms of energy, nuclear energy, electricity, and magnetism:

- Fuel Cells
- Energy Production
- Solar Energy
- Chemical Energy

- Potential and Kinetic Energy
- Nuclear Energy Forms
- Nuclear Medicine
- Nuclear Submarines
- Electrical Energy
- The Body Electric
- Electricity Production
- Electromagnetism
- Lodestone
- Introduction to Nuclear Energy
- Natural Nuclear Reactions
- The Atomic Bomb
- Introduction to Electricity
- Harnessing Electricity
- High Wire Act
- Introduction to Magnetism
- Animal Navigation
- Earth as a Magnet

The Energy I Video Library is part of the complete Discovery Channel/Films for the Humanities & Sciences Science Video Library. © 2003

Physical Processes

- **CD-ROM #8116 (Windows/Macintosh)**
- **Preview clip online**

Pictures, diagrams, text, sound, and video help students understand electricity, electromagnetism, energy, forces and motion, and sound and light in this completely interactive CD-ROM.

- *Forces and Motion* includes information on forces of attraction and repulsion, gravity, friction, springs and elastic, balanced and unbalanced forces, speed, distance and time, moments and pivots, pressure, and measuring forces.
- *Light and Sound* answers questions such as: What are waves? What makes sounds? Topics include pitch and frequency; loudness and amplitude; sound traveling in different materials; hearing; effects of properties of light; how light is reflected; colors in white light; effects of color filters; and modern applications of light.
- *The Earth and Beyond* includes information on apparent movement of the sun and stars; night and day; relative positions and motion of the planets; eclipses; the earth as seen from space; comets and asteroids; and the life cycle of stars.
- *Energy Source and Energy Transfer* includes information on the variety of energy sources—coal, oil, natural gas, water, solar, nuclear, wind, wave, tidal, geothermal, and batteries. Generation of electricity is discussed, along with finite and renewable sources, energy transfer and conservation, and the impact of production on the environment.