



National 4-H Curriculum
BU-06850



Wired for Power



Project Activity Guide

Name _____
County _____





Acknowledgments

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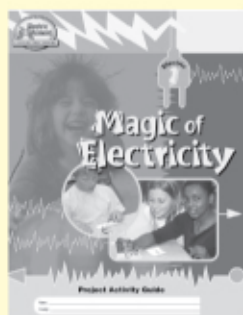
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Source Citations: The following sources were helpful in developing the Electric Excitement Series:

The Story of Electricity and Magnetism by Bernard Seeman, 1967, Harvey House, Inc., New York

Science Projects About Electricity and Magnets by Robert Gardner, 1994, Enslow Publishers, Inc. Springfield, NJ.

For more on Electricity, look for these other guides in this set.



Magic of Electricity

Chapter 1: Getting Started

- Activity 1 Plugging In
- Activity 2 Getting It Together
- Activity 3 Bright Lights

Chapter 2: Electricity on the Move

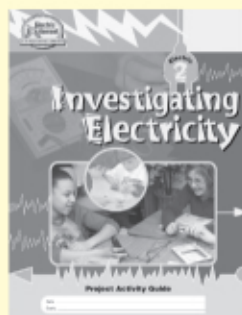
- Activity 4 Control the Flow
- Activity 5 Conducting Things
- Activity 6 Circuit Sense
- Activity 7 Is There a Fork in the Road?

Chapter 3: Magnets in Motion

- Activity 8 May the Force Be with You

Chapter 4: Current Attractions

- Activity 9 A Passing Force
- Activity 10 Attract or Repel?
- Activity 11 Earth Attractions
- Activity 12 Electric Attractions
- Activity 13 Sense the Current
- Activity 14 Make It Spin



Investigating Electricity

Chapter 1 Getting Started

- Activity 1 Get It Together
- Activity 2 Going Back and Forth
- Activity 3 The Electric Detective's Most Important Tool
- Activity 4 Investigating Ohm's Law

- Activity 5 To Flow or Not to Flow

Chapter 2 Understanding Circuits

- Activity 6 Decoding Circuit Diagrams
- Activity 7 Case of the Series Circuit
- Activity 8 Case of the Parallel Circuit

Chapter 3 Circuits in Action

- Activity 9 Circuit Sense
- Activity 10 The Off and On Case
- Activity 11 The Case of the Switching Circuit

Chapter 4 Electricity at Work

- Activity 12 Stronger Connections
- Activity 13 Stop the Crime



Entering Electronics

Chapter 1 Introducing Electronics

- Activity 1 What Is This and That?
- Activity 2 Hunting for Electronic Wizards

Chapter 2 What do I need?

- Activity 3 How Many and How Much?
- Activity 4 Hot Wire Hook-Ups
- Activity 5 The Capacity to Resist

Chapter 3 Learning About Semiconductors

- Activity 6 Diodes—One Way Only!
- Activity 7 Dim Your Bright Lights!

Chapter 4 Performing with LEDs

- Activity 8 Does Your LED Glow?
- Activity 9 How Fast Do I Blink?

Chapter 5 Who's Been Snooping?

- Activity 10 Gotcha!
- Activity 11 My! How Bright is the Light?

Chapter 6 Bigger and Better!

- Activity 12 Surprise! Surprise!
- Activity 13 More Volume, Please!



Electric Helper's Guide

The Experiential Learning Process
Developing Life Skills
Youth Learning Characteristics

Chapter 1 Electric Explorations

- Activity 1 Generating Electric Excitement
- Activity 2 Conducting an Electric Skillathon
- Activity 3 Tour Time
- Activity 4 Loading the Circuit
- Activity 5 Switching Switches

Chapter 2 Electric Games

- Activity 6 Electric Quiz Bowl
- Activity 7 Hunting for Hazards
- Activity 8 Electric Bingo
- Activity 9 Playing Electric Pyramid
- Activity 10 Electric Glossary Game
- Activity 11 Guessing Game

Chapter 3 Talking About Electricity

- Activity 12 Parts and Symbols
 - Activity 13 Show Time
 - Activity 14 Public Performance
- Electric Project Meeting Ideas
Evaluating the Impact
Electric Resources

Wired for Power

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Note to the Electric Project Helper

Welcome to *Electric Excitement*! You will enjoy helping youth demystify the “magic” of electric circuits, magnetism, motors and electronics. From building burglar alarms to learning how to select stereo equipment, this curriculum contains dozens of hands-on, useful and fun projects. These activities can be used in a variety of settings such as in the classroom, with special interest clubs, after school groups or community clubs, or one-on-one.

You will be a key individual with whom young people can share the experiences outlined in this activity guide. You will provide encouragement and recognition, as they develop technical and scientific electrical literacy. In addition, these young people will learn important life skills such as creative thinking, decision making, problem solving and participating as members of a team.

Wired for Power is designed for youth that understand basic electric principles such as the concept of magnetism, electron flow, circuit design and circuit design principles. It is recommended that youth have already completed the first two guides in this series, *Magic of Electricity* and *Investigating Electricity*.

Your Role

- Review this guide and the **Electric Group Activity Guide**
- Support the youth in his or her efforts to set goals and complete the **Planning Guide** and **Electric Achievement Program**
- Help select electric projects to construct, give assistance in doing the activities and answer questions
- Help the young person to think about why something happened the way it did
- Serve as a resource person to help connect the young person with the community, resource materials and others knowledgeable about electricity

The Electric Excitement Series

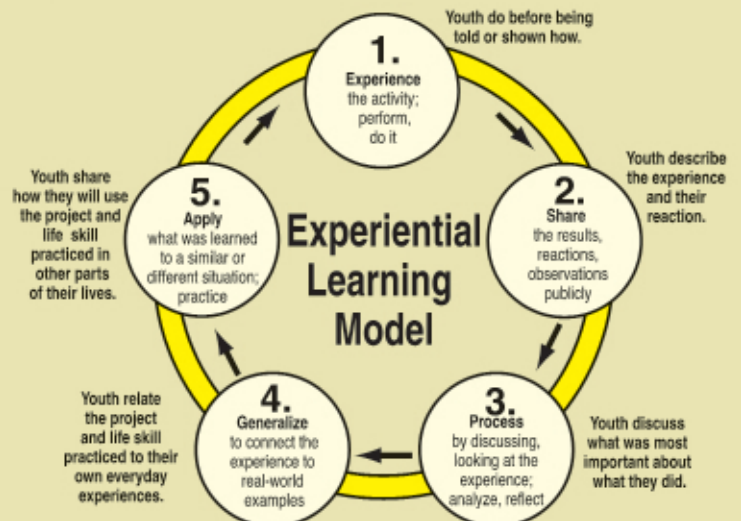
This is the third of four Electric Excitement Series activity guides.

Activity Guide	Level 1	Age	Grade
<i>Magic of Electricity</i>	1	9–11	4–5
<i>Investigating Electricity</i>	2	11–13	6–7
<i>Wired for Power</i>	3	13–16	8–9
<i>Electronics I</i>	4	16–18	10–12

These activity guides may be used by youth at any grade-level based on their electric skills, knowledge and expertise. A fifth activity guide, the *Electric Group Activity Guide*, provides additional group activities that can be adapted to the family, classroom or youth group. These activities strengthen understanding of electrical concepts and reinforce electrical skills.

The Experiential Learning Model

The experiential learning model is used in each activity as a means to help the young person gain the most from the experience.



Pfeiffer, J.W., & Jones, J.E., "Reference Guide to Handbooks and Annuals" © 1983 John Wiley & Sons, Inc. Reprinted with permission of John Wiley & Sons, Inc.

The five steps in this learning model encourage the young person to try to do the activity before being told or shown how. The activity is the experience part of the cycle. Use the questions listed in the *Making Connections* section of each activity to encourage the young person to think about what he or she has learned from the experience. The reflect and application questions ask the youth to **share** what they did; **process** what was most important about the experience; **generalize** the life skill and electric skill practiced to their own lives; and think through how they could **apply** the life skill or science process skill to a new situation.

To fulfill the experiential learning process, you must complete all the steps, including the review questions in *Making Connections*. The experiential model enhances learning and adjusts to a wide variety of learning styles.

Evaluating the Experience

1. By asking the questions under *Making Connections* you can evaluate your youth's understanding of the key concepts and life skills practiced in each activity. Listening to and encouraging consideration of each question, results in conclusions and opportunities for further application. In addition, the *Success Indicator* shown in the introduction of each activity will help you evaluate the experience.
2. In the *Electric Group Activity Guide*, you will find a leader assessment sheet, *Evaluating the Impact*. Use this sheet to help you evaluate your youth's understanding of electricity and circuits as he or she completes these activities.
3. Youth and volunteer helper assessments of the Electric Excitement series can be found on page 35, *Electric Group Activity Guide*.

Wired for Power

How This Book Works

Feel the Power!

Congratulations! You have successfully completed *Magic of Electricity* and *Investigating Electricity* of the 4-H electric Excitement Series. Are you ready for the *Wired for Power* activities? You will build upon many of the skills you learned in the first two levels plus learn some new ones. Set aside some time each week to explore one or more. Don't forget to invite a family member or a friend to work with you on the activities. These projects can even be done with your classmates or in a special interest club, after school group or community club. Sometimes it is more fun and interesting to explore new things together.

The Activities

Each activity in the Electric Excitement series is designed to help you learn something new about electricity. These activities also provide opportunities to practice a life skill that you can use every day. Here is a quick look at the various sections of each activity.

Skills

Each activity lists electric skills, science process skills and life skills that you will learn and use. You will practice these types of skills when you answer the questions and discuss each activity with your electric helper.

Success Indicators

Can you do what these say, and can you do it more than once? If so, you have mastered this skill. If you have trouble with this skill, just keep practicing until you can.



Tools

These are the materials you'll need to complete the activity. By organizing and planning for each activity you'll be practicing an important skill.

Power Up

This is the "do" part of the activity. You will usually get to share part of what you do with others.

Closing the Circuit

Here is an extra activity which will help you understand or practice what you have learned in each activity.

Making Connections

This is where you and your helper get together to see what you have learned about electricity. You will use these questions to help you discuss what you learned, what you did, what was important about what you did, what it meant to you and how you could use what you learned in the future. The *Making Connection* questions are found at the end of each chapter. Check the box after talking over each question with your helper.

Your Project Helper

Your electric project helper is an important part of your overall experience in the electric project. The choice of a helper is yours. This person may be your project leader or advisor, troop leader, teacher, family member, neighbor, friend or anyone who has the interest to work with you on these activities. Involve your helper as you set your goals, discuss the questions following each activity and sometimes work together on an activity.



Light Bulb Icon

Here you will find tips to help you complete the activity or general information about electricity.



Brain Boosters

These are more challenging activities for you to do. They will help you expand your knowledge and skills to other areas. Each time you successfully complete one of these, record it on your achievement program page and have your helper initial and date it.



Safety Icon

These are helpful hints to keep yourself safe when working with electricity. The activities in this guide are designed to be safe, but remember you are dealing with electricity, which can be dangerous.



Kite Icon

Check the kite for interesting facts and trivia about the magic world of electricity.

Glossary Words

All definitions for the words listed here are found in the glossary on page 34-35.



Journal

Use a journal to record your answers to *Making Connections* found at the end of each chapter.

My Project Helper _____

Phone # _____

E-mail address _____

Wired for Power Planning Guide

My Plans

- Select an electric project helper
- Complete all four steps of the *Wired for Power* Planning Guide
- Do at least seven activities each year
- Take part in at least two leadership experiences each year

My Name _____

My Project Helper_____

[illegible]

1 My Electric Project Goals

I plan to complete my *Wired for Power* activity book by _____

2 Leadership Experiences

Participate in at least two of these experiences each year. Put a check mark by the ones you plan to do.

Experience	Plan To Do	Date Completed
Give an electric demonstration		
Teach someone something about electricity		
Encourage a friend to be a part of the electric project		
Attend an electric workshop		
Give a speech on an electric subject		
Tour an electric facility		
Exhibit an electric project		
My own activities:		

3 Electric Project Highlights

List and record the date every time you do and learn something exciting in *Wired for Power*.

4 Electric Project Review

Once you have completed what you planned, arrange to talk with your helper about what you have learned. You will want to have your planning guide, achievement program and the *Making Connections* section of this guide up-to-date.

Wired for Power Achievement Program

Guidelines

- Do at least three Required Activities and four Optional Activities (Brain Boosters) this year and check them off.
- Have your electric helper date and initial this log as you complete the activities

Optional Activities (Brain Boosters)

Select and do any of the Brain Boosters in *Wired for Power* or make up your own. Record the page number of each one you complete.

Required Activities			Optional Activities (Brain Boosters)			
Activity Name	Date Completed	Helper's Initials	Page/No.		Date Completed	Helper's Initials
Tools are Important						
The Code of Safe Practices						
How Much Electricity are You Using?						
Where the Service Begins						
Wired for Power						
Light Up Your Life						
What's In a Name (plate)?						
How Much is Too Much?						
What's In the Box?						
Is It Live?						
Are Your Outlets Grounded?						
The Amazing Journey						
Watt's What?						
You the Electrician						



Wired for Power



Achievement Program Certificate

I certify that _____
has successfully completed the requirements
of Electric Excitement: *Wired for Power*

Helper's Signature _____

Date _____

Tools Are Important

Do you always have the right tools for the job? What about your electrical tools? Do you have the ones you need most often or do you frequently use some that weren't necessarily made for the task? In this activity you'll take an inventory of the electric tools and supplies you have and identify others you might need.

Power Up

Look at the list of tools required for the activities in this guide. Check the ones you already own. Next, visit a hardware or electrical supply store. Find and record the prices of all the tools you either need now or might need someday, and the store where they can be purchased. Decide which tools you will purchase and where you will get them. After you purchase these tools, store them in one spot, such as in a toolbox, so that you can locate them easily when doing an electric project.



Activity:

Put together a basic electrical tool and supply kit

Life Skill:

Acquiring/Evaluating Information—Obtaining data and information

Electric Skill:

Identifying basic electrical tools and supplies

Science Process Skill: *Deciding what to purchase with limited resources*

Success Indicator:

Identifies electrical tools

National Science Standard:

Tools help scientists make better observations, measurements and equipment for investigations



Pencil

Tool	Activity	Own	Need	Price	Store
Pencil	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14				
Calculator	8				
Neon circuit tester or a plug tester	10, 11, 13, 14				
Screwdriver	11, 14				
Ruler	12				
Crayons or markers	13				
Hair dryer or portable electric radio	13				
Needle nose pliers	14				
Switch	14				
Sandpaper	14				
Wire stripper	14				
Other					

Glossary Words

- Circuit tester
- Potential energy

Closing the Circuit

What factors do you consider when making or considering a purchase? People often consider such things as price, quality, manufacturer's reputation or warranties and store location. What other considerations have you made when making a purchase? How important are these considerations to you when making a purchase?

Fill in the chart as you think about making the following purchase:

You are doing an electric project and need to buy a portable CD player to complete the project. You go to the store and they have a selection of several CD players from which to choose. On a scale of 1 to 10, how important are the following considerations when purchasing your CD player?

	Not Important			Somewhat Important				Most Important		
Price	1	2	3	4	5	6	7	8	9	10
Quality	1	2	3	4	5	6	7	8	9	10
Manufacturer	1	2	3	4	5	6	7	8	9	10
Warrantee	1	2	3	4	5	6	7	8	9	10
Store Location	1	2	3	4	5	6	7	8	9	10
Other:	1	2	3	4	5	6	7	8	9	10
	1	2	3	4	5	6	7	8	9	10
	1	2	3	4	5	6	7	8	9	10
	1	2	3	4	5	6	7	8	9	10

Discuss with your helper the importance of different considerations that you make when deciding on a purchase.



Potential energy is a measure of the ability to do work. There is energy stored in the wood and leaves of a tree, in the water of a lake and in the stones on a mountain. This trapped,

potential energy is energy that is capable of being used, but it is not being used at the present time. Examples of potential energy are:

- a D-cell battery sitting inside a flashlight could turn on the light if the switch is turned on
- the wood of a tree could release heat energy when the wood is burned
- the water in a lake could turn an electric turbine when it moves through a dam
- the stone on a mountain could push other stones away when it rolls down the mountain side



Find the Electric Words

V U C E B B S R E W O P O M L I R K U D S Y
L O I W E V P E L I L F H I T I M X R O G V
E N R G N W O T E R O T C U D N O C N L M O
B I C A E A L L C A K K O M W A U N T T I L
F B U G M O R P T Q B P P O I R M E E B Y T
O T I H O P C I R C U I T T R R O G N A L O
L I T C T O E L O I M N R E R I W A I T E H
R C T O O V I R N T U O N R E N I K C T J M
E L E C R N Z E A A S T O K I N U L L E E M
T O S I T A D P I G Y T N E M A L I F R L E
E N T R C M E U C R E R E N T N U R I Y I T
M N E L E C T R O M A G N E T K C Y S A P E
B E R Y L A P M I C I U A M I O T O R O I R
Z A L T E R N A T I N G C U R R E N T Y B S
I B R I L O I R R U O R U Q P K T Y O R R I
T L U V S E R I E S C I R C U I T O P I E L
L O M I B B O R N I O T C O P I Z E E R T P
O A L T O L J I E B E Y U P C T U L T R E I
B L I C W A E F R O N M B I H J P R I O M T
A P U U N T P O G E C I R E P E G A T L O V
S M C D I L T T Y O C T Z R I T O R L I N O
D I H N L R R E N T C O C U L J A T P E A N
I C U O I H M D R E P P I R T S E R I W V I
M N A C P A R A L L E L C I R C U I T A L L
O J O M W I R E G A U G E E M I N K P U A A
R E A T I P N E L E C T R A N L L O L F G F

Alternating current
Amp
Amperage
Battery
Circuit
Circuit tester
Conductor

Conductivity
Current
Electricity
Electromagnet
Electron
Energy
Filament

Galvanometer
Meter
Motor
Ohm
Parallel circuit
Power
Series circuit

Volt
Voltage
Volt-ohm meter
Wire gauge
Wire stripper



Brain Boosters

Electricians have special tools designed to do things such as strip wire, detect current, etc. Talk with an electrician or salesperson to find out about these tools.

The Code of Safe Practices

Wouldn't it be nice to have another electrical outlet in your bedroom? Doesn't it always seem that you never have an electrical outlet where it is needed? Can you just add an additional outlet, or do you need to follow some rules and guidelines? Let's see if you can find the answers to these questions.

Power Up

Visit, or contact by telephone, your local or county electrical inspector. Find out what duties are performed by an electrical inspector. Ask about the education and training that is required to become an electrical inspector. See how the local laws and regulations concerning the installation of a new home electrical outlet differ from the **National Electrical Code**. Record what you learn in the *Interview Notes*.



Activity:

Interview an electrical inspector

Life Skill:

Acquiring/Evaluating Information—Obtaining and analyzing information

Electric Skill:

Understanding the local electrical code

Science Process Skill:

Communicating with others

Success Indicator:

Interviews a local electrical inspector

National Science Standard:

Many people choose science as a career



Pencil

Interview Notes

Date _____

Name of Electrical Inspector _____

Position _____

Duties _____

Education and Training _____

Local Laws and Regulations that Differ from National Code _____

Closing the Circuit

The National Electric Code sets the standards for safe electrical installations and must be followed by consumers, electricians and builders. What other codes and standards do people follow to improve safety in their lives? With your helper, make a list of some "safety codes or rules" that we encounter daily.

Examples:

Automobile driving rules
State Car Inspections
Swimming pool rules

Discuss with your helper why rules and codes are important to the safety and well-being of people and communities.

Glossary Words

- National Electric Code



In 1859, electric lights were installed in the first U.S. home in Salem, MA. However, it was not until 1879 that Thomas Edison produced the first commercially practical electric lamp. Edison also developed a system to distribute electricity for light and power in homes and businesses. By 1889, electric lights were installed in the White House.



National Electrical Code (NEC)

The National Electrical Code (NEC) was developed as a set of rules to encourage safe practices while working with electricity. The National Electrical Code is updated every few years. In addition to the National Electrical Code, local municipalities, counties and states may adopt regulations that need to be followed by consumers as well as electricians and builders. A permit may be required from a local inspector whenever you install something new to your wiring system.

Before attempting any electrical work, contact a local inspector to learn more about the electrical code in your area and procedures that you need to follow when making changes to your electrical system. Your local electrical utility may also have wiring and inspection requirements.



Brain Boosters

1. Find out more about local and state electric codes from books in your local library or sites on the World Wide Web. Tell your parents or another adult what you learned.
2. Give a demonstration or talk on the importance of electric codes.

How Much Electricity Are You Using?

Did you know that electricity travels from the electric company over power lines to your home? Do you also know how to tell how much electricity your family uses each day? Each week? Each month? In this activity you will test your skills in reading an electrical meter and in determining your family's electricity usage over the course of a month.

Power Up

Locate the **electrical meter** in your home. Determine if it is a **cyclometer** or a **pointer-type meter**. Read the meter and record your findings on the chart. Take readings from the electrical meter every day, at the same time every day, for a week and then once a week for the rest of the month.

To measure how much electricity is used in a day, read the meter and take a Day 1 reading. Record the reading on the line below. The next day read the meter again. By subtracting Day 1's reading from Day 2's reading, you will find out the amount of energy you and your family have used (measured in **kilowatt-hours**).

Activity:

Life Skill:

Electric Skill:

Science Process Skill:

Success Indicator:

National Science Standard:

Determine electrical usage

Acquiring/Evaluating Information—Obtaining and analyzing data

Reading an electrical meter

Using resources wisely

Reads an electrical meter

Tools help scientists make better observations, measurements, and equipment for investigations



Electrical meter, pencil



Day 2 reading _____
 Day 1 reading _____
 Total kilowatt hours used _____

	Date	Time	Meter Reading	Electricity Used Since Last Reading (kwh)
Week One/Day One				
Day Two				
Day Three				
Day Four				
Day Five				
Day Six				
Day Seven				
Week Two				
Week Three				
Week Four				



Electric Meters

Electricity travels from utility power lines, through a meter where the amount of electricity used is measured, and into a home or business. Customers are charged based upon the number of kilowatt-hours of electricity they use.

How to Read an Electric Meter

Cyclometer

Some electric meters are digital, like the mileage total on the odometer of a car. These meters are called cyclometers and are read from left to right.

Meter Reading: 5 4 3 2 1



Pointer-Type Meter

Pointer-type electric meters have four or five clock faces. Follow these instructions to read this type of meter:

The clock faces are read from right to left. Write down the number that the dial is pointing to, recording the reading from right to left. If the dial is between two numbers, always write down the lower of the two numbers.

Meter Reading: 4 1 2 3 0



If a dial points directly to a number, you must decide if the meter has really gotten to the number or is ALMOST there. To decide, look at the clock to the right of the one in question. If the one to the right has passed zero (is pointing to a 1, 2 or 3) then it has gotten there—record the number it is pointing to. For example:

Meter Reading: 5 4 3 2 1

If the clock face to the right of the one in question has not passed zero (is pointing to 7, 8 or 9) then you should record the number the clock is pointing to MINUS one. For example:



Meter Reading: 3 9 2 3 0



Making Connections

Share With Your Helper

- ☐ What tools did you include in your electrical toolbox?
- ☐ What surprised you about the number of kilowatt-hours your family used in a day, week and month? When were the times of greatest energy use? What might explain this?

Process What's Important

- ☐ What special regulations or rules does your area have that differ from the National Electrical Code?
- ☐ Why might it be important that you know how to read an electrical meter and calculate energy usage?

Generalize To Your Life

- ☐ What terminology used by the electrical inspector did you have trouble understanding? How could you use questions to improve your understanding of a difficult topic?
- ☐ What can you or your family do to conserve electric energy?

Apply What You Learned

- ☐ How do you decide between what you really need and what you want when you are thinking of purchasing something?
- ☐ What are some things that you can do to use resources wisely?



Brain Boosters

Find one of your family's electric bills and identify the following on the bill: provider, account number, dates of service (billing period), meter reading - Begin _____ End _____, total kilowatt-hours consumed and amount due before tax. Calculate the total electricity cost in dollars per kilowatt hour and share what you learned with your helper.



The electric company sends people to read the meter at your home to record your electric usage. However, with new computer technology, a computer in the office of the electric company can read some electrical meters in homes and businesses far away.

Glossary Words

- Cyclometer
- Electrical meter
- Kilowatt-hour
- Pointer-type meter