



# Electricity

## Merit Badge Workbook

This workbook can help you but you still need to read the merit badge pamphlet (book). No one can add or subtract from the Boy Scout Requirements #33216. Merit Badge Workbooks and much more are below: [Online Resources](#).

Workbook developer: [craig@craiglincoln.com](mailto:craig@craiglincoln.com). Requirements revised: 2004, Workbook updated: February 2009.

Scout's Name: \_\_\_\_\_ Unit: \_\_\_\_\_

Counselor's Name: \_\_\_\_\_ Counselor's Ph #: \_\_\_\_\_

### 1. Demonstrate that you know how to respond to electrical emergencies by doing the following:

a. *Show* how to rescue a person touching a live wire in the home. \_\_\_\_\_

---

---

b. *Show* how to render first aid to a person who is unconscious from electrical shock. \_\_\_\_\_

---

---

c. *Show* how to treat an electrical burn. \_\_\_\_\_

---

---

d. Explain what to do in an electrical storm. \_\_\_\_\_

---

---

e. Explain what to do in the event of an electrical fire. \_\_\_\_\_

---

---

2. Complete an electrical home safety inspection of your home, using the checklist found in this pamphlet or one approved by your counselor. Discuss what you find with your counselor. ([Sample Home Electrical Checklist](#))

---

---

---

---

---

3. Make a simple electromagnet and use it to show magnetic attraction and repulsion. ([Sample Plans](#)) \_\_\_\_\_

4. Explain the difference between direct current \_\_\_\_\_

---

---

---

---

5. Make a simple drawing to show how a battery and an electric bell work.

6. Explain why a fuse blows or a circuit breaker trips. \_\_\_\_\_

Tell how to find a blown fuse or tripped circuit breaker in your home. \_\_\_\_\_

Show how to safely reset the circuit breaker. \_\_\_\_\_

7. Explain what overloading an electric circuit means. \_\_\_\_\_

Tell what you have done to make sure your home circuits are not overloaded. \_\_\_\_\_



---

---

---

---

---

**10. Explain the following electrical terms:**

**volt,** \_\_\_\_\_

---

**ampere,** \_\_\_\_\_

---

**watt,** \_\_\_\_\_

---

**ohm,** \_\_\_\_\_

---

**resistance,** \_\_\_\_\_

---

**potential difference,** \_\_\_\_\_

---

**rectifier,** \_\_\_\_\_

---

**rheostat,** \_\_\_\_\_

---

**conductor,** \_\_\_\_\_

---

**ground,** \_\_\_\_\_

---

**circuit,** \_\_\_\_\_

---

**and short circuit.** \_\_\_\_\_

---

11. Do any TWO of the following: \_\_\_\_\_

- (a) Connect a buzzer, bell, or light with a battery. Have a key or switch in the line. \_\_\_\_\_
- (b) Make and run a simple electric motor (not from a kit). ([Sample Plans](#)) \_\_\_\_\_
- (c) Build a simple rheostat. Show that it works. \_\_\_\_\_
- (d) Build a single-pole, double-throw switch. Show that it works. \_\_\_\_\_
- (e) Hook a model electric train layout to a house circuit. Tell how it works. \_\_\_\_\_

**Online Resources** (Use any Internet resource with caution and only with your parent's or guardian's permission.)

**Boy Scouts of America:** ► [scouting.org](http://scouting.org) ► [Guide to Safe Scouting](#) ► [Age-Appropriate Guidelines](#) ► [Safe Swim Defense](#)  
 ► [Scout](#) ► [Tenderfoot](#) ► [Second Class](#) ► [First Class](#) ► [Rank Videos](#) ► [Safety Afloat](#)

**Merit Badge Books:** [www.scoutstuff.org](http://www.scoutstuff.org) *Please don't post workbooks on your site. Please instead post links to these:*  
 MeritBadge.org: <http://meritbadge.org/wiki/index.php/MBW> -or- usscouts.org: <http://www.usscouts.org/mb/worksheets/list.asp>

### Requirement Resources

These resources and much more are at: <http://meritbadge.org/wiki/index.php/Electricity>

1. [how to rescue a person touching a live wire](#) - [CDC's Electrical Fires & Burn Treatment](#) - [CDC First Aid For Electrical Accidents](#)  
[Mayo Clinic First Aid Guide:Electrical Shock](#) - [Electrical burns](#)
- 1d. [What to do in an electrical storm](#)
2. The electrical home safety inspection checklist from the pamphlet is in the last pages of the [Electricity Workbook](#). Also see the [UL Home Safety Inspection](#)  
[Lessons Videos: Replace an Electrical Switch](#) - [Replace an Outlet](#) - [Test an Outlet](#) - [Test GFCI](#) - [Safety](#)
3. Make a simple electromagnet: [Best site](#) - [Great](#) - [Great](#) - [Great](#) - [Good](#)
4. [PBS Animated diagram of Direct Current vs. Alternating Current](#) [Alternating Current](#) - [Dirrect Current](#)
5. [Battery Diagram](#) - [Make a Lemon into a Battery](#) - [Animation shows how an electric bell works](#)
6. [Why a fuse blows or a circuit breaker trips](#) - [another site](#) - [How to find a blown fuse or tripped circuit breaker](#)  
[How to safely reset the circuit breaker](#) - [another site](#)
7. [Electrical overloading](#) - [Overloaded Circuits](#) - [How to avoid overloaded circuits](#)
8. A sample wiring diagram of a bedroom and graph paper to make your own is in the [Electricity Worksheet](#)
- 9a. How to read an electric meter: [Animated](#) - [another site](#) - [another](#)  
[Determine your energy cost from the meter readings](#) - [another site](#)
- 9b. The BSA Home Energy Audit in the [Electricity Workbook](#) finds many ways to save electricity.  
[How to conserve energy](#) - [another site](#) - [another site](#) - [U.S. Department of Energy](#) - [U.S. Dept of Energy Resources](#)
10. [How Stuff Works: Amps, Watts, Volts and Ohms](#) - [more terms](#) - [glossary of electrical terms](#) - [another great glossary](#)
- 11b. Make and run a simple electric motor (not from a kit): [Best](#) - [Great](#) - [Good](#) - [BoysLife](#) - [4H Book](#)
- 11c. [How to build a simple rheostat](#) - [another site](#)
- 11d. [Build a single-pole, double-throw switch](#)
- 11e. [How a model electric train works](#)

## Sample Home Electrical Inspection Checklist

### Outlets

- Check for outlets that have loose-fitting plugs, which can overheat and lead to fire. \_\_\_\_\_
- Replace any missing or broken wall plates. \_\_\_\_\_
- Make sure there are safety covers on all unused outlets that are accessible to children. \_\_\_\_\_

### Line Cords

- Make sure cords are in good condition-not frayed or cracked. \_\_\_\_\_
- Make sure they are placed out of traffic areas. \_\_\_\_\_
- Make sure that cords are not nailed or stapled to the wall, baseboard or to another object. \_\_\_\_\_
- Make sure that cords are not under carpets or rugs or any furniture rests on them. \_\_\_\_\_

### Extension Cords

- Check to see that extension cords are not overloaded & only be used on a temporary basis, not as permanent wiring. \_\_\_\_\_
- Make sure extension cords have safety closures to help protect children from shock hazards and mouth burns. \_\_\_\_\_

### Plugs

- Make sure your plugs fit securely into your outlets. \_\_\_\_\_
- Make sure no plugs have had the ground pin (the third prong) removed in order to make a three-prong fit a two-conductor outlet; this could lead to an electrical shock. \_\_\_\_\_
- Never force a plug into an outlet if it doesn't fit. \_\_\_\_\_
- Avoid overloading outlets with too many appliances. \_\_\_\_\_

### Ground Fault Circuit Interrupters (GFCIs)

GFCIs can help prevent electrocution. When a GFCI senses current leakage in an electrical circuit, it assumes a ground fault has occurred. It then interrupts power fast enough to help prevent serious injury from electrical shock. GFCIs can be installed at the outlet, or as a replacement for the circuit breaker for an entire circuit at the fuse box.

- Kitchen                     
  Bathrooms                     
  Garage                     
  Laundry room                     
  Outdoors

- Test GFCIs according to the manufacturer's instructions monthly and after major electrical storms to make sure they are working properly. \_\_\_\_\_

### Light Bulbs

- Check the wattage of all bulbs in light fixtures to make sure they are the correct wattage for the size of the fixture. \_\_\_\_\_
- Replace bulbs that have higher wattage than recommended; if you don't know the correct wattage, check with the manufacturer of the fixture. \_\_\_\_\_
- Make sure bulbs are screwed in securely; loose bulbs may overheat. \_\_\_\_\_

### Circuit Breakers/Fuses

- Make sure circuit breakers and fuses are the correct size current rating for their circuit. If you do not know the correct size, have an electrician identify and label the size to be used. Always replace a fuse with the correctly specified size fuse. \_\_\_\_\_
- Make sure everyone in your home knows where the main breaker is located and how to shut of power to the entire house.

**Sample Home Electrical Inspection Checklist** (page 2)**Plug In Appliances**

- Make sure there are no plugged-in appliances where they might fall in contact with water. If a plugged-in appliance falls into water, NEVER reach in to pull it out—even if it's turned off. First turn off the power source at the panel board and then unplug the appliance. If you have an appliance that has gotten wet, don't use it until it has been checked by a qualified repair person.
- 

**Appliances**

- If an appliance repeatedly blows a fuse, trips a circuit breaker or if it has given you a shock, unplug it and have it repaired or replaced. \_\_\_\_\_

**Entertainment/Computer Equipment**

- Check to see that the equipment is in good condition and working properly. Look for cracks or damage in wiring, plugs and connectors. \_\_\_\_\_
- Use a surge protector bearing the seal of a nationally recognized certification agency. \_\_\_\_\_

**Outdoor Safety**

- Electric-powered mowers and other electric tools should not be used in the rain, on wet grass or in wet conditions. \_\_\_\_\_
- Inspect power tools & electric lawn mowers before each use for frayed power cords, broken plugs & cracked or broken housings. If any part is damaged, stop using it immediately. Repair it or replace it. \_\_\_\_\_
- Always use an extension cord marked for outdoor use and rated for the power needs of your tools. \_\_\_\_\_
- Remember to unplug all portable power tools when not in use. \_\_\_\_\_
- When using ladders, watch out for overhead wires and power lines. Stay at least 10 feet from all overhead lines. \_\_\_\_\_
- 

**Lightning**

- During an electrical storm, do not use appliances (i.e., hairdryers, toasters and radios) or telephones (except in an emergency); do not take a bath or shower; \_\_\_\_\_
- Keep batteries on hand for flashlights and radios in case of a power outage. \_\_\_\_\_
- Use surge protectors on electronic devices, appliances, phones, fax machines and modems. \_\_\_\_\_

**Space Heaters**

- Space heaters are meant to supply supplemental heat. Keep space heaters at least 3 ft. away from any combustible materials such as bedding, clothing, draperies, furniture and rugs. \_\_\_\_\_
- Don't use space heaters in rooms where children are unsupervised and remember to turn off and unplug when not in use. \_\_\_\_\_
- Do not use space heaters with extension cords; plug directly into an outlet on a relatively unburdened circuit. \_\_\_\_\_

**Halogen Floor Lamps**

- Halogen floor lamps operate at much higher temperatures than a standard incandescent light bulb. Never place a halogen floor lamp where it could come in contact with draperies, clothing or other combustible materials. \_\_\_\_\_
- Be sure to turn the lamp off whenever you leave the room for an extended period of time. \_\_\_\_\_
- Never use torchiere lamps in children's bedrooms or playrooms. Consider using cooler fluorescent floor lamps. \_\_\_\_\_

## Sample Home Energy Audit (from Energy Merit Badge)

*Remember that even a gas furnace uses an electric fan so saving heat saves electricity.*

### **Attic**

- Insulation - Is there enough insulation between ceiling joists?
- Vents - Sufficient and unobstructed?

### **Living Areas**

- Air Leakage - Tape a foot of toilet paper to a pencil with paper hanging free. Hold near windows and doorframes, window air-conditioning units, and electrical covers. If paper moves, you may need weather-stripping, caulking, or storm windows.
- Wall Insulation - Are the walls too cool to the touch on a cold day or too warm on a hot day?
- Thermostat - Set at 68 degrees in winter (turn down 5 degrees more when sleeping), 78 in summer.
- Drapes - During winter, open drapes and shades to let sunlight in. Close at night. During the summer, close drapes.
- Unused Rooms - Close heating and cooling vents, doors in areas seldom used.
- Use fans instead of air conditioning when possible. Fans can also help circulate air when the air conditioning is on.

### **Fireplace**

- Close the damper when fireplace is not in use.
- Glass doors keep heat from escaping up the chimney.

### **Kitchen**

- Refrigerator/Oven Seal - To test, close a dollar bill in the door. If the bill moves with little resistance, the seal is bad.
- Appliances - Use washers and dryers in the morning and late evening hours when energy requirements are lower.
- Lights - Turn off lights when not used. Install lower wattage and fluorescent light bulbs whenever possible.
- Faucets do not drip.

### **Basement/Crawl Space**

- Heating/Cooling System - Clean or replace filters monthly. Have unit serviced once a year.
- Water Heater - Set temperatures no higher than 160 degrees. Drain sediments 3-4 times a year.
- Ducts/Pipes - Insulate hot water pipes as well as heating and cooling ducts.
- Floors - If you have a crawl space under your house, install batt-type fiberglass insulation under floors.
- Venting - Washer & dryer units should be vented directly to the outside.

### **Outside**

- Weather Stripping & Caulking - Caulk the cracks around windows, weather-strip around doors.
- Windows - Storm windows and double-paned glass can reduce energy usage up to 15%.
- Doors - Keep doors tightly closed on hot or cold days.
- Storm Doors - Help insulate doors