Electrical Circuits

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About **Electrical Circuits**

DeltaScienceModules, THIRD EDITION

Students explore *Electrical Circuits* with twelve hands-on activities and the Delta Science Reader. Once your class has mastered simple open and closed circuits, students progress to constructing parallel and series circuits. They investigate the factors, besides switches, that affect the flow of current. Students design circuit testers to determine how well certain solids and liquids conduct electric current. They demonstrate resistance by comparing the bulb brightness produced by different wires. For fun, students create circuit puzzles to outwit one another with hidden configurations. They also learn to depict their own sophisticated electrical setups with circuit diagrams.

In the Delta Science Reader *Electrical Circuits,* students read about electric charge, electric current, electrical circuits, and two ways in which electricity and magnetism are related. The book also presents biographical sketches of key innovators in this field—Thomas Alva Edison, Alexander Graham Bell, and Lewis Howard Latimer—and describes the work of an electrician. Students discover how water power is used to make electricity and how much energy various household appliances use.

Overview Chart for Hands-on Activities

Hands-on Activity	Student Objectives
1 **Simple Circuits** *page 13*	• discuss and define the parts of a circuit • construct simple circuits • test several arrangements of circuit elements
2 **Electrical Symbols** *page 19*	• draw and interpret circuit diagrams • construct circuits from simple circuit diagrams • compare brightness of bulbs in different circuits
3 **Series and Parallel Batteries** *page 27*	• construct circuits in which the batteries are connected in series • construct circuits in which the batteries are connected in parallel • compare the brightness of bulbs in these two circuits
4 **Series and Parallel Bulbs** *page 37*	• construct circuits in which bulbs are connected in series and in parallel • trace the path of electric current in these two circuits • compare the brightness of bulbs in these two circuits
5 **A Paper-Clip Switch** *page 45*	• construct a switch and place it in a circuit • trace the path of electric current through the circuit • infer the practical importance of switches
6 **Solid Conductors** *page 51*	• predict which solid objects will conduct electric current • construct a circuit to test their predictions • classify different materials as conductors or nonconductors
7 **Liquid Conductors** *page 57*	• construct a circuit to test the conductivity of liquids • test which liquids conduct electric current • classify liquids as conductors or nonconductors
8 **Electrical Resistance** *page 63*	• understand the concept of resistance • predict the relative resistance of two wires • observe that resistance is a function of wire thickness • construct a special circuit with which to examine the relationship between resistance and heat
9 **How Do Bulbs Work?** *page 71*	• examine two different light bulbs • use a circuit to determine how a light bulb is put together • infer how a light bulb works
10 **Making a Bulb** *page 77*	• make an incandescent light bulb • describe why the filament of a bulb glows when the circuit is closed • confirm their ideas about how incandescent bulbs work • compare their bulbs to common household bulbs
11 **Making a Fuse** *page 83*	• make an electric fuse in a circuit • overload the circuit to observe how a fuse works • discover the usefulness of fuses in household circuits
12 **Circuit Puzzles** *page 89*	• construct a circuit tester • use a circuit tester to determine the location of hidden conductors in circuit puzzles • design and decipher circuit puzzles
Assessment *page 95*	• See page 95.

Process Skills	Vocabulary	Delta Science Reader
communicate, make and use models, experiment	**battery, circuit, closed circuit, electric current, electrical energy, electricity, open circuit**	pages 2–4
make and use models; collect, record, display, or interpret data; compare	**battery terminal, circuit diagram**	page 7
predict, make and use models, compare	**parallel circuit, series circuit, volt**	pages 5, 6
make and use models, observe, compare		pages 5, 6
make and use models, observe, infer	**switch**	page 4
predict, make and use models, classify	**conductor, nonconductor**	page 3
make and use models, experiment, classify	**solution**	page 3
predict, observe, make and use models	**Nichrome wire, resistance**	page 3
observe, make and use models, infer	**filament, tungsten**	page 3
make and use models, communicate, compare	**fluorescent, incandescent**	pages 12, 13
make and use models, experiment, infer	**fuse**	
make and use models		pages 4–6

See the following page for the Delta Science Reader Overview Chart.

Overview Chart for Delta Science Reader
Electrical Circuits

Selections	Vocabulary	Related Activity
Think About...		
What Is Electric Charge? *page 2*	atom, discharge, electric charge, electricity, static electricity	Activity 1
What Is Electric Current? *page 3*	conductor, electric current, filament, insulator, resistance	Activities 1, 6, 7, 8, 9
What Is a Circuit? *page 4*	battery, battery terminal, circuit, closed circuit, open circuit, switch, volt, voltage	Activities 1, 5, 12
What Are Series Circuits? *page 5*	series circuit	Activities 3, 4
What Are Parallel Circuits? *page 6*	parallel circuit	Activities 3, 4
What Are Circuit Diagrams? *page 7*		Activity 2
How Do Magnets Work? *pages 8–9*	attract, magnet, magnetism, magnetic field, magnetic pole, repel	
What Is an Electromagnet? *page 10*	electromagnet, electric motor	
What Is a Generator? *page 11*	electrical energy, generator	
People in Science		
• Thomas Alva Edison *page 12* • Alexander Graham Bell *page 12* • Lewis Howard Latimer *page 13* • Electricians *page 13*		Activities 9, 10
Did You Know?		
• About Water Power *page 14* • About Using Energy at Home *page 15*	watt	

See pages 103–111 for teaching suggestions for the Delta Science Reader.

MATERIALS LIST

Electrical Circuits

Quantity	Description
1	aluminum foil*
16	bags, plastic, reclosable, 7 cm × 7 cm
1	baking soda, 1 lb*
64	batteries, D-cell*
64	battery holders
32	bulb holders
32	bulbs, flashlight, #41
32	bulbs, flashlight, #48
2	cardboard, 22 cm × 28 cm*
32	circuit folders*
64	cups, plastic, 4-oz
128	electrical clips
32	Fahnestock clips
1	labels, adhesive, p/100*
64	lids, for plastic cups
16	magnifiers
1	modeling clay, 1 lb
1	paper clips, p/100*
1	paper fasteners, p/100*
1	salt, 1 oz*
1	steel wool pads, p/8
1	sugar, 1 lb*
1	tape, masking*
1	wire, copper, insulated, 30 m*
1	wire, Nichrome, #26, 12 m*
1	wire, Nichrome, #32, 23 m*
1	wire cutters
1	**Teacher's Guide**
8	**Delta Science Readers**

Quantity	Description
TEACHER-PROVIDED ITEMS	
2	fuses, one intact and one blown (optional)
1	knife
–	objects, assorted (nails, coins, metal spoons, strips of cloth, plastic items, pencils)
–	paper towels*
16	rulers, metric
1	scissors
–	water, tap*

* = consumable item

† = in separate box

To order consumable items or refill kits, please call 1-800-442-5444.

ACTIVITY SUMMARY

In this Delta Science Module, students are introduced to electrical circuits—how they are constructed and how they work.

ACTIVITY 1 Students assemble a simple one-bulb, one-battery circuit to examine how the energy that is stored inside batteries causes a flow of electrons, known as electric current, through the pathway of conductors that make up the circuit. They examine and operationally define closed and open circuits.

ACTIVITY 2 Students discuss battery terminals and their relationship to the direction of electric current flow within a circuit. They also examine symbols used to represent the parts of a circuit and how these symbols can be combined to make a circuit diagram that represents the circuit.

ACTIVITY 3 Students are introduced to the volt, the unit by which the strength of a battery is measured. They construct two different kinds of circuits—those in which the batteries are wired in series and those in which they are wired in parallel. Students construct and investigate two- and four-battery circuits to examine how a bulb is affected by batteries arranged in series and in parallel.

ACTIVITY 4 Students look at circuits in which the bulbs are wired in series and in parallel. Students construct and investigate two-bulb circuits to examine how the brightness of the bulbs is affected by the bulbs' series and parallel arrangements.

ACTIVITY 5 Students examine switches. Students construct a switch and attach it to their circuits. They observe how switches mechanically close and open the pathway through which electric current flows, thereby allowing control of the flow of current in a circuit without disconnecting and then reconnecting wires and other circuit elements.

ACTIVITY 6 Students examine conductors and nonconductors. They test a variety of objects and then sort them according to their abilities as conductors.

ACTIVITY 7 Students test different liquids to determine whether the liquids are conductors or nonconductors. They test plain tap water and several solutions and then compare the quality of the best liquid conductor with the quality of the best solid conductor.

ACTIVITY 8 Students examine the concept of resistance. They are introduced to two sizes of Nichrome wire and see how each allows different amounts of electric current to flow through it, as evidenced by the different degrees of bulb brightness in the test circuits.

ACTIVITY 9 Students use magnifying lenses to examine the filaments inside two different light bulbs.

ACTIVITY 10 Students construct a circuit that contains a light bulb that they themselves have made using Nichrome wire as the filament. This type of wire is highly resistant to electric current and, therefore, becomes hot and glows.

ACTIVITY 11 Students examine fuses. Students construct a circuit to force electric current through a strand of steel wool that functions as a fuse. They observe how a fuse protects all the elements of the circuit and prevents fires from starting in the event of a surge of electric current.

ACTIVITY 12 The module concludes with the students examining and then constructing circuit puzzle cards. They apply what they have learned when they construct one-battery, one-bulb circuit testers, and identify the arrangement of conductors concealed by cardboard covers.