



Date: Second Saturday in December

Check-in: 7:30 a.m.

Clinic Time: 8 a.m. - noon

Place: We Energies
Public Service Building Auditorium
231 W. Michigan St.
Milwaukee, WI 53203

Questions?

Contact the Three Harbors Council
at 414-774-1776
or visit
www.threeharborsscouting.org/meritbadges

Helpful Reminders

- ✔ Bring all your project work to the Clinic.
- ✔ Watch the Electricity Merit Badge video.
- ✔ Read the Electricity Merit Badge book.



GOOD LUCK, BOY SCOUTS!

Boy Scouts Electricity Merit Badge



Clinic requirements and information

The Electricity Merit Badge requirements listed below are the ones that will be tested at the Clinic either as a paper test or project demonstration form. Some of the options offered in the Boy Scout Merit Badge Requirements are not offered at the Clinic. Before attending the Electricity Merit Badge Clinic, you must view the Electricity Merit Badge video on www.threeharborsscouting.org/meritbadges, and read the Electricity Merit Badge Book and the instructions enclosed in this booklet. **To be eligible for an electricity merit badge, you must pass the following requirements at the Clinic:**

Project Demonstrations

1. Demonstrate how to respond to an electrical emergency:
 - 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.
3. Make a simple electromagnet. Operate electromagnet to show magnetic attraction and repulsion.
5. Show how a battery and an electric bell work.
8. On a floor plan of a room in your home, make a wiring diagram of the lights, switches, and outlets. Show which fuse or circuit breaker protects each one.
11. Do the following two items:
 - a. Connect a buzzer, bell or light with a battery. Have a key or switch in the line.
 - d. Build a single-pole, double-throw switch. Show that it works.



Paper Test

1. Know how to rescue a person touching a live wire in the home. Describe first aid procedures for a person who is unconscious from electrical shock.
4. Explain the difference between direct current and alternating current. Be familiar with common uses of each and how to identify different currents.
6. Tell why a fuse blows or a circuit breaker trips. Identify how to detect a blown fuse or tripped circuit breaker in your home. Understand how to safely replace a fuse or reset the circuit breaker.
7. Describe what overloading an electric circuit means.
9. Read an electric meter, and calculate electric usage and energy cost from the meter readings. (Use your family's bill for practice.)
10. Define electrical terms found in the glossary of the Electricity Merit Badge Book, such as volt, ampere, watt, ohm, resistance, potential difference, rectifier, rheostat, conductor, ground, circuit and short circuit.



Requirement 2 Complete an electrical home safety inspection



At your home, do an electrical safety check. Bring your completed home safety inspection to the Clinic.

Electrical Cords & Outlets

Are all wires and cords in good condition?
 Yes No

Are wires and cords kept out from beneath furniture and carpets?
 Yes No

Are outlets properly used and not overloaded? Be sure that you do not have more than one item plugged into each individual outlet.
 Yes No

Are indoor extension cords only used inside?
 Yes No

Do your outlets all have ground fault circuit interrupters?
 Yes No

Circuit breakers/fuses

Do you have the correct size and rating for your circuit breaker/fuse box?
 Yes No

If you have fuses, do any fuses need to be replaced?
 Yes No

Appliances

Are electrical appliances, such as computers and video game equipment properly plugged in and well ventilated to avoid overheating?
 Yes No

Are electrical items, such as the television, stereo, curling iron and hair dryer kept away from water to avoid accidental electrocution?
 Yes No

Are hot items like toasters and coffee makers clear of flammable items?
 Yes No

Are you using any electrical appliances that have been recalled for consumer product safety?
 Yes No

Outdoor safety

Are extension cords used safely, or are they in the way of lawn mowers and other equipment like power tools?
 Yes No

Lightning

Do you use electrical equipment during lightning storms?
 Yes No

Do you have surge protectors on electrical equipment to protect it during electrical storms?
 Yes No

Space heaters

Are space heaters and other heating devices UL listed and always kept at least 3 feet away from other objects?
 Yes No

Are space heaters turned off before going to bed?
 Yes No

Halogen floor lamps

Do you have any halogen floor lamps in your house?
 Yes No



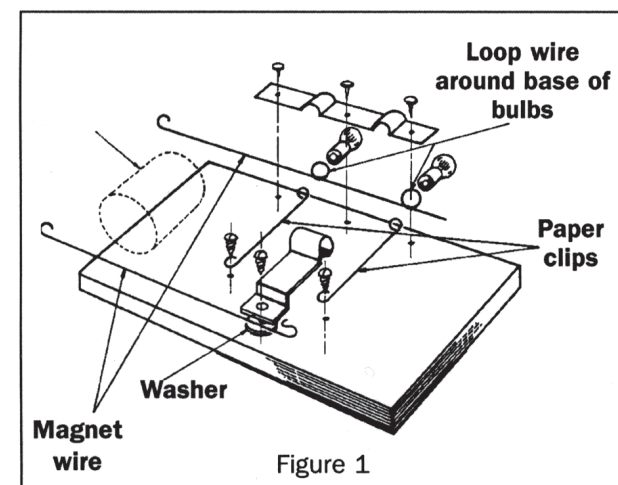
Requirement 11 Single-pole Double-throw switch



Materials and Tools

Three round-head, 1/2" screws	One metal strip 3" long, 1/2" wide
Two 1-1/2 volt flashlight bulbs	Two paper clips
One piece friction tape 3" long	One small washer
One piece magnet wire 8" long	Three upholstery tacks (or similar type tacks)
One piece magnet wire 10" long	One piece of soft wood (5"x3"x1/2")

Mount and connect a light with battery; have a key or switch in the line. Construct a single-pole double-throw switch; show that it works. In completing Requirement 11, also refer to Switches in your Electricity Merit Badge Book.



you may have at home, and can be replaced after the Clinic, or new ones can be purchased. Take these materials and assemble them as shown in Figure 1. Remember that the wire must be scraped bare of insulation (or coating) where the turns are made around the side of the base of the bulbs, and that the contact here must be tight. These two pieces may be cut from the electric magnet wire.

The paper clips will need to be bent and adjusted, and you can use screws to make the contact tight at the base of the bulbs.

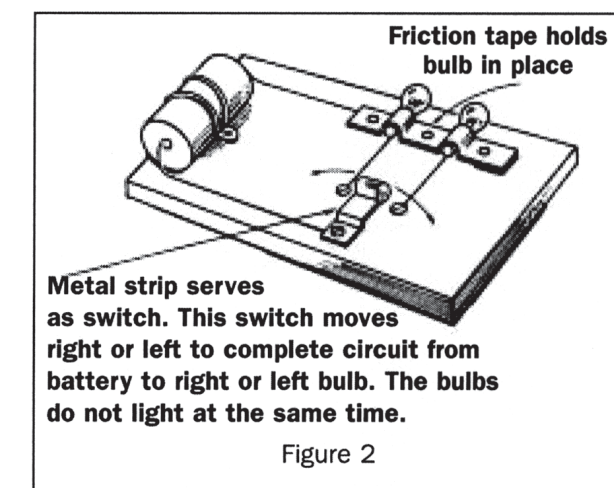


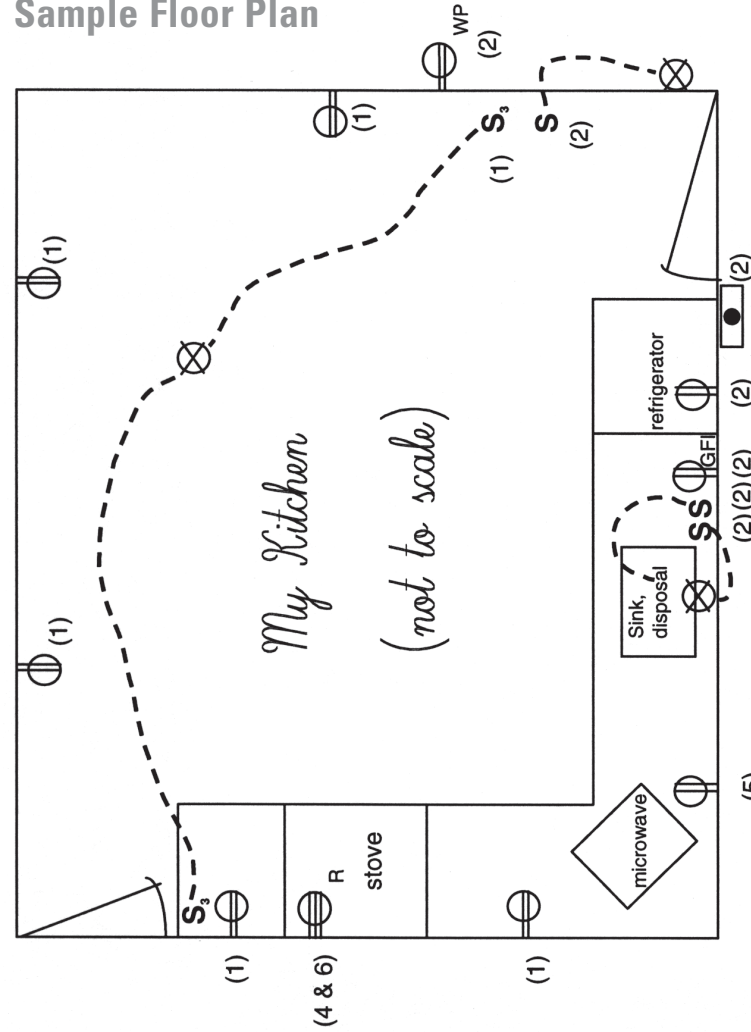
Figure 2 shows a size D flashlight battery providing power for the circuit. It is necessary to hold the bare end of the wire to the battery tightly to provide contact. You can test your experiment with a battery of this type if you care to, but do not bring a battery to the Clinic.

Note: Before arriving to the Clinic, write your name and Troop number on the back of the board in permanent marker.

In order to complete the requirements for the badge, it **will be necessary** to construct a simple electrical device at home, before you come to the Clinic. This combines the two requirements 11A and 11B. It will involve some simple materials that you should be able to find around the house. The lamp bulbs could come from flashlights



Sample Floor Plan



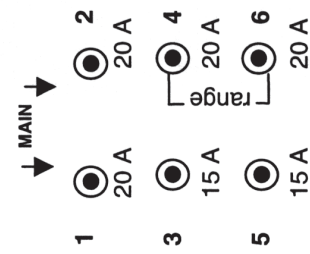
Use these symbols commonly used in household wiring diagrams to sketch the kitchen in your home.

- Light Fixture
- Duplex Receptacle
- Duplex Receptacle, half controlled by switch
- Single-pole Switch
- Three-way Switch
- Range Outlet
- Dryer Outlet
- Ground Fault Interrupter Circuit (next to sinks in newer homes)
- Weatherproof Receptacle
- Doorbell

----- Switch Wiring

Then, using the instructions of Requirements 6 and 8, determine which circuits control the electrical outlets and switches in the room. Sketch either the fuse box or the circuit breaker box in your home and show the circuits that provide electricity to the kitchen.

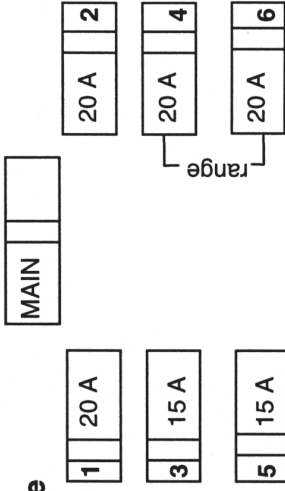
Fuse Box Example



Note: Plug-based round fuses are shown to left; cartridge fuses (see below) also are available. Show what is in your fuse box.



Circuit Box Example



Materials and Tools

- 1-1/2" long and 1/2" thick steel machine bolt
- Bell battery
- Heavy cardboard – small piece
- Horseshoe or bar magnet
- Iron or steel fragments
- Knife
- Pliers
- Scissors
- Sewing needle
- Spool of no.24 insulated copper wire, or bell/magnet wire
- Thread
- Writing paper

In completing Requirement 3, also refer to Forms of Electricity in your Electricity Merit Badge Book.

Basic Experiments

For the first few experiments, let's discover some new things about magnets.

Lay your magnet flat on a table and put a piece of writing paper over it. Sprinkle some small bits of iron or steel on the paper. Now tap the paper several times. What did the filings do? Refer to Figure 1 and Figure 2 for results.

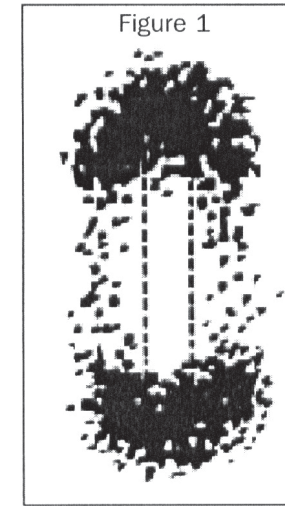


Figure 1

The patterns show you there are two points where the magnets are strongest. These are called the "poles." To identify them, they are called the "North Pole" or "N" and the "South Pole" or "S."

Between the poles, the patterns show there are "lines of force" along which your particles aligned themselves.

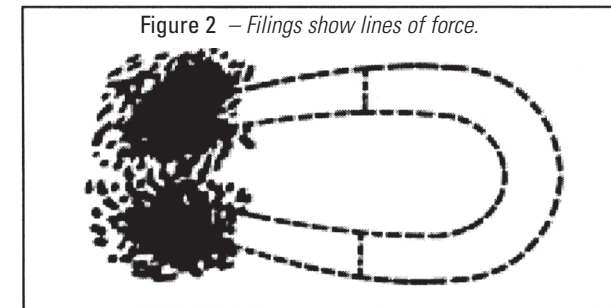


Figure 2 – Filings show lines of force.

Two magnets, when brought together, will attract each other if UNLIKE poles (north pole of one, south pole of the other) are brought close together. But the two magnets will repel each other if LIKE poles (north pole of one, north pole of the other) are placed close together. See Figure 3 for illustration of like and unlike poles.

Three important characteristics of a magnet:

1. It has two poles.
2. It has lines of force.
3. Like poles repel; unlike poles attract.

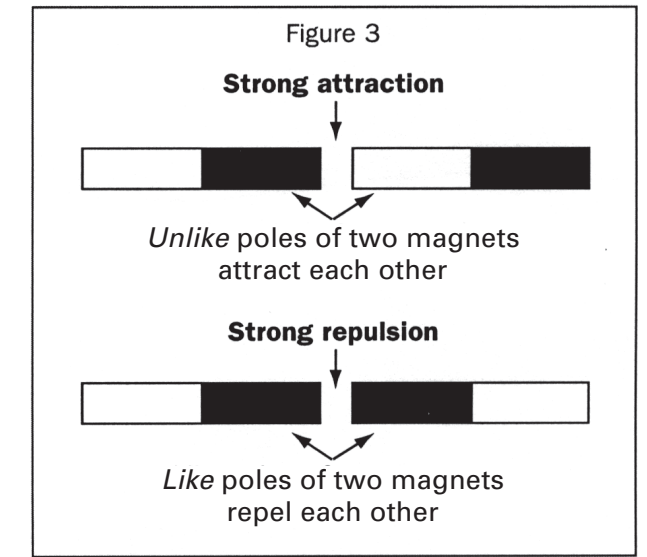


Figure 3

To Make A Simple Magnet

Use your magnet and sewing needle. Stroke the needle against one end of the magnet in the same direction – not back and forth.

Now test the needle for magnetism against an iron or steel object. If it clings, you have made a small magnet out of your needle.

Tie a piece of fine thread around the midpoint of the needle as in Figure 4. Hold the thread about a foot above the needle and watch what happens. Because the needle always swings to a north-south position, you can see that you have made a simple compass.

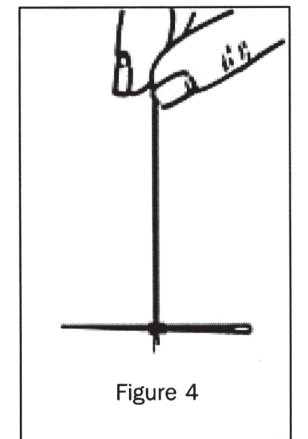


Figure 4



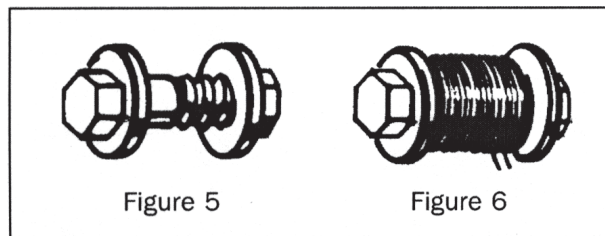
Your bar or horseshoe magnet and the magnetized needle you have made are called permanent magnets because they hold their magnetism for a long time, if they are not jarred or hammered.

There is another kind of magnet called an electromagnet. This kind of magnet is usually made with a soft iron core wound with a copper wire coil. It exerts strong magnetic force only as long as electricity is flowing through the coil.

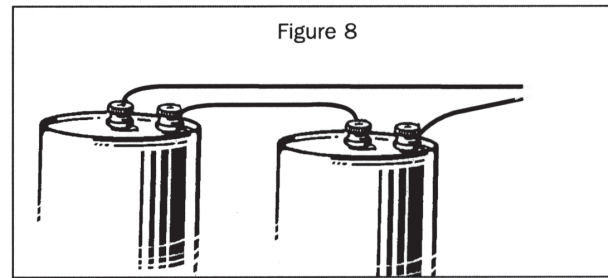
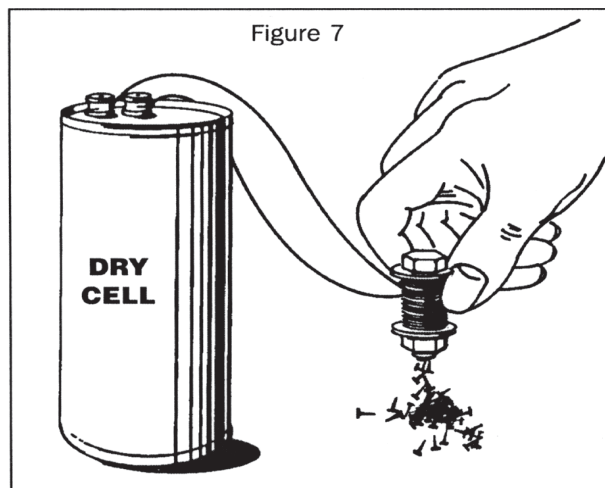
How to Make a Simple Electromagnet

Cut two washers from heavy cardboard to fit snugly on your steel machine bolts as shown in Figure 5. Screw one washer up against the head of the bolt and screw the other one on about 1/4" from the end of the bolt.

Now take your insulated copper magnet or bell wire and wind it onto the bolt between the two washers. Keep winding, always in the same direction, until the wire is nearly up to the edges of the washers as in Figure 6.



Leave about a foot of wire extending from both ends of the coil winding from leads. Scrape the insulation off the ends of the wire leads so they will make good electrical contact.



Now attach the leads to the binding post of a bell battery as in Figure 7. Test your electromagnet on iron or steel objects, such as tacks, paper clips or nails.

You can make a more powerful electromagnet by using two batteries. Connect the two batteries as shown in Figure 8.

Note: Do not leave your magnet connected to the battery for more than a minute or so at a time. If it is connected too long and too often, the battery will weaken very rapidly.

Note: Before arriving at the Clinic, label your electromagnet with your name and Troop number.



Make and submit a diagram of the kitchen of your house or another house and show the lights, switches and convenience outlets which are located in it. Determine which fuse or circuit breaker controls each light, switch or outlet in the kitchen. **Use the symbols located on the reverse side of this sheet.**

- Using the symbols shown, on a sheet of paper, show the location of all lights, convenience outlets, switches, etc. located in the kitchen of your home. The goal of this requirement is to write the number of the fuse or circuit breaker that serves the outlet, light or switch beside the symbol.
- Discuss this requirement with your parent or guardian. Ask your parent or guardian to accompany you to the basement or a place where the electric service enters your home. If you live in a home or apartment house where this requirement cannot be done, arrange to do it with a friend at his home.
- Place a dry board, large enough for your two feet, in front of the fuse or circuit breaker cabinet. Stand on the board.
- Disconnect or open the main fuse or circuit breaker. (This should be done during daylight hours.) **WARNING - Do not touch any wires. To do so might result in fire, serious injury or death.**
- Write the size of the fuse or circuit breaker protecting each circuit on your sheet of paper. Do this for all the circuits in your house. See examples on the reverse side of the sheet. In the case of plug fuses, fuse-trons, and fuse-stats, the size is either stamped or printed on some metal part. Some fuses also can be identified by color. In the case of cartridge fuses, the size is imprinted on a navy blue paper wrapped around the fuse. Circuit breaker size is marked on the face of the breaker.

- Loosen all the fuses, except one, by giving it a complete turn to the left. (There are several kinds of fuses; plug, fuze-tron, fuze-stat and cartridge type, each having its own particular type of terminal to fit easily into the holders made to receive them.) If you have circuit breakers, turn off all but one of them.
- Put the main switch back in the "on" position.
- Now try the lights, switches and outlets in the kitchen of your home. The ones that light or work are on the circuit controlled by the single fuse or circuit breaker you left connected. You may find that none of the lights, switches or outlets are controlled by the fuse or circuit breaker you left on. This is okay.
- Disconnect or open the main fuse or circuit breaker. Then loosen the fuse from step 8 and tighten another, or switch off the circuit breaker and switch on another, and repeat directions in 7 and 8. (Only have one fuse or circuit breaker making contact at a time.)
- Keep on until you have determined which fuse or circuit breaker protects each of the lights, switches, and outlets in the kitchen.
- Now tighten all fuses or switch on all circuit breakers and remember to reset electric clocks to the correct time.

Also consider and be prepared to answer why fuses and circuit breakers are used and why they have a rating. What happens if you were to replace a fuse or circuit breaker with a higher rated part? What should you do if a circuit trips?