

# Electricity: The Invisible River of Energy

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**AIMS Multimedia**



1-800-FOR-AIMS

1-800-367-2467

# Congratulations!

You have chosen a learning program that will actively motivate your students AND provide you with easily accessible and easily manageable instructional guidelines designed to make your teaching role efficient and rewarding.

The AIMS Teaching Module provides you with a video program keyed to your classroom curriculum, instructions and guidelines for use, plus a comprehensive teaching program containing a wide range of activities and ideas for interaction between all content areas. Our authors, educators, and consultants have written and reviewed the AIMS Teaching Modules to align with the Educate America Act: Goals 2000.

This ATM, with its clear definition of manageability, both in the classroom and beyond, allows you to tailor specific activities to meet all of your classroom needs.

## RATIONALE

In today's classrooms, educational pedagogy is often founded on Benjamin S. Bloom's "Six Levels of Cognitive Complexity." The practical application of Bloom's Taxonomy is to evaluate students' thinking skills on these levels, from the simple to the complex: Knowledge (rote memory skills), Comprehension (the ability to relate or retell), Application (the ability to apply knowledge outside its origin), Analysis (relating and differentiating parts of a whole), Synthesis (relating parts to a whole), and Evaluation (making a judgment or formulating an opinion).

The AIMS Teaching Module is designed to facilitate these intellectual capabilities, AND to integrate classroom experiences and assimilation of learning with the students' life experiences, realities, and expectations. AIMS' learner verification studies prove that our AIMS Teaching Modules help students to absorb, retain, and to demonstrate ability to use new knowledge in their world. Our educational materials are written and designed for today's classroom, which incorporates a wide range of intellectual, cultural, physical, and emotional diversities.

# **ORGANIZATION AND MANAGEMENT**

To facilitate ease in classroom manageability, the AIMS Teaching Module is organized in four sections. You are reading Section 1, Introduction to the Aims Teaching Module (ATM).

## **SECTION 2,**

### **INTRODUCING THIS ATM**

will give you the specific information you need to integrate the program into your classroom curriculum.

## **SECTION 3,**

### **PREPARATION FOR VIEWING**

provides suggestions and strategies for motivation, language preparedness, readiness, and focus prior to viewing the program with your students.

## **SECTION 4,**

### **AFTER VIEWING THE PROGRAM**

provides suggestions for additional activities plus an assortment of consumable assessment and extended activities, designed to broaden comprehension of the topic and to make connections to other curriculum content areas.

# FEATURES

## INTRODUCING EACH ATM

### SECTION 2

Your AIMS Teaching Module is designed to accompany a video program written and produced by some of the world's most credible and creative writers and producers of educational programming. To facilitate diversity and flexibility in your classroom, your AIMS Teaching Module features these components:

#### **Themes**

The Major Theme tells how this AIMS Teaching Module is keyed into the curriculum. Related Themes offer suggestions for interaction with other curriculum content areas, enabling teachers to use the teaching module to incorporate the topic into a variety of learning areas.

#### **Overview**

The Overview provides a synopsis of content covered in the video program. Its purpose is to give you a summary of the subject matter and to enhance your introductory preparation.

#### **Objectives**

The ATM learning objectives provide guidelines for teachers to assess what learners can be expected to gain from each program. After completion of the AIMS Teaching Module, your students will be able to demonstrate dynamic and applied comprehension of the topic.

## **PREPARATION FOR VIEWING**

### **SECTION 3**

In preparation for viewing the video program, the AIMS Teaching Module offers activity and/or discussion ideas that you may use in any order or combination.

#### **Introduction To The Program**

Introduction to the Program is designed to enable students to recall or relate prior knowledge about the topic and to prepare them for what they are about to learn.

#### **Introduction To Vocabulary**

Introduction to Vocabulary is a review of language used in the program: words, phrases, usage. This vocabulary introduction is designed to ensure that all learners, including limited English proficiency learners, will have full understanding of the language usage in the content of the program.

## **Discussion Ideas**

Discussion Ideas are designed to help you assess students' prior knowledge about the topic and to give students a preview of what they will learn. Active discussion stimulates interest in a subject and can motivate even the most reluctant learner. Listening, as well as speaking, is active participation. Encourage your students to participate at the rate they feel comfortable. Model sharing personal experiences when applicable, and model listening to students' ideas and opinions.

#### **Focus**

Help learners set a purpose for watching the program with Focus, designed to give students a focal point for comprehension continuity.

#### **Jump Right In**

Jump Right In provides abbreviated instructions for quick management of the program.

## **AFTER VIEWING THE PROGRAM**

### **SECTION 4**

After your students have viewed the program, you may introduce any or all of these activities to interact with other curriculum content areas, provide reinforcement, assess comprehension skills, or provide hands-on and in-depth extended study of the topic.

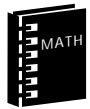
## SUGGESTED ACTIVITIES

The Suggested Activities offer ideas for activities you can direct in the classroom or have your students complete independently, in pairs, or in small work groups after they have viewed the program. To accommodate your range of classroom needs, the activities are organized into skills categories. Their labels will tell you how to identify each activity and help you correlate it into your classroom curriculum. To help you schedule your classroom lesson time, the AIMS hourglass gives you an estimate of the time each activity should require. Some of the activities fall into these categories:



### Meeting Individual Needs

These activities are designed to aid in classroom continuity. Reluctant learners and learners acquiring English will benefit from these activities geared to enhance comprehension of language in order to fully grasp content meaning.



### Curriculum Connections

Many of the suggested activities are intended to integrate the content of the ATM program into other content areas of the classroom curriculum. These cross-connections turn the classroom teaching experience into a whole learning experience.



### Critical Thinking

Critical Thinking activities are designed to stimulate learners' own opinions and ideas. These activities require students to use the thinking process to discern fact from opinion, consider their own problems and formulate possible solutions, draw conclusions, discuss cause and effect, or combine what they already know with what they have learned to make inferences.



### Cultural Diversity

Each AIMS Teaching Module has an activity called Cultural Awareness, Cultural Diversity, or Cultural Exchange that encourages students to share their backgrounds, cultures, heritage, or knowledge of other countries, customs, and language.



### Hands On

These are experimental or tactile activities that relate directly to the material taught in the program. Your students will have opportunities to make discoveries and formulate ideas on their own, based on what they learn in this unit.



### Writing

Every AIMS Teaching Module will contain an activity designed for students to use the writing process to express their ideas about what they have learned. The writing activity may also help them to make the connection between what they are learning in this unit and how it applies to other content areas.



### In The Newsroom

Each AIMS Teaching Module contains a newsroom activity designed to help students make the relationship between what they learn in the classroom and how it applies in their world. The purpose of In The Newsroom is to actively involve each class member in a whole learning experience. Each student will have an opportunity to perform all of the tasks involved in production: writing, researching, producing, directing, and interviewing as they create their own classroom news program.



### Extended Activities

These activities provide opportunities for students to work separately or together to conduct further research, explore answers to their own questions, or apply what they have learned to other media or content areas.



### Link to the World

These activities offer ideas for connecting learners' classroom activities to their community and the rest of the world.



### Culminating Activity

To wrap up the unit, AIMS Teaching Modules offer suggestions for ways to reinforce what students have learned and how they can use their new knowledge to enhance their world view.

## **VOCABULARY**

Every ATM contains an activity that reinforces the meaning and usage of the vocabulary words introduced in the program content. Students will either read or find the definition of each vocabulary word, then use the word in a written sentence.

## **CHECKING COMPREHENSION**

Checking Comprehension is designed to help you evaluate how well your students understand, retain, and recall the information presented in the AIMS Teaching Module. Depending on your students' needs, you may direct this activity to the whole group yourself, or you may want to have students work on the activity page independently, in pairs, or in small groups. Students can verify their written answers through discussion or by viewing the video a second time. If you choose, you can reproduce the answers from your Answer Key or write the answer choices in a Word Bank for students to use. Students can use this completed activity as a study guide to prepare for the test.

## **CONSUMABLE ACTIVITIES**

The AIMS Teaching Module provides a selection of consumable activities, designed to specifically reinforce the content of this learning unit. Whenever applicable, they are arranged in order from low to high difficulty level, to allow a seamless facilitation of the learning process. You may choose to have students take these activities home or to work on them in the classroom independently, in pairs or in small groups.

## **CHECKING VOCABULARY**

The Checking Vocabulary activity provides the opportunity for students to assess their knowledge of new vocabulary with this word game or puzzle. The format of this vocabulary activity allows students to use the related words and phrases in a different context.

## **TEST**

The AIMS Teaching Module Test permits you to assess students' understanding of what they have learned. The test is formatted in one of several standard test formats to give your students a range of experiences in test-taking techniques. Be sure to read, or remind students to read, the directions carefully and to read each answer choice before making a selection. Use the Answer Key to check their answers.

## **ADDITIONAL AIMS MULTIMEDIA PROGRAMS**

After you have completed this AIMS Teaching Module you may be interested in more of the programs that AIMS offers. This list includes several related AIMS programs.

## **ADDITIONAL READING SUGGESTIONS**

AIMS offers a carefully researched list of other resources that you and your students may find rewarding.

## **ANSWER KEY**

Reproduces tests and work pages with answers marked.

# Electricity: The Invisible River of Energy

## THEMES

*Electricity: The Invisible River of Energy* is a multimedia program designed to show students all of the aspects of electricity. This program discusses the nature of electricity at the atomic level, including the movement of electrons through circuits, resistors, and insulators. Students are exposed to all of the measurements of electrical power and energy, including the differences between volts, watts, and amps.

## OVERVIEW

Electricity is formed by the movement of electrons and is one of the most important forms of energy that we have. Everything around us is made up of atoms, which are in turn made up of electrons, neutrons, and protons. Electricity is divided into two categories, static and current. A conductor is a material that allows electrons to flow easily through it. The potential difference between a negative terminal and a positive terminal of a wire is measured in volts. All electricity flows in paths called circuits. The resistance in the flow of electricity is measured in ohms, and the flow of electricity is measured in amps. Sometimes, fuses or circuit breakers are used to prevent the overflow of current in a circuit.

## OBJECTIVES

- ▶ To understand the theories behind electricity.
- ▶ To determine the component parts of all electrical currents.
- ▶ To recognize the different types of electricity and their uses.
- ▶ To discover the different measurements of electrical power and current.
- ▶ To see the types of materials that conduct or repel electrical currents.

Use this page for your individual notes about planning and/or effective ways to manage this  
AIMS Teaching Module in your classroom.

Our AIMS Multimedia Educational Department welcomes your observations and comments.  
Please feel free to address your correspondence to:

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## INTRODUCTION TO THE PROGRAM

Electricity is such a constant presence in our lives, we often take it for granted. Electricity provides our homes with light and heat. It allows us to communicate with others, and it helps us get from one place to another. At the turn of the century, life changed dramatically as humans learned to control electricity and use it to power "labor-saving" devices such as the electrical iron and the washing machine. Perhaps no other form of energy has changed and shaped our lives as much as electricity.

## INTRODUCTION TO VOCABULARY

Ask students to look up the word "electricity" in the dictionary. What is the definition? Where did the word originate? What other non-scientific meaning does the word have?

(Electricity is a form of energy produced by the movement of electrons. The word "electricity" originates from the Latin word *electrum*, which means amber. Amber is a substance which exhibits electromagnetic qualities. Electricity also means a strong contagious excitement.)

## FOCUS

Electricity provides us with many conveniences. Ask students to spend a few days thinking more closely about the ways that electricity enriches our lives. In what ways would our lives be more difficult without electricity? Ask students to keep this question in mind as they begin the unit.

## DISCUSSION IDEAS

Ask students to name a way that electricity is used in each of the areas listed below.

our homes  
industry  
communication  
agriculture  
business  
transportation  
science

# JUMP RIGHT IN

## HOW TO USE THE ELECTRICITY: THE INVISIBLE RIVER OF ENERGY AIMS TEACHING MODULE

### Preparation

- ▶ Read *Electricity: The Invisible River of Energy* **Themes**, **Overview**, and **Objectives** to become familiar with program content and expectations.
- ▶ Use **Preparation for Viewing** suggestions to introduce the topic to students.

### Viewing ELECTRICITY: THE INVISIBLE RIVER OF ENERGY

- ▶ Set up viewing monitor so that all students have a clear view.
- ▶ Depending on your classroom size and learning range, you may choose to have students view *Electricity: The Invisible River of Energy* together or in small groups.
- ▶ Some students may benefit from viewing the video more than one time.

### After Viewing ELECTRICITY: THE INVISIBLE RIVER OF ENERGY

- ▶ Select **Suggested Activities** that integrate into your classroom curriculum. If applicable, gather materials or resources.
- ▶ Choose the best way for students to work on each activity. Some activities work best for the whole group. Other activities are designed for students to work independently, in pairs, or in small groups. Whenever possible, encourage students to share their work with the rest of the group.
- ▶ Duplicate the appropriate number of **Vocabulary**, **Checking Comprehension**, and consumable activity pages for your students.
- ▶ You may choose to have students take consumable activities home, or complete them in the classroom, independently, or in groups.
- ▶ Administer the Test to assess students' comprehension of what they have learned, and to provide them with practice in test-taking procedures.
- ▶ Use the **Culminating Activity** as a forum for students to display, summarize, extend, or share what they have learned with each other, the rest of the school, or a local community organization.

## SUGGESTED ACTIVITIES

### Writing

From Ben Franklin's famous experiment with a kite to Thomas Edison's revolutionary uses for electrical power, many people have helped us understand the potential of electricity. Ask students to choose a person from the list below. Have each student write a one-page summary of their chosen person's contributions to the study of electricity. Encourage students to use library books and encyclopedia articles to learn more about their chosen topics.



60 Minutes

Alexander Graham Bell

Charles Coulomb

Thomas Edison

Joseph Henry

Lord Kelvin

Guglielmo Marconi

Samuel Morse

Georg Ohm

Thales of Miletus

Count Volta

### Meeting Individual Needs

Ask students to define the following words as they relate to the study of electricity. From what person did each term originate?



30 Minutes

- ampere - unit of measurement for the flow of electricity that measures the number of electrical charges that pass a given point in a second; from Andre Marie Ampere
- coulomb - unit of measure for the amount of electrical charge an object has; Charles Coulomb
- hertz - unit of frequency equal to one unit per cycle; Heinrich Hertz
- ohm - unit of measurement for resistance; Georg Ohm
- volt - used to measure the potential difference between terminals; Alessandro Volta

### Connection to History

After Benjamin Franklin's experiments with lightning, electrical demonstrations became a fad. In 1786, during a thunderstorm, the Italian anatomist Luigi Galvani attached the legs of a frog to a copper hook which hung on an iron rail. The frog's legs did twitch, but not because they were struck by lightning. Galvani declared that the twitch was caused by a current present in the frog's body. What really made the frog's legs twitch?



20 Minutes

(The chemical action of moisture, found in the frog's body, and contact between the two metals produced electricity. This is the same phenomenon that makes a battery work.)

## Link to the World

How has humankind's use of electricity changed life on Earth? What would life be like if we did not know how to control and use electricity? Ask students to list as many things as they can that depend on electricity. Their lists can include things that they use everyday, such as television, light bulbs and radios. Their lists can also include things that we do not have direct contact with, but which influence our lives. These things might include factory machines that produce our clothing, computers that control our nation's military and defense system, and water processing plants that keep our drinking water clean.



20 Minutes

## Hands On

For this simple experiment, students will need a comb and a sheet of paper. Ask them to shred the paper into pieces that are approximately the size of dimes. Next, tell them to run the comb through their hair ten times. Just after combing their hair, have them move the comb over the paper pieces. What happens? What is the reason?



15 Minutes

(The paper pieces stick to the comb. As the comb moved through their hair, it lost electrons and became negatively charged. This negative charge attracted the positively charged atoms in the paper pieces.)

## Connection to Health

Electricity is a very important tool in the world of medicine. In addition to providing light, heat and power for hospitals and clinics, electricity is used to diagnose, treat and cure illnesses. Ask students if they can think of some ways that electricity is used in these ways. Encourage all students to contribute their ideas.



Extended Time

(Electricity is used to heat scalpels that can seal off blood vessels during surgery. It is also used to power small electrical lasers that are used to perform delicate procedures. Controlled amounts of electrical current are used to treat back and joint pain. A pacemaker uses a weak electrical current to regulate a person's heartbeat. An electrocardiogram records heart activity. X-ray and ultrasound machines powered by electricity allow doctors to look inside a patient and find potential problems.)

### Extended Activity

Ask students if they know where the power in their community comes from. Where is the power plant that supplies electricity? How is the electricity produced? Are the turbines used to generate electricity powered by hydroelectric power, or running water? Are the turbines powered by steam? If so, how is water heated to produce the steam—with oil, coal or nuclear power?



20 Minutes

Ask students to discuss the possible advantages and disadvantages of their local power station. Remind them to discuss financial, practical and environmental aspects. If possible, arrange for the class to visit the power station and get a first-hand look at how electricity is produced.

### Critical Thinking

Most of us have been bathed in the light of incandescent bulbs since we were born. Edison's invention has changed little since the 1870s. Ask students to do a little research to find out what makes the light bulb such a valuable little invention. How does it work? Why does it last so long? What makes it so bright?



45 Minutes

(A light bulb directs a small flow of electricity through a small metal wire or filament. Edison had to try many filaments before he discovered one that would not burn up. Tungsten, which has a very high melting point, was the perfect choice and is still used today. As electricity passes through the tungsten filament, the metal becomes so hot, it glows. Edison sucked all of the air out of his bulb to keep the tungsten from burning. Today, bulbs contain argon gas, which further lowers the tungsten's melting point. In addition, bulbs are painted white to increase their luminosity.)

### Culminating Activity

Using what they have learned in the unit, ask each student to write a question related to the program. Collect the questions and use them to write a review quiz. After giving the quiz, ask students if they enjoyed designing the test. How would they feel about designing more tests in the future?



60 Minutes

**VOCABULARY**

The following terms are from *Electricity: The Invisible River of Energy*. Fill in the number of each term next to its closest definition.

- |              |                         |
|--------------|-------------------------|
| 1. Amperes   | 6. Watts                |
| 2. Charge    | 7. Potential Difference |
| 3. Circuit   | 8. Coulomb              |
| 4. Electrons | 9. Electricity          |
| 5. Ohms      | 10. Electroplating      |

- \_\_\_ The unit of measure for the amount of electrical charge an object has
- \_\_\_ Power required to operate a device
- \_\_\_ Units of measurement for the flow of electricity that measures the number of electrical charges that pass a given point in a second
- \_\_\_ The load of an electrical particle, either positive or negative
- \_\_\_ A process that causes an electrical bond between two objects when they come in contact with each other
- \_\_\_ Units of measurement for resistance
- \_\_\_ A path through which electricity flows
- \_\_\_ The difference in electrical states of two points that causes the flow of current between them
- \_\_\_ A form of energy created by the movement of electrons
- \_\_\_ Negatively-charged particles located outside the nucleus of an atom

**CHECKING COMPREHENSION**

Read the following sentences and circle the letter of the word that best fills each blank.

Electricity, formed by the movement of \_\_1\_\_ is one of the most important forms of energy that we have. Everything around us is made up of atoms, which are in turn made up of electrons, neutrons, and \_\_2\_\_. Electricity is divided into two categories, static and \_\_3\_\_. A \_\_4\_\_ is a material that allows electrons to flow easily through it. The potential difference between a negative terminal and a positive terminal of a wire is measured in \_\_5\_\_. All electricity flows in paths called \_\_6\_\_. The resistance in the flow of electricity is measured in \_\_7\_\_. The flow of electricity is measured in \_\_8\_\_. Sometimes, \_\_9\_\_ or circuit breakers are used to prevent the overflow of current in a circuit. A magnet created by the flow of electricity through a coiled wire is called an \_\_10\_\_.

- |   |   |
|---|---|
| 1. A. protons<br>B. neutrons<br>C. electrons<br>D. conductors | 6. A. circuits<br>B. currents<br>C. insulators<br>D. ohms               |
| 2. A. protons<br>B. neutrons<br>C. electrons<br>D. nucleus    | 7. A. amps<br>B. ohms<br>C. volts<br>D. watts                           |
| 3. A. cyclic<br>B. AC<br>C. DC<br>D. current                  | 8. A. watts<br>B. ohms<br>C. volts<br>D. amps                           |
| 4. A. circuit<br>B. conductor<br>C. resistor<br>D. fuse       | 9. A. insulators<br>B. conductors<br>C. fuses<br>D. coulomb             |
| 5. A. amps<br>B. watts<br>C. ohms<br>D. volts                 | 10. A. polar magnet<br>B. electroplating<br>C. fuse<br>D. electromagnet |

### ELECTRICITY QUESTIONS

Answer the following questions using the information presented in *Electricity: The Invisible River of Energy*.

1. Electricity is formed by the movement of what subatomic particle?
2. What two categories is electricity divided into?
3. What unit measures the amount of electric charge that an object has?
4. Name a common item that can generate current electricity.
5. Which is a better conductor of electricity: copper or glass?
6. Which current always flows in one direction: AC or DC?
7. Name the two basic types of circuits.
8. What unit measures the resistance of a circuit?

**TRUE OR FALSE**

Place a T next to statements that are true and an F next to statements that are false.

1. \_\_\_ Lightning is a form of static electricity.
2. \_\_\_ Some gases, like neon, can conduct electricity.
3. \_\_\_ Car batteries operate on alternating current while residential outlets use direct current.
4. \_\_\_ Whether AC or DC, all electricity flows in circuits.
5. \_\_\_ In order for electricity to flow through a circuit, the flow of protons must be strong enough to overcome the resistance of the circuit.
6. \_\_\_ Electrons have a positive charge.
7. \_\_\_ The flow of electricity is measured in amps.
8. \_\_\_ Neither fuses nor switches can prevent an electrical overload.
9. \_\_\_ The watt is a unit for measuring power required to operate a device.
10. \_\_\_ Electrical generators work in the opposite manner of electric motors.

**NUMBER CODE**

|       |        |        |
|-------|--------|--------|
| A = 1 | H = 6  | R = 11 |
| C = 2 | I = 7  | S = 12 |
| D = 3 | L = 8  | T = 13 |
| E = 4 | M = 9  | V = 14 |
| F = 5 | O = 10 | W = 15 |

1. Every charged ion exerts an electrical 5-7-4-8-3 around itself.  
\_\_\_\_\_
2. Current electricity refers to the 5-8-10-15 of electrons or ions through conductors.  
\_\_\_\_\_
3. Lightening is the most powerful example of 12-13-1-13-7-2 electricity.  
\_\_\_\_\_
4. Most 9-4-13-1-8-12 make excellent conductors.  
\_\_\_\_\_
5. The potential difference between terminals is measured in 14-10-8-13-12.  
\_\_\_\_\_
6. Alternating currents can 11-4-14-4-11-12-4 the direction of their flow.  
\_\_\_\_\_
7. In a 12-4-11-7-4-12 circuit, current must pass through all the devices plugged into the circuit.  
\_\_\_\_\_
8. Resistance converts electrical energy into 6-4-1-13.  
\_\_\_\_\_

**ELECTRICITY PUZZLE**

E \_\_\_\_\_ The process that causes an electrical bond between two objects when they come in contact with each other is known as \_\_\_\_\_ .

L \_\_\_\_\_ \_\_\_\_\_ is a powerful natural form of static electricity.

E \_\_\_\_\_ An \_\_\_\_\_ is created by the flow of electricity through a coiled wire.

C \_\_\_\_\_ A \_\_\_\_\_ is a path through which electricity flows.

T \_\_\_\_\_ Lightening is caused by the rapid motion of molecules in \_\_\_\_\_ which produces negatively and positively charged particles.

R \_\_\_\_\_ \_\_\_\_\_ opposes the flow of electricity in electrical circuits by converting electrical energy into heat.

I \_\_\_\_\_ Material that does not conduct electricity is known as an \_\_\_\_\_ .

C \_\_\_\_\_ A \_\_\_\_\_ is used to measure the amount of electric charge that an object has.

**WORD SEARCH**

The following words can be found in the maze below. The letters may be arranged horizontally, vertically, diagonally or backward.

**Circuit**  
**Insulator**  
**Battery**  
**Ohms**  
**Protons**  
**Power**  
**Resistance**  
**Watts**  
**Amps**  
**Charge**

b R C H A R G E m s o y  
a E h u i u s C i a p W  
w S b a h y p l b l a A  
r l w P a c o R h N b T  
y S s R b s y C u S i T  
e T h O a h w U y U p S  
t A b T H u l a L w p  
t N a O c M a T s A t o  
s C w N y i S u b T u b  
t E s S m a c h a O y i  
y B A T T E R Y t R t y  
A M P S s s u R E W O P

**TEST**

Circle the phrase which best answers each question.

1. Electricity is formed by the movement of:
  - atoms.
  - protons.
  - electrons.
  - neutrons.
  
2. What is caused by the flow of electrons or ions through conductors?
  - static electricity
  - current electricity
  - voltage
  - ampere
  
3. Lightning is an example of:
  - static electricity.
  - current electricity.
  - voltage.
  - ampere.
  
4. Alternating current:
  - always flows in the same direction.
  - is always in a series circuit.
  - is always in a parallel circuit.
  - reverses directions in cycles.
  
5. Most metals are conductors because they have at least \_\_\_\_\_ per atom.
  - one nucleus
  - one free electron
  - one free neutron
  - one free proton

**TEST (CONTINUED)**

6. Electrical devices are rated in watts according to the \_\_\_\_ they need to operate.
- number of circuits
  - amount of heat per second
  - number of switches
  - amount of energy per second
7. Which of these cannot be produced by the flow of electricity through a conductor?
- light
  - heat
  - water
  - magnetic fields
8. The rotation of an electric motor is the result of \_\_\_\_ of magnetic fields in the motor.
- the strength
  - the direction
  - the positive and negative terminals
  - attraction and repulsion
9. A major development in the production of electrical current is the:
- circuit.
  - fuse.
  - switch.
  - solar cell.
10. A conductor is:
- an insulated material.
  - a material that allows electrons to flow easily through it.
  - a material that impedes the flow of electrons through it.
  - a material that causes electrons to increase in a solar cell.

## **ADDITIONAL AIMS MULTIMEDIA PROGRAMS**

You and your students might also enjoy these other AIMS Multimedia programs:

*Force and Work: Energy in Action*

*Heat and the Changing States of Matter*

*Motion: Newton's Three Laws*

*Waves: Energy in Motion*

*Light, Lenses and Lasers*

## ANSWER KEY for page 18

### VOCABULARY

The following terms are from *Electricity: The Invisible River of Energy*. Fill in the number of each term next to its closest definition.

- |              |                         |
|--------------|-------------------------|
| 1. Amperes   | 6. Watts                |
| 2. Charge    | 7. Potential Difference |
| 3. Circuit   | 8. Coulomb              |
| 4. Electrons | 9. Electricity          |
| 5. Ohms      | 10. Electroplating      |

- 8 The unit of measure for the amount of electrical charge an object has
- 6 Power required to operate a device
- 1 Units of measurement for the flow of electricity that measures the number of electrical charges that pass a given point in a second
- 2 The load of an electrical particle, either positive or negative
- 10 A process that causes an electrical bond between two objects when they come in contact with each other
- 5 Units of measurement for resistance
- 3 A path through which electricity flows
- 7 The difference in electrical states of two points that causes the flow of current between them
- 9 A form of energy created by the movement of electrons
- 4 Negatively-charged particles located outside the nucleus of an atom

## ANSWER KEY for page 19

### CHECKING COMPREHENSION

Read the following sentences and circle the letter of the word that best fills each blank.

Electricity, formed by the movement of \_\_1\_\_ is one of the most important forms of energy that we have. Everything around us is made up of atoms, which are in turn made up of electrons, neutrons, and \_\_2\_\_. Electricity is divided into two categories, static and \_\_3\_\_. A \_\_4\_\_ is a material that allows electrons to flow easily through it. The potential difference between a negative terminal and a positive terminal of a wire is measured in \_\_5\_\_. All electricity flows in paths called \_\_6\_\_. The resistance in the flow of electricity is measured in \_\_7\_\_. The flow of electricity is measured in \_\_8\_\_. Sometimes, \_\_9\_\_ or circuit breakers are used to prevent the overflow of current in a circuit. A magnet created by the flow of electricity through a coiled wire is called an \_\_10\_\_.

1. A. protons  
B. neutrons  
 C. electrons  
D. conductors
2.  A. protons  
B. neutrons  
C. electrons  
D. nucleus
3. A. cyclic  
B. AC  
C. DC  
 D. current
4. A. circuit  
 B. conductor  
C. resistor  
D. fuse
5. A. amps  
B. watts  
C. ohms  
 D. volts
6.  A. circuits  
B. currents  
C. insulators  
D. ohms
7. A. amps  
 B. ohms  
C. volts  
D. watts
8. A. watts  
B. ohms  
C. volts  
 D. amps
9. A. insulators  
B. conductors  
 C. fuses  
D. coulomb
10. A. polar magnet  
B. electroplating  
C. fuse  
 D. electromagnet

## ANSWER KEY for page 20

### ELECTRICITY QUESTIONS

Answer the following questions using the information presented in *Electricity: The Invisible River of Energy*.

1. Electricity is formed by the movement of what subatomic particle?
2. What two categories is electricity divided into?
3. What unit measures the amount of electric charge that an object has?
4. Name a common item that can generate current electricity.
5. Which is a better conductor of electricity: copper or glass?
6. Which current always flows in one direction: AC or DC?
7. Name the two basic types of circuits.
8. What unit measures the resistance of a circuit?

### ANSWERS:

1. **electron**
2. **static and current**
3. **the coulomb**
4. **a battery or generator**
5. **copper**
6. **DC**

## ANSWER KEY for page 21

### TRUE OR FALSE

Place a T next to statements that are true and an F next to statements that are false.

1.   T   Lightning is a form of static electricity.
2.   T   Some gases, like neon, can conduct electricity.
3.   F   Car batteries operate on alternating current while residential outlets use direct current.
4.   T   Whether AC or DC, all electricity flows in circuits.
5.   F   In order for electricity to flow through a circuit, the flow of protons must be strong enough to overcome the resistance of the circuit.
6.   F   Electrons have a positive charge.
7.   T   The flow of electricity is measured in amps.
8.   F   Neither fuses nor switches can prevent an electrical overload.
9.   T   The watt is a unit for measuring power required to operate a device.
10.   T   Electrical generators work in the opposite manner of electric motors.

## ANSWER KEY for page 22

### NUMBER CODE

|       |        |        |
|-------|--------|--------|
| A = 1 | H = 6  | R = 11 |
| C = 2 | I = 7  | S = 12 |
| D = 3 | L = 8  | T = 13 |
| E = 4 | M = 9  | V = 14 |
| F = 5 | O = 10 | W = 15 |

1. Every charged ion exerts an electrical 5-7-4-8-3 around itself.

**field**

---

2. Current electricity refers to the 5-8-10-15 of electrons or ions through conductors.

**flow**

---

3. Lightening is the most powerful example of 12-13-1-13-7-2 electricity.

**static**

---

4. Most 9-4-13-1-8-12 make excellent conductors.

**metals**

---

5. The potential difference between terminals is measured in 14-10-8-13-12.

**volts**

---

6. Alternating currents can 11-4-14-4-11-12-4 the direction of their flow.

**reverse**

---

7. In a 12-4-11-7-4-12 circuit, current must pass through all the devices plugged into the circuit.

**series**

---

8. Resistance converts electrical energy into 6-4-1-13.

**heat**

---

## ANSWER KEY for page 23

### ELECTRICITY PUZZLE

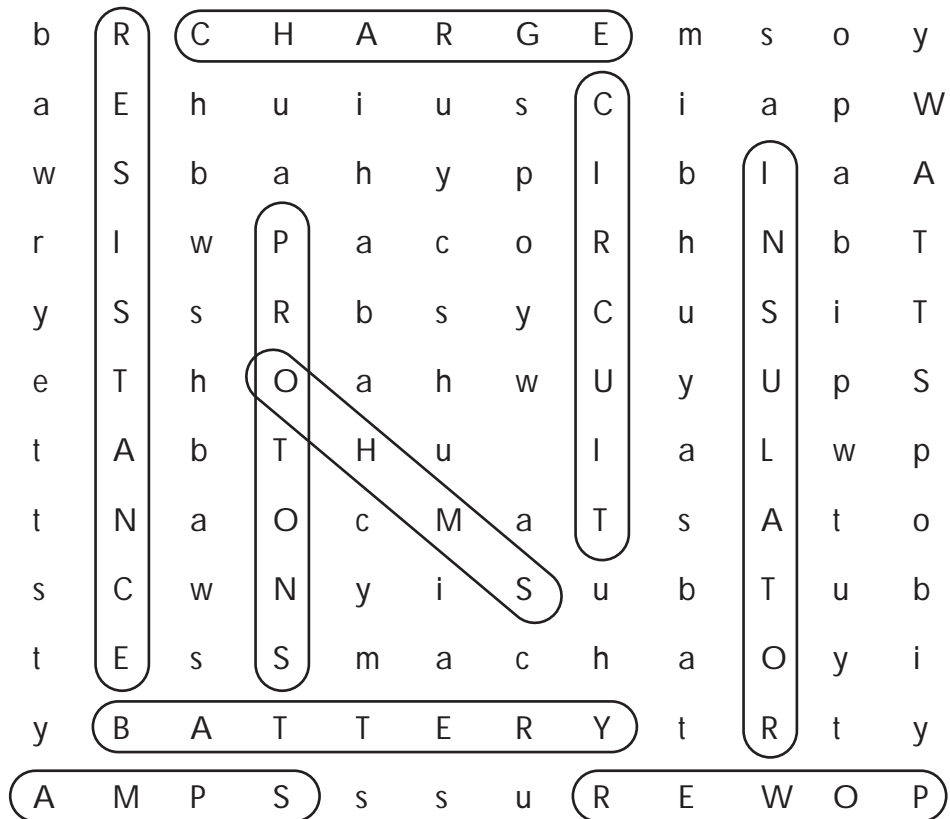
- E** lectroplating \_\_\_\_\_ The process that causes an electrical bond between two objects when they come in contact with each other is known as \_\_\_\_\_ .
- L** ightening \_\_\_\_\_ \_\_\_\_\_ is a powerful natural form of static electricity.
- E** lectromagnet \_\_\_\_\_ An \_\_\_\_\_ is created by the flow of electricity through a coiled wire.
- C** ircuit \_\_\_\_\_ A \_\_\_\_\_ is a path through which electricity flows.
- T** hunderclouds \_\_\_\_\_ Lightening is caused by the rapid motion of molecules in \_\_\_\_\_ which produces negatively and positively charged particles.
- R** esistance \_\_\_\_\_ \_\_\_\_\_ opposes the flow of electricity in electrical circuits by converting electrical energy into heat.
- I** nsulator \_\_\_\_\_ Material that does not conduct electricity is known as an \_\_\_\_\_ .
- C** oulomb \_\_\_\_\_ A \_\_\_\_\_ is used to measure the amount of electric charge that an object has.

# ANSWER KEY for page 24

## WORD SEARCH

The following words can be found in the maze below. The letters may be arranged horizontally, vertically, diagonally or backward.

- Circuit
- Insulator
- Battery
- Ohms
- Protons
- Power
- Resistance
- Watts
- Amps
- Charge



## ANSWER KEY for page 25

### TEST

Circle the phrase which best answers each question.

1. Electricity is formed by the movement of:
  - atoms.
  - protons.
  - **electrons.**
  - neutrons.
2. What is caused by the flow of electrons or ions through conductors?
  - static electricity
  - **current electricity**
  - voltage
  - ampere
3. **Lightning** is an example of:
  - **static electricity.**
  - current electricity.
  - voltage.
  - ampere.
4. Alternating current:
  - always flows in the same direction.
  - is always in a series circuit.
  - is always in a parallel circuit.
  - **reverses directions in cycles.**
5. Most metals are conductors because they have at least \_\_\_\_\_ per atom.
  - one nucleus
  - **one free electron**
  - one free neutron
  - one free proton

## ANSWER KEY for page 26

### TEST (CONTINUED)

6. Electrical devices are rated in watts according to the \_\_\_\_ they need to operate.
- number of circuits
  - amount of heat per second
  - number of switches
  - amount of energy per second
7. Which of these cannot be produced by the flow of electricity through a conductor?
- light
  - heat
  - water
  - magnetic fields
8. The rotation of an electric motor is the result of \_\_\_\_ of magnetic fields in the motor.
- the strength
  - the direction
  - the positive and negative terminals
  - attraction and repulsion
9. A major development in the production of electrical current is the:
- circuit.
  - fuse.
  - switch.
  - solar cell.
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- an insulated material.
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  - a material that causes electrons to increase in a solar cell.