



Electricity Merit Badge

Class 4 – Safety at Home



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Classes

- Class 1 – Basics Electricity (shared with the Electronics Merit Badge)
- Class 2 – Magnetism
- Class 3 – Electric Power, Alternating Current
- **Class 4 – Safety at Home**
 - **Safety Devices; fuses, circuit breakers, GFCIs**
 - **Safe Loads**



Lightning – Crouch!

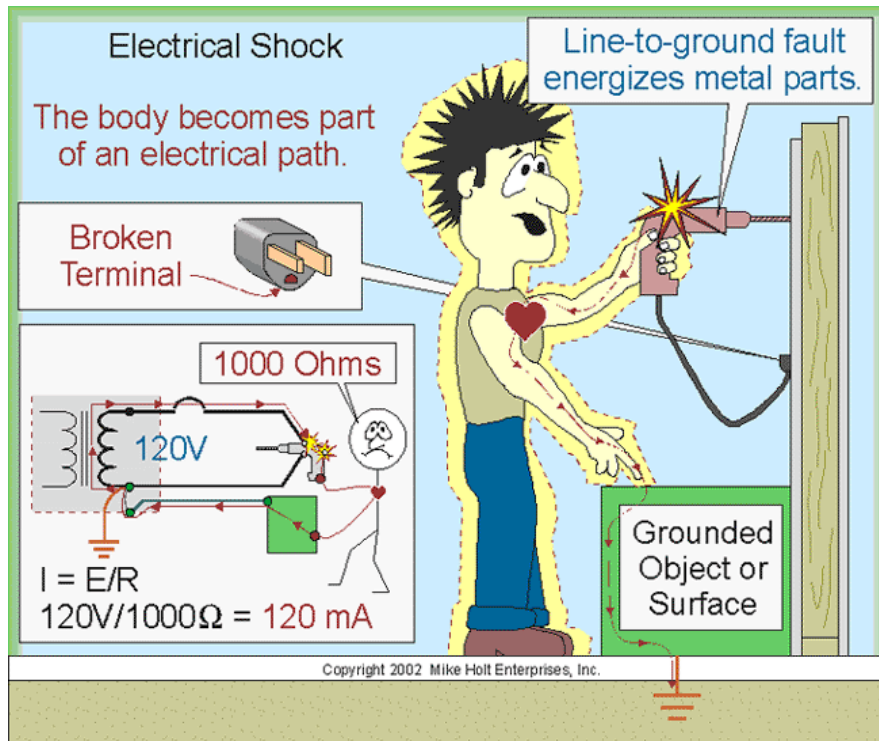
- Leave high area, go to low-lying areas
- Stay away from lakes, streams, and metal fences
- Find dense forest in a depression
- Get under cover
- In the open, crouch



- Spread out, keep 100 feet between you
- Balance on your soles



Tickle, Shock, Kill



- Finger touching wire or wire in outlet
- When will it tickle?
- When will it shock?
- When will it kill you?

Used with permission from Mike Holt Enterprises



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Electrical Emergency



- Don't touch the person if still connected to wire
- You can get stuck and shocked too!
- Turn off circuit breaker
- Use a wood pole, rug, rubber doormat to move person away from danger



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Electrical Emergency



- Don't use anything wet
- Water & metal conducts electricity
- Call 911
- Yell for help
- If not breathing, start CPR



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CPR: cardiopulmonary resuscitation

CALL



CALL 911

BLOW



**TILT HEAD,
LIFT CHIN,
CHECK
BREATHING**



**GIVE TWO
BREATHS**

PUMP



**POSITION HANDS
IN THE CENTER OF
THE CHEST**



**FIRMLY
PUSH DOWN
TWO INCHES
ON THE CHEST
30 TIMES**

- Take a CPR course to get really good at this.
- Don't forget, call for help first then give CPR

**CONTINUE WITH TWO BREATHS
AND 30 PUMPS UNTIL HELP ARRIVES**

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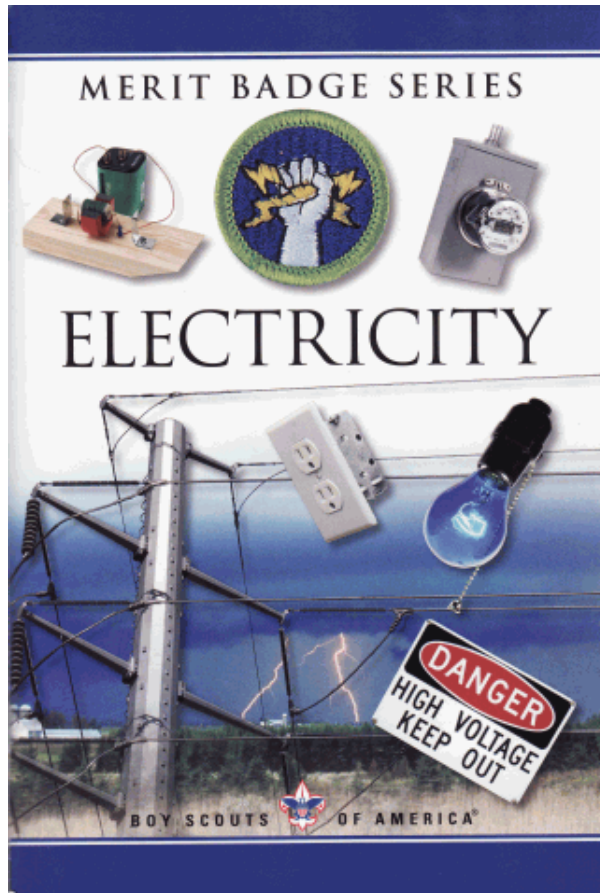
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A-B-C-D



- A is for airway
- B is for breathing
- C is for circulation
- D is for defibrillation
- Read about it in the merit badge book
- Take a CPR course



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Treating Burns... Don't

- Don't touch the burn; you may cause infection
- Don't put anything on a burn; you can make it worse
- Don't move the person unless he or she is in danger of further injury
- Let the medical professionals handle the movement and treatment



How Not to Get Shocked

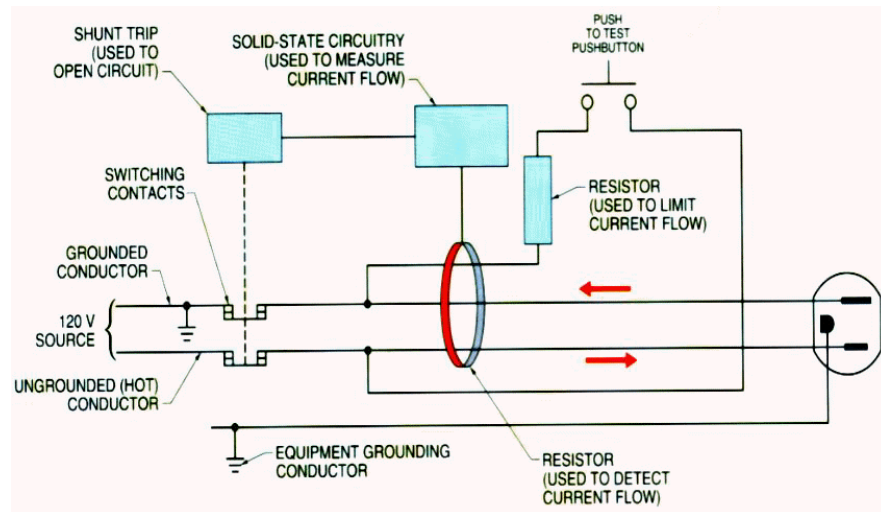


- Make sure there is a GFCI near any place that gets wet
- Make sure there is a GFCI near water
 - Outside
 - Sinks
 - Showers
 - Bathtubs



GFCI means Ground Fault Circuit Interrupter

- If you touch just one side of the outlet, it detects an “imbalance” and immediately turns off power
- They are required near water such as sinks, showers and outdoors



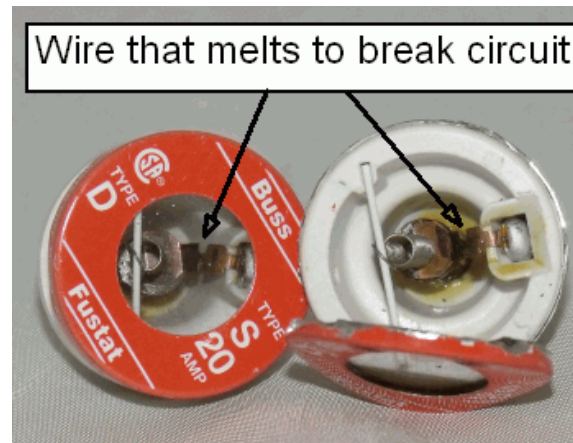
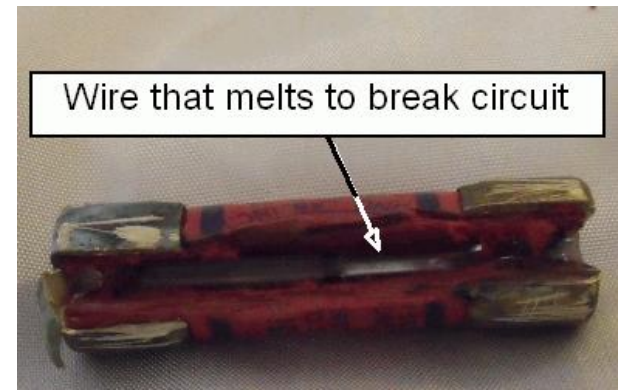
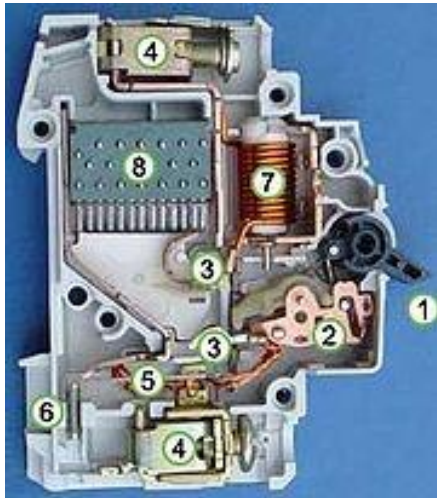
GFCI Circuit Breaker



- Some homes have circuit breakers that are also GFCIs
- There should be one for:
 - the kitchen
 - all bathrooms
 - outside outlets



Inside Circuit Breakers & Fuses



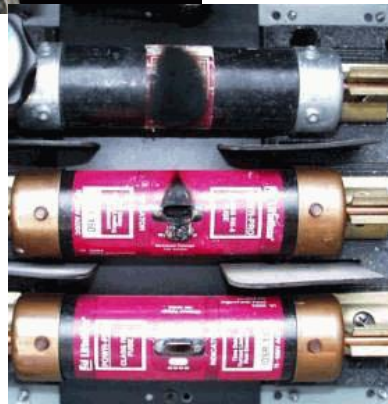
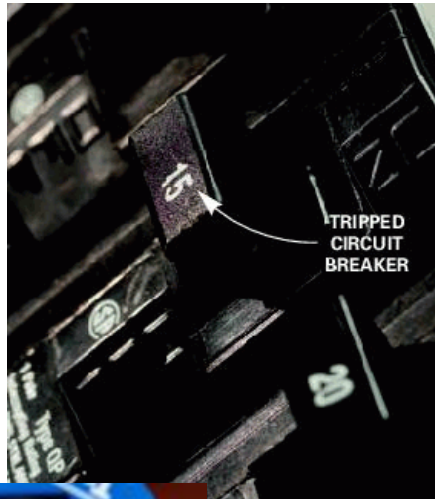
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Tripped Breaker or Fuse



- Breaker will be between OFF and ON
- Fuse will be burned or blackened
- Fuse window will show burned wire



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Know What Circuit Breaker or Fuse to Use



- Are your circuit breakers or fuses marked?
- Do you know which breaker or fuse will turn off which rooms?
- Have you checked?



Electrical Fire

- Use an extinguisher that's safe for electrical fires
- Never use water; you might get shocked; water can conduct electricity
- Turn off house power
- If it doesn't look safe to put out the fire, leave the house
- Once safely outside, call 911



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Safe or Not Safe?



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Safe or Not Safe?

Not safe

- Not in the wall
- No cover
- Could hurt anyone who touches sides



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Safe or Not Safe?



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Safe or Not Safe?

Safe

- Near the sink
- GFCI outlet is safe near a sink



Safe or Not Safe?



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Safe or Not Safe?

Not safe

- Plug not firmly inserted

Suspicious

- Is outlet loose inside?
- Are those scorch marks on the outlet?



Safe or Not Safe?



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Safe or Not Safe?

Not Safe

- Too many wires
- Might be overloaded
- Wires on floor where people step on them



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Safe or Not Safe?



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Safe or Not Safe?

Safe

- GFCI outlet on left
- Right outlet is connected to GFCI outlet
- Right outlet is marked “GFCI”
- Both outlets are safe near water and outside



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What's the Load?

Microwave: 1,100 watts



Toaster Oven: 1,500 watts



Toaster: 900 watts



Coffee Maker: 1,200 watts



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What's the Load?

	<i>Add it up</i>
Microwave: 1,100 watts	1100
Toaster Oven: 1,500 watts	1500
Toaster: 900 watts	900
Coffee Maker: 1,200 watts	<u>1200</u>
	4700

How do you know the watts?
It's on the label usually on the back.



What Size Circuit Breaker?

Add it up

1100

1500

900

1200

4700

$$P \text{ (watts)} = I \text{ (amps)} \times E \text{ (volts)}$$

transpose to:

$$I \text{ (amps)} = P \text{ (watts)} / E \text{ (volts)}$$

$$I = 4700 \text{ watts} / 120 \text{ volts}$$

$$I = \mathbf{39 \text{ amps}}$$

Too much! Kitchen circuit breakers are
15 amps or 20 amps.



I = 39 amps: What to do?

Microwave: 1,100 watts



Toaster Oven: 1,500 watts



Toaster: 900 watts



Coffee Maker: 1,200 watts



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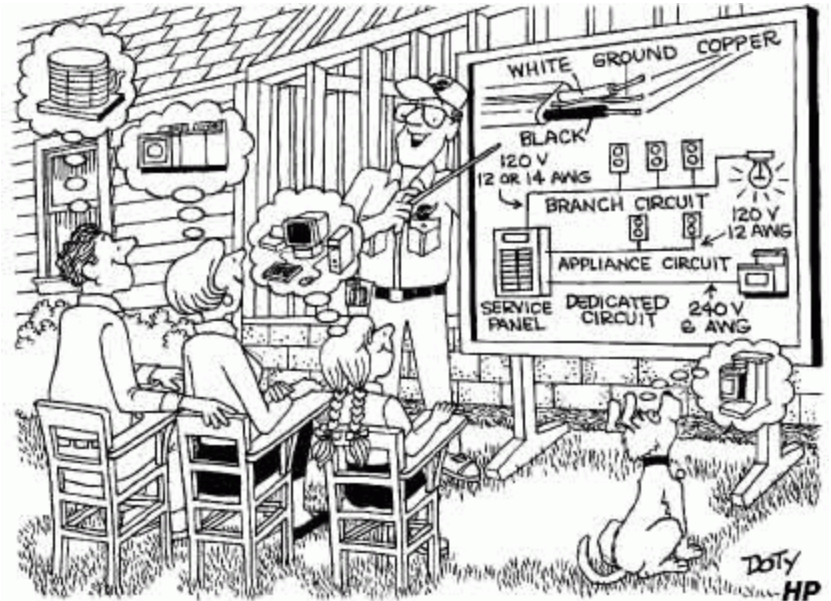
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Circuits

- Each part of a house has a different circuit
- Each circuit has its own circuit breaker or fuse
- A kitchen often has 2 or more circuits to handle the load of appliances



Used with permission: the Copper Development Association Inc



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Wiring Circuits



- Boxes contain wires
- Boxes support a switch or an outlet
- Boxes support ceiling lights and fans
- Wires run from boxes through walls and ceilings to the breaker panel



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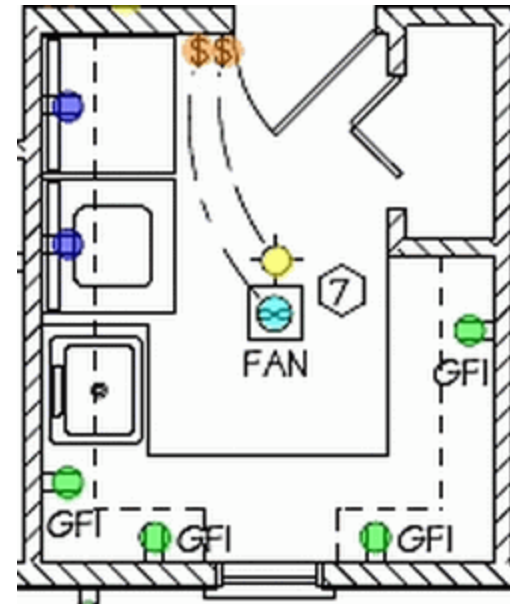
When You Get Home...

- Check your circuit breaker or fuse panel
 - Are they all labeled?
- Pick a room draw, a room outline
- Mark the location of outlets and switches
 - Plug in lamps
 - Turn on switches
 - Turn off the circuit breaker and make sure it is labeled correctly



This is a Fancy Version

- Hand-drawn is OK
- Notice the electrical symbols
- The symbols are in the Electricity merit badge book



When You Get Home...

- Check for high wattage appliances
 - Toasters
 - Microwaves
 - Coffee Makers
 - Large TV sets
 - Electric heaters
- Make sure there aren't too many appliances on a single circuit



If a Breaker Trips or a Fuse Blows A Multiple Choice Quiz

What are the correct answers?

- You should
 - Turn on the breaker
 - Find out what caused it and disconnect it
 - Replace the fuse
- You should not
 - Turn on the breaker
 - Find out what caused it and disconnect it
 - Replace the fuse



Be Safe With Batteries



- Most any battery under 36 volts will not shock you
- But, is the battery connected to anything with a higher voltage like a charger?



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Batteries Are Not Completely Safe



Auto battery = acid that burns



Most batteries have caustic chemicals inside = hurts pet if they eat any

Rechargeable batteries save energy but have harmful chemicals inside = send to disposal site



NiCAD Batteries & Fluorescent Bulbs – Recycle!

- NiCAD rechargeable batteries contain cadmium – dangerous in the trash
- Fluorescent bulbs (CFCs) and tubes contain mercury – dangerous in the trash
- Take to a local safe disposal site
- If they break or leak, wash your hands and then get adult help cleaning them up



Summary of Electrical Terms 1

- **alternating current.** Current that regularly reverses direction, traveling first in one direction and then in the opposite direction. Power companies generate alternating current to make it easier to transmit electricity over long distances. Abbreviated *AC*.
- **ammeter.** An instrument for measuring current in amperes.
- **ampere.** A unit measuring the strength of an electrical current, based on the number of electrons transferring past a given point per second. Many elements of a wiring system are rated in amperes for the greatest amount of current they can safely carry. The ampere, abbreviated *amp*, is named for French physicist Andre-Marte Ampere.
- **circuit.** A loop-shaped path through which electric current travels from the source through some device using electricity, such as a light- bulb, and back to the source.



Summary of Electrical Terms 2

- **circuit breaker.** A safety switch installed in a circuit to break the transfer of electricity when the current exceeds a set amount. Circuit breakers can be reset once "tripped." See *also* fuse.
- **conductor.** A substance or device through which electricity passes. Most metals are good conductors of electricity-that is, they allow electricity to travel through them with little resistance. Gold and silver are the best conductors of electricity but are too expensive for general use. Copper, which is relatively cheap and plentiful, is used most often, especially in transmission lines that carry electricity from power plants to homes, schools, and businesses. Devices that run on electricity have copper wiring. Aluminum is not as good a conductor as copper, but because it is cheaper and lighter, it is also frequently used.
- **current.** The transfer of electricity in one direction.
- **cycle.** One complete reversal of alternating current; a forward current and backward current. Ordinary household current experiences 60 cycles per second (60 hertz).



Summary of Electrical Terms 3

- **direct current.** An electric current of constant direction- that is, the transfer of electrons goes only in one direction. Abbreviated DC.
- **fuse.** A safety device installed in a circuit to prevent an over- load. Designed to melt or "blow" when current exceeds a set amount, it opens the circuit and stops the transfer of electricity. Fuses cannot be reused once blown. See *also* circuit breaker.
- **galvanometer.** A device that detects and determines the strength of electrical currents.
- **ground.** To connect any part of an electrical wiring system to the ground or to another conducting body, such as a metal water pipe or a metal rod driven into the earth.
- **grounding wire.** Conductor that grounds a metal component but does not carry current during normal operation.
- **hertz.** A unit of frequency equal to one cycle per second. Abbreviated *Hz*.



Summary of Electrical Terms 4

- **hot wire.** Ungrounded conductor carrying electrical current. Usually identified by black or red insulation.
- **insulation.** Covering of nonconducting material used on wires.
- **insulator.** A material that does not conduct electricity, such as rubber or plastic.
- **kilowatt.** Unit of electrical power equal to 1,000 watts. Abbreviated kw.
- **kilowatt-hour.** Unit of energy used for metering and selling electricity. One kilowatt-hour equals 1,000 watts used for one hour (or any equivalent, such as 500 watts used for two hours). Abbreviated kwh.
- **load.** The part of an electrical circuit that uses the electric power. In a lighting circuit, the load is the lightbulb.



Summary of Electrical Terms 5

- **neutral wire.** Grounded conductor that completes a circuit by providing a return path to the source. Always identified by white or gray insulation.
- **ohm.** A unit of measurement for electrical resistance to a current. It is named for German physicist Georg Simon Ohm (1787-1854), whose Ohm's law states that the pressure of one volt will cause a current of one ampere to flow through a resistance of one ohm (Voltage = Current x Resistance). This simple formula shows the relationship between volts, amperes, and resistance in any electric circuit.
- **outlet.** An electrical device where the switch can easily be connected to a fixture or equipment that uses electricity.
- **overload.** Condition in which an electrical circuit carries more current than it can safely handle.
- **receptacle.** The device that you plug electric cords into, sometimes called an outlet.



Summary of Electrical Terms 6

- **resistance.** The opposition against the free transfer of electrons in a conductor. Measured in ohms.
- **resistor.** A device designed to restrict the transfer of current in (or introduce resistance into) an electric circuit.
- **rheostat.** A resistor built so that the current traveling through the circuit can be adjusted at will. Volume controls and dimmer switches are examples
- **short circuit.** A completed, low-resistance circuit that allows electrons to follow a shorter, unintended path back to the power source rather than follow the longer path that goes through the load. Occurs when bare wires touch each other; often results from worn insulation.
- **source.** Point of supply, such as a generator or battery.



Summary of Electrical Terms 7

- **switch.** Device to break the transfer of electricity. When the switch is on, the circuit is closed and current may travel through it. When the switch is off, the circuit is open and electricity cannot transfer.
- **volt.** A unit of potential difference, or a unit of measurement of electrical pressure or force. Abbreviated *V*
- **voltage.** Pressure at which a circuit operates, expressed in volts. Voltage is like the pressure in a water pipe. For example, 120 volts have twice the pushing force of 60 volts.
- **voltmeter.** An instrument for measuring the difference in electric potential (electrical pressure) between two points.
- **watt.** Unit that measures electrical power at the point where it is used in a circuit. One watt of power equals one volt of pressure times one ampere of current. Many electrical devices are rated in watts according to the power they consume. Abbreviated *W*



What We Learned

- ✓ With lightning around get under cover or crouch
- ✓ Don't grab someone who is touching wires
 - Turn off the power
 - Use a dry, non-conductive item to move the person away from danger
- ✓ Learn CPR



What We Learned

- ✓ Study “Responding to Electrical Emergencies” in Merit Badge booklet
- ✓ Don’t touch or treat an electrical burn
- ✓ Don’t move the person unless he or she is in further danger



What We Learned

- ✓ GFCIs
 - ✓ Means Ground Fault Circuit Interrupter
 - ✓ Protects from shock and electrocution
- ✓ Circuit Breakers and Fuses protect the house from electrical fires
- ✓ Some Circuit Breakers also contain a GFCI



What We Learned

- ✓ Find the short before turning the circuit breaker on or replacing the fuse
- ✓ Batteries have chemicals inside that can be dangerous
- ✓ Rechargeable batteries don't go in the trash; they need to be recycled or sent to a disposal site

