Electric Excitement
4-H ELECTRIC SERIES

National 4-H Curriculum
BU-06851

Entering Electronics

ELECTRONICS

Project Activity Guide

Name_____

County _____

REVIEWED & RECOMMENDED
National 4-H Curriculum

Acknowledgments

2002 Electric Revision Design Team

Design Team Members: Lori Marsh, Virginia Polytechnic Institute and State University; George Duncan, University of Kentucky; Roger Tormoehlen, Purdue University; Dominion Electric Power, and Wayne Newhart, Tipmont REMC

Design Team Liaison: Kathleen Jamison, Virginia Polytechnic Institute and State University

Writer: Laurie W. DeMarco, Science Education Consultant, Salem, VA

Design and Production: Northern Design Group, White Bear Lake, MN

1997 Electric Design and Review Team

Principal Author: George Duncan, Extension Agricultural Engineer, University of Kentucky

Design Team: Roger Tormoehlen, Purdue University; Richard Spray, Clemson University; Lori Marsh, Virginia Polytechnic Institute and State University; S. Dee Jepsen, The Ohio State University; Randall Reeder, The Ohio State University; Robert Horton, The Ohio State University; Ed Maxa, North Carolina State University; Mike Nolan, Huron County, Ohio; Tom Zurcher, University of Minnesota Extension; engineers from electric utilities including American Electric Power, Ohio Edison

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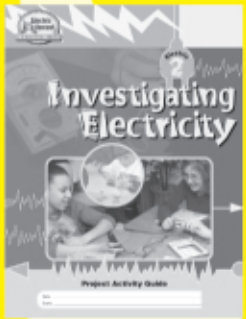
The Story of Electricity and Magnetism by Bernard Seeman, 1967, Harvey House, Inc., New York

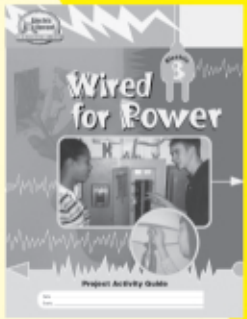
Science Projects About Electricity and Magnets by Robert Gardner, 1994, Enslow Publishers, Inc. Springfield, NJ.

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

Magic of Electricity



Investigating Electricity



Wired for Power

Electric Helper's Guide

Entering Electronics

Contents

Note to the Electric Project Helper

This guide is the fourth in the 4-H Electric Excitement series developed to involve youth in the exciting world of electricity, and to improve their life skills and leadership in a science area. The first two guides should be completed by the youth in preparation for advancing to the Electronics I Guide. Electronics I introduces the basics of solid-state electronics. It also provides hands-on activities that give youth practical experience in understanding modern day electronic equipment, and provides them with career skills and opportunities. 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.

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 Electronics I 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 fourth activity guide in the *Electric Excitement Series*.

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

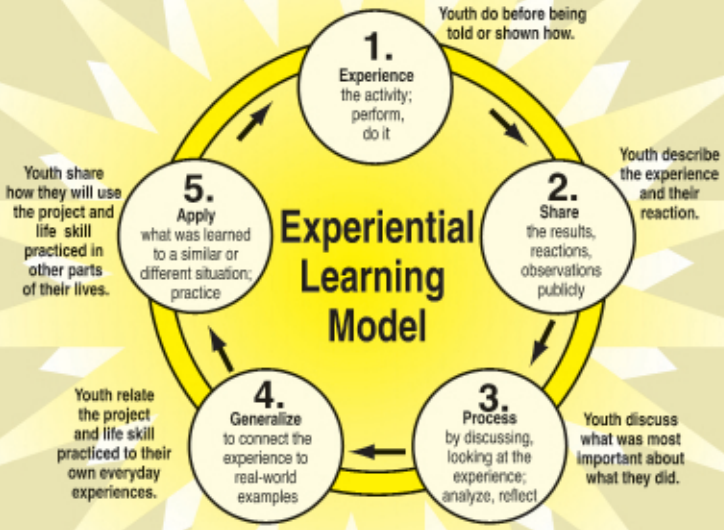
These activity guides may be used by youth at any grade-level based on their electric skills, knowledge and expertise. A fifth activity guide, the *Electric Group Activity Guide*, provides additional group activities that can be adapted to the family, classroom or youth group. These activities strengthen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

Electronics I Guide

This activity guide is designed for intermediate to advanced learners in the electric series. An understanding of DC circuits, voltage, amperage, current flow, polarity and some soldering is essential to properly undertake the activities. This guide can be used by an individual in a self-study mode or with a small group. The activities are especially designed to help youth develop skills in planning, organizing, making decisions, analyzing and communicating their experiences to others. Resources listed can provide further information and help on understanding and explaining these activities.

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. The *Making Connection* questions are found at the end of each chapter. In addition, the *Success Indicator* shown in the introduction of each activity will also help you evaluate the experience.
2. At the end of Book 5, *Electric Group Activity Guide*, you will find an assessment sheet, *Evaluating the Impact*. Use this sheet to help you evaluate your youth's understanding of electronics 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*.

How This Book Works

Are you ready to learn about electronics? Through the activities in this guide you will have many exciting experiences and challenges. You will learn about diodes, transistors, LED's, photocells, SCR's, IC's and amplifiers! These items are components in the family of solid-state electronics. Solid-state refers to the "solid" materials from which the electrical components are fabricated, such as silicon, gallium, boron, phosphorous, germanium, etc. The delicately prepared solid-state devices are usually enclosed in plastic or metal cases for physical protection and heat dissipation. They are also referred to as semi-conductors because they can either conduct or not conduct the flow of electric current. In this manner, they can act as switches and amplifiers. These components are an essential part of all modern day electronics products found in the home, office and business.

The Activities
Each activity in the Electric Excitement series is designed to help you learn something about electricity and electronics as you practice a life skill you can use everyday. 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. Here is a quick look at the various sections found in 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.

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 38.

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

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 Connections* 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.

Entering Electronics
Planning Guide

My Plans

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

My Name _____

My Project Helper _____

Helper's Phone Number _____ E-mail Address _____

1 My Electric Project Goals

I plan to complete my *Entering Electronics* 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 electronics assembly business		
Tour an electric generating plant		
Search the Internet for electric topics		
Exhibit an electric project		
My own activities: (Use additional paper as needed.)		

3 Electric Project Highlights

List and record the date every time you do and learn something exciting in *Entering Electronics.*

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.

Entering Electronics
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 *Entering Electronics* 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**
What is This and That?						
Hunting for Electronic Wizards						
How Many and How Much?						
Hot Wire Hook-Ups						
The Capacity to Resist						
Diodes—One Way Only!						
Dim Your Bright Lights!						
Does Your LED Glow?						
How Fast Do I Blink?						
Gotcha!						
My! How Bright is the Light?						
Surprise! Surprise!						
More Volume, Please!						

Electric Excitement
4-H ELECTRIC SERIES

Entering Electronics

Achievement Program Certificate

I certify that _____
has successfully completed the requirements of Electric Excitement: *Entering Electronics*

Helper's Signature_____

Date _____

What is This and That?

Activity:	***Identify electrical and electronic parts***
Life Skill:	***Acquiring/Evaluating Information —Obtaining data and information***
Electric Skill:	***Knowledge of electronic parts***
Science Process Skill:	***Planning and organizing***
Success Indicator:	***Accurately identifies electrical and electronic parts***
National Science Standard:	***Tools help scientists make better observations, measurements and equipment for investigations***
	***Pencil***

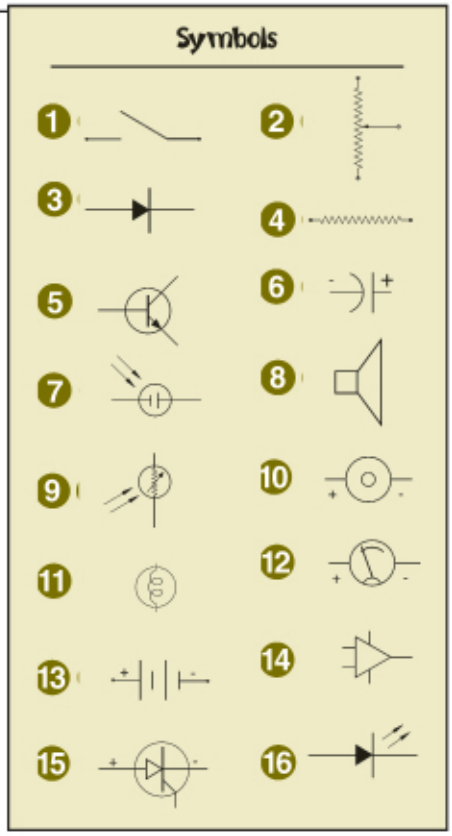
Do you know the difference between a resistor and a capacitor? Or, between a diode and a transistor? In this activity you will check your knowledge of electrical and electronic parts. Search through the references listed at the end of this book and other materials to help you identify the parts.

You may not be able to identify all of the parts right away. If you do not know all the parts now, continue working through the activities to learn about these parts, then come back and identify additional parts until you complete the list.

Power Up

Electrical and electronic parts symbols and images are defined and shown in many publications. Put the letter for each part shown in the picture in the blank beside the proper part name. Then describe to your electronics helper what each part is and how it is used. Check the *High Voltage Glossary* (pg. 38) for descriptions of many of the terms.

Picture	Part	Symbol
_____	Battery	_____
_____	Battery Holder	
_____	Bulb	_____
_____	Switch	_____
_____	Terminal strip	
_____	Diode	_____
_____	Transistor	_____
_____	Resistor	_____
_____	Potentiometer	_____
_____	Light Emitting Diode (LED)	_____
_____	Capacitor	_____
_____	Photocell	_____
_____	Buzzer	_____
_____	Meter	_____
_____	Silicon Controlled Rectifier (SCR)	_____
_____	Integrated Circuit (IC)	_____
_____	Speaker	_____
_____	Plug, miniature	
_____	Solar Cell	_____



Closing the Circuit

People use many methods to describe something without saying or writing the entire word or phrase. One of these methods is by using the first letter of the words in the phrase to make up a word (acronym), for example, SCUBA stands for S(self) C (contained) U (underwater) B (breathing) A (apparatus). See if you can use a dictionary or an encyclopedia to find out the meaning of these words:

MODEM _____

_____

RADAR _____

_____

LASER _____

_____

NASA _____

_____

Can you think of other words we use that are actually made up of the first letters of many words? How does this make it easier to communicate? What are other "shorthand" methods that people use to communicate?

Electronics developed from experiments made in the 1800's with electric currents flowing through glass tubes. Among the first men to develop such experiments was Heinrich Geissler (1814–1879), a German manufacturer of scientific instruments. He removed most of the air from a glass tube, and found that the tube would glow with colors when different gases were placed in the tube and an electric current was sent through it.

Glossary Words

- **Terminal Strip**
- **Transistor**
- **Potentiometer**
- **Capacitor**
- **Buzzer**
- **Silicon Controlled Rectifier (SCR)**
- **Diode**
- **Resistor**
- **Light Emitting Diode (LED)**
- **Photocell**
- **Meter**
- **Integrated circuit (IC)**

Brain Boosters

Sketch some other symbols you see daily and describe their important meaning and use.

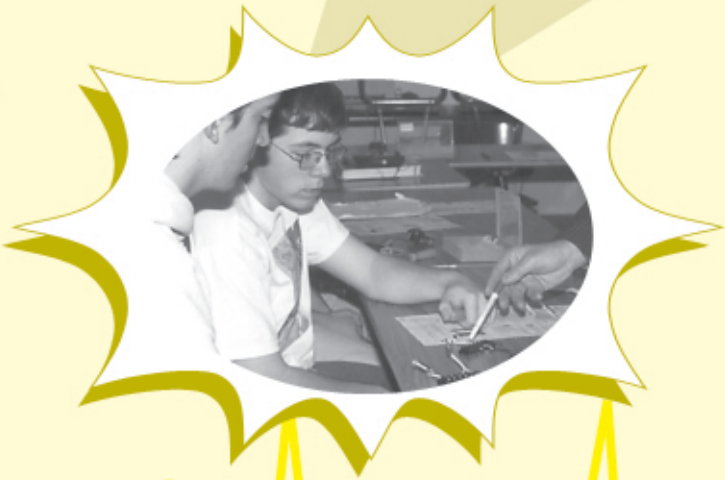
Activity 2

Hunting for Electronic Wizards

Activity:	***Identify devices that use electrical and electronic devices***
Life Skill:	***Acquiring/Evaluating Information—Obtaining data and information and identifies need for data***
Electric Skill:	***Recognizing electrical and electronic devices***
Science Process Skill:	***Planning, organizing and decision making***
Success Indicator:	***Extensive and accurate list of devices***
National Science Standard:	***Electricity in circuits can produce light, heat, sound, and magnetic effects***
Tools	***Pencil***

Electronics is a branch of the science of electricity. "Electronics" takes its name from electrons, which are the tiny, negatively charged particles of atoms. Electronics deals chiefly with the flow of electrons (or electrical current) passing through vacuum tubes, gas-filled tubes, transistors and other similar devices. Electrical fans, generators and motors are not considered electronics because they depend only on electrons flowing through wires.

Electronic systems composed of **semi-conductors** are used as an essential part of all modern day electronics products found in the home, office and business. They do such things as operate the remote control for your TV or stereo, or dictate the power-level and timing in your microwave. In this activity you will discover the many items that we use every day that depend on electronics to operate.



Power Up

Prepare for a hunting expedition around your home, school, or other place for 'wizards' of the electronics world. Do this with a friend for more fun! Prepare a form as outlined below and see how many items you can "target."

Individual Item	Contained In	Action Performed (light, motion, sound, switch, etc.)

Glossary Words

- **Electronics**
- **Semi-conductor**

The World of Electronics

Electronic components are used in many of the devices that we use in the home, school, or workplace. Electronics make possible radio, television, CD players, tape recorders and telephones. Electronic thermostats control the temperature in some houses, and photoelectric cells turn on security lights when darkness comes.

In industry, electronic devices operate many powerful machines. They regulate the current used in spot welding, control the speed of lathes and other machines driven by electric motors, adjust temperatures in ovens, or measure and control the thickness of manufactured items. Photoelectric cells or "electric eyes" sort fruit and other products according to size and color. Electronic facsimile machines, computers, scanners and printers assist in operating most businesses.

Electronic devices are used in medicine, astronomy, business, physics, navigation, national defense, music and many other fields. What electronic devices do you use?

Making Connections

Share With Your Helper

- ☐ What electronic parts did you already know?
- ☐ Where or how did you find information about the other parts?
- ☐ How could you best recognize electronic devices around the house?

Process What's Important

- ☐ What appliances or devices around your home, school, or other places use electronic components?
- ☐ Why is knowledge of electronic parts important to the success of an electronic project?

Generalize To Your Life

- ☐ Where can you find electronics information when you need to know something about electronics?

Apply What You Learned

- ☐ How will you prepare yourself to do the activities in this guide?
- ☐ How do we use symbols in communication?

Sir William Crookes, a British scientist, invented the Crookes vacuum tube. He observed that when obstacles were placed in these vacuum tubes, they cast shadows on the sides of the tubes when a current flowed through them. This indicated that the current consisted of particles.

Vacuum tubes ushered in the age of electronics, but these devices were cumbersome, inefficient and expensive to make. Today we use smaller and less expensive transistors to perform the same electrical tasks as vacuum tubes once did. Giving credit to where it is due, discoveries with vacuum tubes led the way to the marvels of electronics that we know today.

Brain Boosters

1. Describe to your helper what our lives would be like if we did not have electronics. How have electronics improved our way of life?

2. Visualize how electronic parts and devices could be used for new devices and equipment for the home, school or work place. Make notes about some of these ideas and discuss with your helper, parent, teacher or electronic leader.

Activity 3

How Many and How Much?

Activity:	***Acquire electronic parts for activities***
Life Skill:	***Acquiring/Evaluating Information—Creating data gathering processes***
Electric Skill:	***Choosing parts to meet specifications***
Science Process Skill:	***Planning and organizing***
Success Indicator:	***Finding needed electronic parts at low cost***
National Science Standard:	***Tools help scientists make better observations, measurements and equipment for investigations***
	***Pencil***

Several parts are needed to do the activities in *Entering Electronics*. In this activity you will obtain parts for the activities you plan to do. Electrical parts can be purchased from electrical supply catalogs, stores or Internet sites.

Power Up

Listed are the parts you will need for each activity. Indicate in the chart which parts you have, which ones you'll need and price for each. Some of the parts have to be prepared for easy electrical connections. Wire leads are necessary to extend the short pins or tabs of some parts and enable them to connect together for circuit fabrication.

PARTS NEEDED FOR ACTIVITIES IN ELECTRONICS I

	Activity Number, Quantity and Price of Parts Required									
Parts Required	**4**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**Price**
Battery, 1.5 Volt, "C" Size		1	2	2	2	2		2	4	
Battery Holder, "C" Size, for 1 Battery		1								
Battery Holder, "C" Size, for 2 Batteries			1	1	1			1	1	
Bulb, 1.5 Volt, Screw Base		1								
Bulb, 6 Volt, Screw Base			1							
Bulb Base, Screw Type for above		1	1							
Switch, On-Off, knife-blade or equal		1	1	1	1	1	1	1	1	
Terminal Strip, 6 position		1	1	1	1	1	1	1		
Terminal Strip, 8 position									1	
Diode, 3 amp, 25 Volt or greater		1								
Transistor, NPN, #2N4401, GE20 or SK3854			1			1				
Resistor, 1000 Ohm, 1.2 Watt			1		1	1		1**		
Resistor, 120 Ohm, ½ Watt					1					
Resistor, 220 Ohm, ½ Watt					1				1	
Resistor, 2.2 Ohm, ½ Watt							1	2	1	
Potentiometer, 5000 Ohm, linear		1	1							
Transistor, Unijunction, 2N4891, SK9122					1					
Light Emitting Diode (LED) 1.5 to 2.0 Volt				1	1					
Capacitor, 22 mfd, 25 Volt					1					
Capacitor, 0.2 mfd, 15 Volt or greater									2	
Capacitor, 10 mfd, 15 Volt or greater									1	
Capacitor, 470 mfd, 15 Volt or greater									1	
Capacitor, 1000 mfd, 15 Volt or greater									1	
Photocell, resistive CDS type						1		1		
Buzzer, 4–24 Volt DC, under 50 ma current						1		1		
Solar Cell, 0.5 Volt, 100–300 ma output							1			
Meter, 0–50 ma							1			
Silicon Controlled Rectifier, SK3570 or equal								1		
Integrated Circuit, LM383, SK3853 or equal									1	
Speaker, 3 to 6 inch, 4 Ohm (or 8 Ohm)									1	
Plug, Miniature									1	
2 to 3 inch pieces of #18 or #20 insulated solid wire	*						4	5	13	
Soldering iron	1						1	1	1	
Solder	1						1	1	1	
Wire cutting tool	1						1	1	1	
Wire stripping tool	1						1	1	1	

* Number of wires as required to connect to the parts being used.
** Other values can be used for tests.

Closing the Circuit

There are many transistors and other electronic parts today that have similar characteristics. Cross-referenced lists show parts that can be substituted for one another. Did you find substitute parts when you went looking for those needed for these projects?

Do you use a computer? If so, try preparing a spreadsheet of the above parts lists so you can make changes or additions as needed and print a list for your records or to share with another person. Include a list of the substitute parts that you found in your search.

Marquis Guglielmo Marconi (1874–1937), an Italian inventor and electrical engineer, is recognized for his work in developing wireless telegraphy, or radio. Modern day electronics began in 1896 when Guglielmo Marconi transmitted and received radio signals over a distance of two miles. On Dec. 12, 1901 he produced the first transatlantic wireless signal in history!

Brain Boosters

Improve your record keeping skills by expanding the parts resource list above to include a column for the source of the parts. Use this information to determine your cost of each activity and where the parts can be obtained.

The Barrier Terminal Block

Many of the parts are used in several different activities. *Entering Electronics* projects use a quick and easy way to connect different parts in various circuits. A barrier terminal block is the means used in these activities to conveniently connect parts. The terminal block has screw terminals where wires can be clamped tightly under the screw head. The screw terminals are made in pairs. Each pair of screws is electrically connected by a short metal conductor, but are insulated from other pairs. With this feature you can quickly make connections of selected wire leads under one pair of screws but keep them electrically isolated from other connections. A small flat tip screwdriver is used to build and disassemble the test circuits. The terminal blocks are available in different sizes and number of screw pairs. Shown is a six-position terminal size.

Glossary Words

- **Solder**
- **Terminal Block**