Scouting America

# Electricity Merit Badge Workbook

## SCOUTMASTER BUCKY

Scouts participating in a Scoutmaster Bucky merit badge opportunity, whether online or in person, should consider using the Electricity merit badge pamphlet for discovery and knowledge, along with the class preparation pages for clarifications, insights, and expectations.

https://scoutmasterbucky.com/merit-badges/electricity/electricity-pamphlet.pdf

https://scoutmasterbucky.com/merit-badges/electricity/electricity-cpp.pdf

**REQUIREMENT 10b REQUIRES COUNSELOR APPROVAL.**

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|---|---|
| **REQUIREMENT 1:** | Demonstrate that you know how to respond to electrical emergencies by doing the following: |
| **REQUIREMENT 1a:** | Explain how to turn off power for a particular circuit and the whole house in the event of an emergency. |

Notes:

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| **REQUIREMENT 1b:** | Demonstrate how to rescue a person touching a live wire in the home. |

Consider using the Electricity Merit Badge Pamphlet for preparation information

**This requirement must be reviewed with your merit badge counselor.**

**BE PREPARED!**

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| **REQUIREMENT 1c:** | Describe how to safely get out of a car in an accident if you suspect a utility wire is on the car. |

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| **REQUIREMENT 1d:** | Show how to render first aid to a person who is unconscious from an apparent electrical shock. |

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| **REQUIREMENT 1e:** | Show how to treat an electrical burn. |
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| **REQUIREMENT 1f:** | Explain what to do in the event of an electrical fire. |
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Notes:

| **REQUIREMENT 1g:** | Explain what to do if caught out in the open during an electrical storm. |
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Notes:



| **REQUIREMENT 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. |
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Don't forget to bring any work you have done in preparation to share with your counselor

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## ELECTRICAL HOME SAFETY INSPECTION EXAMPLE

**Outlets**

Fix electrical outlets that have loose-fitting plugs

Replace any missing or broken wall plates

Place safety covers on all unused outlets that are accessible to children

**Cords / Extension Cords**

Replace frayed or cracked cords in all appliances, lights, and electronic equipment

Move cords out of traffic areas

Check that no nails or staples are used on cords

Check that no cords are under carpets or rugs

Check that no furniture is resting on cords

Check for overloaded extension cords

Check for permanently used extension cords – they should be only used temporarily

Install safety closures on all extension cords

**Plugs**

Check that all plugs fit their outlets correctly

Check that the ground pin has not been removed from any plugs

Check that no plugs have been forced into an outlet

**Ground Fault Circuit Interrupters (GFCIs)**

Ensure GFCIs are installed in appropriate outlet locations in the kitchen, bathroom, laundry room, garage, and other locations where water may be present

Test GFCIs according to the manufacturer's instructions

Arrange replacement of non-functioning GFCI with a new GFCI

Repair any appliance that trips a GFCI at an authorized repair service or replace the appliance

**Light Bulbs**

Check bulbs in light fixtures to make sure they are the correct wattage for the size of the fixture. Replace bulbs that have a higher wattage than recommended

Check that all bulbs are screwed in securely

**Circuit Breakers/Fuses**

Check that circuit breakers and fuses are the correct size current rating for their circuit. Have a licensed electrician identify and label the correct size.

**Appliances**

Repair or replace any appliance that repeatedly blows a fuse or trips a circuit breaker or has given anyone a shock.

Check for appliances being used where they may fall into water. Figure out a better place to use the appliance and move it.

Check to see that all appliances are in good condition and working properly

Use surge protectors for all computer and home entertainment equipment and other appliances susceptible to burn-out from power spikes

**Outdoor Safety**

Check power tools and electric lawn mowers for frayed power cords, broken plugs, and cracked or broken housings

Check that all extension cords being used outside are specifically designed for outdoor use and are rated for the power needs of the tools being used

Check that no portable power tools are left plugged in when not in use

**Lightning**

During an electrical storm, do not use appliances, computers, or telephones

During an electrical storm, do not take a shower or bath

Check that flashlights with fresh batteries are available for power outages

**Space Heaters**

Check that all space heaters are a minimum of 3 feet from any combustibles

Check that space heaters are not used where children may be left unsupervised

Check that all unused space heaters are turned off and unplugged

Check that space heaters are connected directly to an outlet and not an extension cord

**Halogen Floor Lamps**

Check that all halogen lamps are away from combustibles

Do not use halogen lamps where children may be left unsupervised



| **REQUIREMENT 3:** | Make a simple electromagnet and use it to show magnetic attraction and repulsion. |
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| **REQUIREMENT 4a:** | Explain the difference between direct current and alternating current, the advantages and disadvantages of each, and give a practical example of the use of each type. |
|---|---|

DIRECT CURRENT:

Notes:

ALTERNATING CURRENT:

Notes:



| **REQUIREMENT 4b:** Explain three ways that electricity is produced. |
| --- |
| Way #1: |
| Way #2: |
| Way #3: |



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| **REQUIREMENT 5:** | Make a simple drawing to show how a battery and an electric bell work. Describe the purpose of each of the components. |

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| **REQUIREMENT 6a:** | Define what overloading an electric circuit means. Tell what you have done to make sure your home circuits are not overloaded. |

Notes:

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| **REQUIREMENT 6b:** | Determine if there is an overload on a branch circuit by either getting the current draw from all the equipment plugged into the circuit or use the power equation to calculate the current draws. |

Notes:



| **REQUIREMENT 6c:** | Explain why a fuse blows and a circuit breaker trips. |
|---|---|
| Notes: | |

| **REQUIREMENT 6d:** | Tell how to find a blown fuse and a tripped circuit breaker in your home. |
|---|---|
| Notes: | |

| **REQUIREMENT 6d:** | Show how to safely reset the circuit breaker. |
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| REQUIREMENT 7: | Make a floor plan wiring diagram of the lights, switches, and outlets for a room in your home. Show which fuse or circuit breaker protects each one. |
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| **REQUIREMENT 8a:** | Read a meter associated with an electric bill. Determine the total power used since the bill, and the cost of that power. |
|---|---|

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Electrical meters are usually located on the outside of your home, between the power line coming from the pole and your electrical panel inside. They record how much electricity you and your family are using.

Your electric meter usually has between four and six dials that advance as a central disk turns. The disk is turned by the electricity passing through the meter, giving a readout of how much electricity is being used.

This readout is given in kilowatt hours. One kilowatt hour is equal to the amount of energy it would take to power a 100 watt lightbulb for 10 hours.

Read the numbers from left to right. Do not let the direction of the numbers on each dial confuse you. Some of the dials will be numbered clockwise and other dials may be numbered counterclockwise.
Look exactly where the arrow is pointing. If the arrow is pointing between 2 numbers, the reading is the smaller number. If the arrow is pointing directly on a number, verify what the number should be by referencing the dial to the right of it. If the arrow on that dial is past zero, the reading on the dial to the left is the number the arrow is pointing to. If the arrow on the right hand dial is not to or past the zero yet, the reading on the dial to the left is the previous number.

Digital Meters are much more straightforward, just copy the numbers on the meter display.

Using you last energy bill, you can see the last reading and subtract your current reading from that to get your current electricity usage.

You will still need to figure out what your cost is. Use your math skills to figure it out

| **REQUIREMENT 8b:** | Explain other charges on the bill that were taxes or fees. |
|---|---|
| Notes: | |

| **REQUIREMENT 8c:** | Discuss with your counselor five ways in which your family can conserve energy. |
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| Family Energy Conservation Method #1: | |
| Family Energy Conservation Method #2: | |
| Family Energy Conservation Method #3: | |
| Family Energy Conservation Method #4: | |
| Family Energy Conservation Method #5: | |

| **REQUIREMENT 9:** | Explain the following: |
|---|---|
| **REQUIREMENT 9a:** | *Electrical terms* - current, energy, power, resistance, voltage |
| current: | |
| energy: | |
| power: | |
| resistance: | |
| voltage: | |

| **REQUIREMENT 9b:** | *Units of measure* - ampere (amps), ohms, volts, watts, watt-hours |
|---|---|
| ampere (amps): | |
| ohms: | |
| volts: | |
| watts: | |
| watt-hours: | |

| **REQUIREMENT 9c:** | *Electrical conditions* - generating source with example, ground, open circuit, overvoltage, potential difference, short circuit |
|---|---|
| generating source: | |
| ground: | |
| open circuit: | |
| overvoltage: | |
| potential difference: | |

| | |
|---|---|
| short circuit: | |
| **REQUIREMENT 9d:** | *Equipment and their use* - circuit, conductor, Ground Fault Circuit Interrupter (GFCI), insulator, inverter, rectifier, rheostat, substation, surge protection, solar panel, transformer, transmission and distribution systems, wind turbine. |
| circuit: | |
| conductor: | |
| ground fault circuit interrupter (GFCI): | |
| insulator: | |

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| inverter: |
| rectifier: |
| rheostat: |
| substation: |
| surge protection: |

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| solar panel: |
| transformer: |
| transmission and distribution systems: |
| wind turbine: |

**DO TWO OF THE FOLLOWING (10A, 10B, 10C, 10D, 10E, or 10F) FOR REQUIREMENT 10**

**REQUIREMENT 10a:** Connect a buzzer, bell, or light with a battery. Have a key or switch in the line.

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| **REQUIREMENT 10b:** | Make and run a simple electric motor (from a kit is acceptable, if approved by your counselor ahead of time). |
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**COUNSELOR APPROVAL:** IS REQUIRED.

Counselor's Name _____ Phone or Email _____

Counselor's Signature _____ Date _____ ☐ *approved*

| **REQUIREMENT 10c:** | Build a simple rheostat. Show that it works. |
|---|---|

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| **REQUIREMENT 10d:** | Build a single-pole, double-throw switch. Show that it works. |
|---|---|

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| **REQUIREMENT 10e:** | Explain how 3-way switch wiring works in a lighting circuit. |
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Notes:

| **REQUIREMENT 10f:** | Connect two lights together in a series circuit along with a battery and a switch. Then connect the same circuit in parallel. Discuss the differences in the two circuits. |
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| **REQUIREMENT 11:** | Identify three career opportunities that would use skills and knowledge in electricity. |
|---|---|
| Career Opportunity #1: | |
| Career Opportunity #2: | |
| Career Opportunity #3: | |
| **REQUIREMENT 11:** | Pick one and research the training, education, certification requirements, experience, and expenses associated with entering the field. |
| Selected Career Opportunity: | |
| Training Requirements: | |
| Education Requirements: | |
| Certification Requirements: | |
| Experience Requirements: | |

| | |
|---|---|
| Expenses Associated with: | |
| **REQUIREMENT 11:** | Research the prospects for employment, starting salary, advancement opportunities and career goals associated with this career. |
| Prospects for Employment: | |
| Starting Salary: | |
| Advancement Opportunities: | |
| Career Goals: | |
| **REQUIREMENT 11:** | Discuss what you learned with your counselor and whether you might be interested in this career. |
| Notes: | |