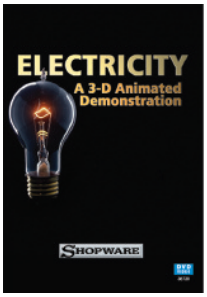

SHOPWARE

Instructor's Guide

Electricity: A 3-D Animated Demonstration

OHM'S LAW

Introduction

This instructor's guide provides information to help you get the most out of *Ohm's Law,* 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*.

Ohm's Law explores the law's applications and limitations with regard to series and parallel circuits.

Learning Objectives

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

- Identify the properties of series, parallel, and complex circuits
- State and apply Ohm's Law
- Calculate equivalent resistance in series, parallel, and complex circuits

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 investigates the application and limitations of Ohm's Law. Series circuits and parallel circuits are described. Using equivalent resistance, practical exercises are developed in the application of Ohm's Law to series circuits, parallel circuits, and circuits of greater complexity.

Main Topics

Topic 1: Ohm's Law
The film's opening introduces Georg Simon Ohm's exploration of resistance and the emergence of Ohm's Law, which demonstrates the relationship between voltage, resistance, and current.

Topic 2: Series Circuits
Here, students examine the composition and function of a series circuit, and apply Ohm's Law to analyze voltage, resistance, and current in this type of circuit.

Topic 3: Series Calculations: Equivalent Resistance
In this segment, students learn how to apply Ohm's Law to determine the equivalent resistance in a series circuit, as well as its current and voltage.

Topic 4: Parallel Circuits
This section centers on the components and function of parallel circuits, as well as applies Ohm's Law to determine this type of circuit's voltage, resistance, and current.

Topic 5: Parallel Calculations: Equivalent Resistance
In this segment, students apply Ohm's Law to determine a parallel circuit's equivalent resistance, as well as its current and voltage.

Topic 6: Complex Circuits
This final segment demonstrates how Ohm's Law can be used to calculate equivalent resistance, current, and voltage in circuits with structures more complicated than those of series and parallel circuits.

Fast Facts

- In the early 19th century, German physicist Georg Simon Ohm demonstrated that resistance depends on both the electric potential difference in a wire and the current flowing through it.
- The relationship between voltage, resistance, and current that Ohm uncovered is known as Ohm's Law.
- Ohm's Law applies most usefully with good conductors: the law does not work with more complex resistors, like electric motors and semi-conductors.
- Most power sources are usually connected to several different loads at a time.
- Resistors are connected one after another in a series circuit.

- In a series circuit, if one resistor fails, the circuit is broken and electricity no longer flows.
- In a series circuit, voltage varies across each different resistance, and the voltage depends on the number of resistors in the circuit. Remove a resistor from the circuit and the voltage drop across a resistor changes for every resistor left behind.
- In a parallel circuit, each resistor has a separate pathway to and from the power source's terminals.
- The amount of charge leaving one terminal of a parallel circuit must equal the amount of charge arriving at the other terminal.
- The simplest circuit has one path for current flow and a single resistor. The more complex series circuit has a single path for current flow but has more than one resistor. A parallel circuit is yet more complex with more than one resistor, each with its own pathway for current.

Vocabulary Terms

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

complex circuit: A circuit with hundreds or thousands of parts, and that combines series and parallel circuits. They are used in items such as televisions and computers.

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

current: The flow of electricity, commonly measured in amperes.

equivalent resistance: Total resistance of all the individual resistances in a circuit.

load: A device that consumes electrical power and is connected to a source of electricity.

Ohm's Law: Defines the relationship between voltage, resistance, and current.

parallel circuit: A circuit that splits into branches. A break in one branch will not stop current in the other branches.

potential difference: Work that must be done against electrical forces to move a unit charge from one point to the other.

resistance: The characteristic of materials to oppose the flow of electricity in an electric circuit.

resistor: A device used to control current by providing resistance.

semi-conductor: A material with the ability to conduct electricity which falls between that of conductors and insulators.

series circuit: A circuit that connects a source, load, and conductors in a single loop. Any break in the circuit will stop the flow of current.

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.

Pre-Program Discussion Questions

1. What is a circuit, and what is it used for?
2. Based on their descriptors, what might series and parallel circuits be?
3. Given what you have surmised in question 2, what might be the composition of a complex circuit?
4. What is "resistance" in the context of electricity? What might a resistor be?
5. What is voltage? Is it measurable? Explain.

Post-Program Discussion Questions

1. What is significant about Georg Simon Ohm's work with conductor resistance?
2. What does Ohm's Law measure? What variables are involved in the law's calculations?
3. Describe the basic components of series and parallel circuits. What are their primary differences?
4. Why is voltage compared to water in the program? What does the comparison demonstrate, particularly in terms of voltage drop?
5. Explain the equivalent resistance formulas for series and parallel circuits.

Individual Student Projects

Just How Circuits Work
Students review How Circuits Work at http://www.howstuffworks.com/circuit.htm and then create their own version of how series, parallel, or more complex circuits work. Students may submit their project to the How Stuff Works Web site, or share it with their classmates.

Creating Calculations
Students can come up with several problems that require Ohm's Law to solve. They can have their classmates do the calculations.

Integrated Circuits
Students can research the creation and evolution of the integrated circuit. They can create a timeline that includes a prediction of how such circuits will further evolve in the future.

Group Activities

Work the Circuit
Students can build parallel and series circuits, maintaining a process and observation journal. Students can also compare series and parallel circuits. Circuit-making sites include the following (you can also reference books in this guide's Additional Resources section):

- Comparing Series and Parallel Circuits: http://msnucleus.org/membership/html/k-6/as/technology/3/ast3_2a.html
- Exploring Series and Parallel Circuits: www.iit.edu/~smile/ph9113.html
- Parallel and Series Circuits: http://wow.osu.edu/experiments/electricity/parallelcirc.html
- Shocking Truth — Circuits: http://library.thinkquest.org/6064/circuit.html

Applying Ohm's Law
Students can practically apply Ohm's Law and document their findings. Several activities include:

- 223 Physics Lab: Ohm's Law & Kirchhoff's Rules: http://phoenix.phys.clemson.edu/labs/223/ohmsla w/index.html
- Ohm's Law: www.allaboutcircuits.com/vol_6/chpt_2/5.html
- Physics Experiment: Ohm's Law: www.batesville.k12.in.us/Physics/PhyNet/e&m/current/labs/ohms_law.htm

Bringing Georg to Life

Students create an activity that has Georg Simon Ohm "himself" explain Ohm's Law and its relationship to series and parallel circuits. This might be in dramatic form (a student is Georg teaching a class and engaging them in calculations); in a print or virtual cartoon/comic book format; or as a children's science book (to make concepts easy to understand). These representations incorporate all relevant physics principles.

Internet Activities

How Interactive Can Circuits Be?

Students review and rate several sites exploring series and parallel circuits. Then, they create a "storyboard" representing a site they would create to best educate students and others on how these circuits function. If students have the tech capability, they might actually design and launch a site. Sites to jumpstart reviews include:

- Experiment 41 — Series and Parallel Circuits: www.physicslessons.com/iphysics.htm
- Series and Parallel Circuits: http://lgfl.skoool.co.uk/viewdetails_ks3.aspx?id=487
- Series and Parallel Circuits — Current Flow and Potential Difference: www.moe.gov.sg/edsoftware/ir/files/physics-electricity/index.html
- Series Circuits: http://lgfl.skoool.co.uk/viewdetails_ks3.aspx?id=478

More About Georg Simon Ohm

Students further explore Ohm's contributions to physics and science and then present a visual, written, or digital biography of his life and work. Sites to jumpstart student research include:

- Georg Simon Ohm: www.theelevatormuseum.org/e/e-11.htm
- Georg Simon Ohm: The Discovery of Ohm's Law: www.juliantrubin.com/bigten/ohmlawexperiments.html
- Georg Simon Ohm: www.thiel.edu/digitalelectronics/people/ohm/Georg%20Ohm.htm

Problem Solving with Ohm's Law

Students can test their ability to apply Ohm's Law by trying their hand at related problem solving. The following sites have problem-solving tasks (be sure to review the questions first and to remove those that students are not likely to understand in terms of content and/or remove visible solutions):

- Ohm's Law: www.grc.nasa.gov/WWW/K-12/Sample_Projects/Ohms_Law/ohmslaw.html
- Ohm's Law Story Problems: www.ahsd25.k12.il.us/schools/thomas/jbingaman/ohmslaw.htm
- Ohm's Law and Series Circuits: www.hazelwood.k12.mo.us/~grichert/sciweb/ohmdcsc.htm
- Ohm's Law Made Easy with a Spreadsheet: www.learnnc.org/lessons/HildaHamilton5232002743

Assessment Questions

1: What was Ohm able to determine through his exploration of conductors?

2: In Ohm's Law, what do R, V, and I represent?

3: What is the voltage if current is 0.5 amps and resistance is 0.8 ohm?

4: What is the resistance if voltage is 3.0 V and current is 1.5 A?

5: What is the result of one failed resistor in a series circuit?

6: Which of the following is *not* characteristic of a parallel circuit?
- **a) Each resistor has a separate pathway.**
- **b) Voltage varies across each different resistance.**
- **c) The voltage drop across a pathway must be the same as that of the entire circuit.**

7: Using V=IR, what is the equation for obtaining the amount of current in a series DC circuit when Voltage, V, and Resistance, R, are known?

8: In a series DC circuit, with a supply voltage of 40 volts and a resistor of 12 ohms, what is the current drawn by the load (resistor)?

9: Which one of the following is true about a parallel circuit?
- **a) The current gets less as it goes round the circuit.**
- **b) The current remains the same and the voltages across each component add up to the battery voltage.**
- **c) The currents add up to the total current and the voltage remains the same.**

10: Which of the following sequences represents the correct way of finding the total resistance of three parallel resistors?
- **a) RT = R1 + R2 + R3**
- **b) 1/RT = 1/R1 + 1/R2 + 1/R3**
- **c) RT = 1/R1 + 1/R2 + 1/R3**

Assessment Questions Answer Key

1: What was Ohm able to determine through his exploration of conductors?
A: Ohm was able to show that resistance depends on both the electric potential difference in a wire and the current flowing through it.
Feedback: The relationship between voltage, resistance, and current that he developed is known as Ohm's Law.

2: In Ohm's Law, what do R, V, and I represent?
A: R = resistance (in ohms); V = voltage (in volts), I = current (in amperes or amps)
Feedback: The unit of resistance is known as the ohm. The resistance of the load is one ohm, when one ampere (amp) of current flows across a potential difference of one volt.

3: What is the voltage if current is 0.5 amps and resistance is 0.8 ohm?
A: 0.4 volts
Feedback: Using Ohm's Law, the equation is V = I x R; in this case, multiply the resistance amount by the amount of current to get the amount of voltage.

4: What is the resistance if voltage is 3.0 V and current is 1.5 A?
A: 2 ohms
Feedback: Using Ohm's Law, the equation is R=V ÷ I; divide the voltage by the current to reach the resistance.

5: What is the result of one failed resistor in a series circuit?
A: The circuit is broken, thus ceasing the flow of electricity.
Feedback: In a series circuit, the resistors are connected one after another in the circuit. The same current flows through all the connectors and loads.

6: Which of the following is *not* characteristic of a parallel circuit?
a) Each resistor has a separate pathway.
b) Voltage varies across each different resistance.
c) The voltage drop across a pathway must be the same as that of the entire circuit.
A: b
Feedback: In a parallel circuit, each resistor has its own separate pathway to and from the terminals of the power source. Since there is only one resistor in each pathway from one terminal to the next, the voltage drop across a single pathway must be the same as the voltage drop across the entire unit. Answer b is true of series circuits.

7: Using V=IR, what is the equation for obtaining the amount of current in a series DC circuit when Voltage, V, and Resistance, R, are known?
A: I=V/R
Feedback: Expressions for Current (I=V/R) and Resistance (R=V/I) should be as familiar as V=IR to the student. These are simple algebraic transpositions.

8: In a series DC circuit, with a supply voltage of 40 volts and a resistor of 12 ohms, what is the current drawn by the load (resistor)?
A: 3.33 Amperes
Feedback: This is obtained by the now familiar I=V/R equation of Ohm's Law for current. I=40 volts/12 ohms=3.33 amps.

9: Which one of the following is true about a parallel circuit?
a) The current gets less as it goes round the circuit.
b) The current remains the same and the voltages across each component add up to the battery voltage.
c) The currents add up to the total current and the voltage remains the same.
A: c
Feedback: In the parallel circuit as a whole, the sum of the currents through each separate pathway must equal the current arriving and leaving the terminals of our source of electricity.

10: Which of the following sequences represents the correct way of finding the total resistance of three parallel resistors?
a) RT = R1 + R2 + R3
b) 1/RT = 1/R1 + 1/R2 + 1/R3
c) RT = 1/R1 + 1/R2 + 1/R3
A: b
Feedback: The total resistance is equal to the reciprocal of the sum of the reciprocal values of the individual resistors.

Additional Resources

BOOKS

Physics Experiments On File™. Facts on File, 2003. ISBN-10: 0816050430

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

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

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

WEB SITES

All About Circuits: Correct Use of Ohm's Law
www.allaboutcircuits.com/vol_1/chpt_5/6.html

All About Circuits: Simple Parallel Circuits
www.allaboutcircuits.com/vol_1/chpt_5/3.html

All About Circuits: Simple Series Circuits
www.allaboutcircuits.com/vol_1/chpt_5/2.html

All About Circuits: What are "series" and "parallel" circuits?
www.allaboutcircuits.com/vol_1/chpt_5/1.html

BBC: Bitesize Revision — Series circuits and parallel circuits
www.bbc.co.uk/schools/ks3bitesize/science/physics/electricity_4.shtml

Classroom of the Future: Electricity and Power in Space
http://iss.cet.edu/electricity

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

HyperPhysics: Ohm's Law
http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

IEEE: Get Connected with Ohm's Law
www.ieee.org/web/education/preuniversity/tispt/lohmslaw.html

Molecular Expressions: Electricity & Magnetism — Ohm's Law
http://micro.magnet.fsu.edu/electromag/java/ohmslaw/index.html

NDT Resource Center: Ohm's Law
www.ndt-ed.org/EducationResources/HighSchool/Electricity/ohmslaw.htm

NDT Resource Center: Series and Parallel Circuits
www.ndt-ed.org/EducationResources/HighSchool/Electricity/seriesparallelcircuits.htm

Pedagogy in Action
http://serc.carleton.edu/sp/index.html

School Physics
www.schoolphysics.co.uk

School for Champions: Ohm's Law for Electrical Circuits
www.school-for-champions.com/science/elect_ohms_law.htm

Science Joy Wagon: The Physics Zone — Ohm's Law
www.sciencejoywagon.com/physicszone/otherpub/wfendt/ohmslaw.htm

Series and Parallel Connections
www.kpsec.freeuk.com/seriespa.htm

the12volt.com — Ohm's Law
www.the12volt.com/ohm/ohmslaw.asp

Virtual Laboratory: Voltage — Welcome to the Voltage Circuit Simulator
http://jersey.uoregon.edu/vlab/Voltage

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

Electricity and Electronics (10-part series)

- **DVD/ VHS #34798**
- **Preview clip online**
- **Close captioned**
- **Correlates to educational standards**
- **Includes viewable/printable instructor's guides.**

This ten-part series provides a comprehensive video guide to the study of electronics, ranging from the fundamental laws and principles of electricity at the atomic level to troubleshooting and repair of electronic components. Lively computer animation and hands-on demonstrations make these videos an ideal resource for the classroom. The series includes the following titles: *Electrical Principles • Electrical 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 Circuit Repair.* A Shopware Production. (18-24 minutes each) © 2006

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 sceince 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
- Solar Energy
- Potential and Kinetic Energy
- Nuclear Energy Forms
- Nuclear Medicine
- Nuclear Submarines
- Electrical Energy
- The Body Electric
- Electricity Production
- Electromagnetism
- Lodestone
- Energy Production
- Chemical Energy
- 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