

TEACHER'S MANUAL

This Suitcase Program provides the materials and lesson plans for teachers of grades 3-5 with content and activities increasing in difficulty by grade level. Activities in this Suitcase Exhibit may assist in meeting the Tennessee State Standards.

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TENNESSEE STATE STANDARDS FOR 3-5

- 3.PS3 Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.
- 3.PS3.2 Apply scientific ideas to design, test, and refine a device that converts electrical energy to another form of energy, using open or closed simple circuits.

For the entire activity and materials and to reserve a Suitcase Exhibit, please call 901.636.2362.

ACTIVITY I: Voltaic Pile

DURATION OF ACTIVITY: 40 minutes

LESSON OBJECTIVES

Students will construct a simple electric cell and then combine several cells to make a battery.

GUIDING QUESTION

How do you make a battery?

TENNESSEE STATE STANDARDS

- 3.PS3.1 Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.
- 3.PS3.2 Apply scientific ideas to design, test and refine a device that converts electrical energy to another form of energy, using open or closed simple circuits.
- 4.PS3.3 Describe how stored energy can be converted into another form for practical use.
- 4.ETS2.1 Use appropriate tools and measurements to build a model.
- 5.ETS1.2 Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype.

MATERIALS INCLUDED

DC voltage meters
Jumper wires with clips
6v, 9v, AA, D Batteries
Coffee filters
Salt, bowl, teaspoon
Film canisters containing pennies and washers
Paper clips
Copper wire

MATERIALS PROVIDED BY TEACHER

Water
Scissors
Lemon

For the entire activity and materials and to reserve a Suitcase Exhibit, please call 901.636.2362.

ACTIVITY II: Alternating and Direct Current

DURATION OF ACTIVITY: 45 minutes

LESSON OBJECTIVES

The teacher will demonstrate the difference between alternating and direct current.

GUIDING QUESTION

What is the difference between alternating and direct current?

TENNESSEE STATE STANDARDS

- 3.PS3.2 Apply scientific ideas to design, test, and refine a device that converts electrical energy to another form of energy, using open or closed simple circuits.
- 4.PS3.3 Describe how stored energy can be converted into another form for practical use.
- 4.ETS2.1 Use appropriate tools and measurements to build a model.
- 5.PS2.5 Explain how forces can create patterns within a system (moving in one direction, shifting back and forth, or moving in cycles), and describe conditions that affect how fast or slowly these patterns occur.

MATERIALS INCLUDED

AC demonstration device
DC demonstration device
Hand generator
9-volt battery

MATERIALS PROVIDED BY TEACHER

None

For the entire activity and materials and to reserve a Suitcase Exhibit, please call 901.636.2362.

ACTIVITY III: Electrostatic Charges

DURATION OF ACTIVITY: 30 minutes

LESSON OBJECTIVES

Students will generate an electrostatic charge.

GUIDING QUESTION

How do you produce electrostatic charges?

TENNESSEE STATE STANDARDS

- 3.PS2.1 Explain the cause and effect relationship of magnets.
- 3.PS2.2 Solve a problem by applying the use of the interactions between two magnets.
- 4.PS3.2 Observe and explain the relationship between potential energy and kinetic energy.
- 5.PS2.2 Make observations and measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

MATERIALS INCLUDED

Hair dryer
Balloons
String
Magnets

MATERIALS PROVIDED BY TEACHER

None

For the entire activity and materials and to reserve a Suitcase Exhibit, please call 901.636.2362.

ACTIVITY IV: Measuring Electricity

DURATION OF ACTIVITY: 30 minutes

LESSON OBJECTIVES

Students will learn about watts and calculate the cost for using electrical appliances.

GUIDING QUESTION

What are watts?

TENNESSEE STATE STANDARDS

- 3.PS3.1 Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.
- 3.ETS1.1 Design a solution to a real-world problem that includes specified criteria for constraints.
- 4.PS3.3 Describe how stored energy can be converted into another form for practical use.
- 4.ETS1.1 Categorize the effectiveness of design solutions by comparing them to specified criteria for constraints.
- 5.ETS1.1 Research, test, re-test, and communicate a design to solve a problem.

MATERIALS INCLUDED

Electric bills
Hair dryer

MATERIALS PROVIDED BY TEACHER

Various electronic devices, such as a radio,
CD player, toaster

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ACTIVITY V: The Electroscope

DURATION OF ACTIVITY: 30 minutes

LESSON OBJECTIVES

Students will construct a device that will let them identify electrostatic charges.

GUIDING QUESTION

How do you identify positive and negative charges?

TENNESSEE STATE STANDARDS

- 3.PS3.1 Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.
- 3.PS3.2 Apply scientific ideas to design, test, and refine a device that converts electrical energy to another form of energy, using open or closed simple circuits.
- 3.ETS1.2 Apply evidence or research to support a design solution.
- 4.PS3.2 Observe and explain the relationship between potential energy and kinetic energy.
- 4.PS3.3 Describe how stored energy can be converted into another form for practical use.
- 4.ETS2.1 Use appropriate tools and measurements to build a model.
- 5.PS2.5 Explain how forces can create patterns within a system (moving in one direction, shifting back and forth, or moving in cycles), and describe conditions that affect how fast or slowly these patterns occur.
- 5.ETS1.1 Research, test, re-test, and communicate a design to solve a problem.

MATERIALS INCLUDED

Folded acetate strips
Acetate sheets
Wool
Balloons

MATERIALS PROVIDED BY TEACHER

None

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ACTIVITY VI: Simple Circuit

DURATION OF ACTIVITY: 45 minutes

LESSON OBJECTIVES

Students will construct simple open and closed circuits.

GUIDING QUESTION

What are open and closed circuits?

TENNESSEE STATE STANDARDS

- 3.PS3.1 Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.
- 3.PS3.2 Apply scientific ideas to design, test, and refine a device that converts electrical energy to another form of energy, using open or closed simple circuits.
- 4.ETS2.1 Use appropriate tools and measurements to build a model.
- 5.ETS1.2 Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype.

MATERIALS INCLUDED

AA batteries
Battery tester
Flashlight bulbs
Bulb holders
Magnetic jumper wires
Electrical tape

MATERIALS PROVIDED BY TEACHER

None

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ACTIVITY VII: Series and Parallel Circuits

DURATION OF ACTIVITY: 45 minutes

LESSON OBJECTIVES

Students will construct series and parallel circuits.

GUIDING QUESTION

What is the difference between a series and a parallel circuit?

TENNESSEE STATE STANDARDS

- 3.PS3.1 Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.
- 3.PS3.2 Apply scientific ideas to design, test, and refine a device that converts electrical energy to another form of energy, using open or closed simple circuits.
- 4.ETS2.1 Use appropriate tools and measurements to build a model.
- 5.ETS1.2 Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype.

MATERIALS INCLUDED

Battery tester
Electrical tape
AA batteries
Flashlight bulbs
Bulb holders
Magnetic jumper wires

MATERIALS PROVIDED BY TEACHER

None

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ACTIVITY VIII: Birds on Electric Wires

DURATION OF ACTIVITY: 30 minutes

LESSON OBJECTIVES

Students will see why birds can safely sit on power lines.

GUIDING QUESTION

Why don't birds get electrocuted when they sit on power lines?

TENNESSEE STATE STANDARDS

- 3.PS3.1 Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.
- 3.PS3.2 Apply scientific ideas to design, test, and refine a device that converts electrical energy to another form of energy, using open or closed simple circuits.
- 4.ETS2.1 Use appropriate tools and measurements to build a model.
- 5.ETS1.1 Research, test, re-test, and communicate a design to solve a problem.

MATERIALS INCLUDED

- 2 AA Batteries
- 2 Flashlight bulbs
- 2 Bulb holders
- 5 Jumper wires

MATERIALS PROVIDED BY TEACHER

None

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ACTIVITY IX: Insulators and Conductors

DURATION OF ACTIVITY: 45 minutes

LESSON OBJECTIVES

Students will test materials to see if they conduct electricity.

GUIDING QUESTION

What materials conduct electricity?

TENNESSEE STATE STANDARDS

- 3.PS3.1 Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.
- 3.PS3.2 Apply scientific ideas to design, test, and refine a device that converts electrical energy to another form of energy, using open or closed simple circuits.
- 3.ETS1.2 Apply evidence or research to support a design solution.
- 4.PS3.3 Describe how stored energy can be converted into another form for practical use.
- 4.ETS1.1 Categorize the effectiveness of design solutions by comparing them to specified criteria for constraints.
- 4.ETS2.1 Use appropriate tools and measurements to build a model.
- 5.ETS1.1 Research, test, re-test, and communicate a design to solve a problem.
- 5.ETS1.2 Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype.

MATERIALS INCLUDED

Battery tester
Use the battery tester:
Electrical tape
AA batteries
Flashlight bulbs
Bulb holders
Magnetic jumper wires
Jumper wires with clips
Bag labeled "Teacher Test Materials"
Bag labeled "Test Materials"

MATERIALS PROVIDED BY TEACHER

None

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ACTIVITY X: Making an Electromagnet

DURATION OF ACTIVITY: 45 minutes

LESSON OBJECTIVES

Students will construct a simple electromagnet.

GUIDING QUESTION

What is an electromagnet?

TENNESSEE STATE STANDARDS

- 3.PS3.1 Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.
- 3.PS3.2 Apply scientific ideas to design, test, and refine a device that converts electrical energy to another form of energy, using open or closed simple circuits.
- 3.ETS1.2 Apply evidence or research to support a design solution.
- 4.PS3.3 Describe how stored energy can be converted into another form for practical use.
- 4.ETS1.1 Categorize the effectiveness of design solutions by comparing them to specified criteria for constraints.
- 4.ETS2.1 Use appropriate tools and measurements to build a model.
- 5.ETS1.1 Research, test, re-test, and communicate a design to solve a problem.
- 5.ETS1.2 Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype.

MATERIALS INCLUDED

AA Batteries
Battery tester
Magnetic jumper wires
Jumper wires with clips
Paper clips
Container of staples
Iron nails

MATERIALS PROVIDED BY TEACHER

None

For the entire activity and materials and to reserve a Suitcase Exhibit, please call 901.636.2362.

SUITCASE EXHIBIT INVENTORY CHECKLIST

School: _____

Check Out: _____

Return Date: _____

MoSH Check In:	Teacher Check In:	Item	Books/Videos/Posters	Teacher Return:
		A	Teacher's Manual	
		B	Binder: Teacher's Resource Materials - Watts Up? teacher's guide, Watts Up? student workbook, monthly electric bills	
		C	Binder: Milliken Electricity & Magnetism transparencies	
		D	Book: Eyewitness: Electricity	
		E	Book: Batteries, Bulbs and Wires	
		F1-F2	Book: Electricity and Magnetism (F1) and CD: (F2)	
		G	Book: Using Electricity	
		H	Book: Magnetism and Electricity	
		I	Pamphlet: Electricity. Boy Scouts merit badge series	
		J	Book: A True Book: Experiments With Electricity	
		K	Book: Science Experiments with Electricity	
		L	Envelope: Edison & His Inventions [historical document]	
		M	8 small labels (M.1 Electrical Safety; M.2 Lightning Safety; M.3 Electricity in Nature; M.4 Everyday Electricity; M.5 Static Electricity; M.6 Series Circuits; M.7 Parallel Circuits; M.8 Conductors & Insulators)	
		N	Poster: Electricity	
		O	Poster: Alternating Current/Direct Current	
		P	Poster: Electrical Circuit	
		Q	4 heading labels with 1 directions sheet (Q.1 Directions; Q.2 A Study of Sources; Q.3 Electrical Circuits; Q.4 Electric Personalities; Q.5 More on the Subject)	
		R	Wheel – Electricity Cost Calculator (located inside front pocket Teacher's Resource Materials binder)	

SUITCASE EXHIBIT INVENTORY CHECKLIST

MoSH Check In:	Teacher Check In:	Item	Materials	Teacher Return:
			Items 1-10 in plastic box #1	
		1	20 AA batteries in 5 plastic containers (1a; 1b; 1c; 1d;1e)	
		2	2 9-volt batteries	
		3	D battery	
		4	battery tester	
		5	roll of electrical tape	
		6a-6e	5 knife switches with spring posts	
		7a-7b	2 telegraph keys	
		8a-8c	3 doorbells (8a; 8b; 8c)	
		9a-9i	9 plastic bags containing test materials (9a; 9b; 9c; 9d; 9e; 9f; 9g; 9h; 9i) see attached page for identification	
		10	Watts Up? meter	
			Items 11-25 in plastic box #2	
		11	17 magnets	
		12	20 large iron nails	
		13a-13c	3 electroscopes	
		14	9 film canisters each containing 5 pennies & 5 zinc washers	
		15	box of small paper clips	
		16	container of salt for voltaic pile	
		17	teaspoon for salt	
		18	4 copper wires for lemon	
		19	20 insulated wires for electromagnets	
		20	film canister: staples for electromagnets	
		21	20 flat, round flashlight bulb holders	
		22	8 white bulb holders	
		23	9 magnifying glasses	
		24	shaved pencil - graphite	
		25	wire stripper tool	

SUITCASE EXHIBIT INVENTORY CHECKLIST

MoSH Check In:	Teacher Check In:	Item	Materials	Teacher Return:
			Items 26-34 in plastic box # 3 blue	
		26	hand generator with plug-in wire attached	
		27	12 compasses	
		28a-28d	potato clock (28a) with 3 attachments (28b-red cable; 28cblack cable; 28d-blue cable)	
		29	8 light bulbs - 6w/6v	
		30	clear incandescent 60-watt ceiling fan light bulb	
		31	compact fluorescent 14-watt bulb	
		32	25 flashlight bulbs – 2.5v	
		33	stack of coffee filters	
		34	solar flashlight	
			Items 35-43 in cardboard box	
		35a-35c	friction rod kit (35a- 3 glass rods; 35b- 3 rubber rods; 35c- 3 plastic rods)	
		36a-36c	friction pads (36a-3 pieces flannel; 36b- 3 pieces silk; 36c- 3 animal furs)	
		37	spool of string	
		38	envelope: 17 folded acetate strips & 17 acetate sheets	
		39	17 pieces of wool cloth	
		40	15 static powered neon lights in film canister	
		41	film canister: amber with feather pieces	
		42	40 balloons consumable item	
		43	DC motor	
			end of items in cardboard box	
		44	6-volt battery	
		45	yellow plastic bowl	
		46	lamp base	
		47a-47c	3 DC voltage meters	
		48	hair dryer	
		49	40 jumper wires with clips	
		50	50 magnetic jumper wires (40 – 12"; 10 – 6")	
		51	LED AC demonstration device	
		52	LED DC demonstration device	

SUITCASE EXHIBIT INVENTORY CHECKLIST

Insulator and Conductor Test Materials Identification

9a	cork magnet pencil sharpened on both ends string balloon black screw sandpaper chain	9b	plastic spring jar top rubber ball drinking straw Lego block pencil with eraser electrical tape cotton ball
9c	pipe cleaner clothespin chalk rubber washer bottle cap coated wire foil foam	9d	wax paper nail Styrofoam peanut popsicle stick brass grommet feather rope nickel
9e	leather strip rubber band paper clip round label black plastic stirrer pop top marble sponge	9f	yarn screen felt safety pin postage stamp stick bobby pin seashell
9g	coated wire, one end stripped cardboard button screw tree slice soft foam quarter Q-tip	9h	pencil eraser bottle screw top paper fastener crayon rock coated paper clip binder clip toy soldier
9i	Teacher Test Materials penny paper		