

## Instructions for Building a Basic Electric Motor

*Materials: 20-gauge magnet wire, two jumbo paper clips, 1 or 2 ceramic disk magnets (or similar), 1 rubber band, D-cell battery, wire cutters, scissors or pocket knife, and a pencil. Note: You can substitute the thinner, 22-gauge wire from the Radio Shack "315-Ft. Magnet Wire Set."*

1. Construct a coil of wire by wrapping the wire around the battery 12 times, leaving about 6 inches at the starting end. Cut the wire, leaving about 6 inches at the other end, and slide the coil off the battery while keeping it from coming apart. Wrap the protruding ends on either side twice around the coil to hold the coil together (see Figure 1, top). Cut the protruding ends so they are each about 1 inch long, and straighten them so they point in opposite directions from the center of the coil, as shown in Figure 1 (top). Reshape the coil and the protruding ends so that the coil is balanced if supported by the protruding ends.

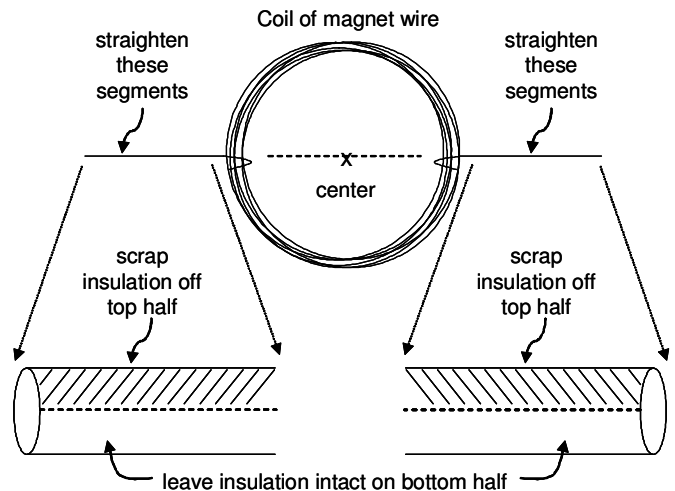


Figure 1

2. The magnet wire is coated with an electrical insulator that can be easily scrapped off with one of the cutting edges of a pair of scissors (or a knife). You will need to scrap off the insulation on the **top side of each** of the two protruding segments of wire for the entire length of each protruding segment as shown in Figure 1 (expanded view of wire at the bottom of the figure).
3. Un-bend and straighten one part of each of the paperclips (Figure 2, top). Then form a loop in the straightened ends of each by wrapping the straightened ends around a pencil (Figure 2, bottom).

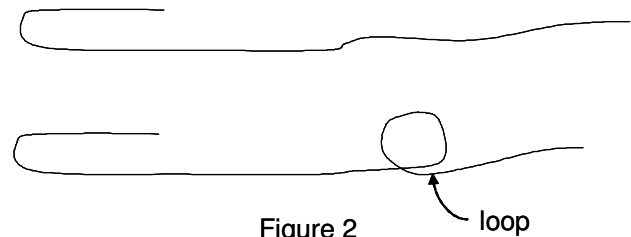


Figure 2

4. Use the rubber band to secure the two paperclips to your battery, as shown in Figure 3. Also as shown in the figure, place one or two magnets on the battery (the magnets will stick to the battery).
5. Now rest the protruding segments of the coil into the two circles formed by the paperclips, and adjust the height by moving the paperclips up or down so that the coil passes just above the magnet as it turns, as shown in Figure 3. You may need to bend the protruding wires so that the coil is balanced (i.e., so that, without the magnet, it doesn't favor one orientation over another).
6. Now give the coil a push and watch it go!

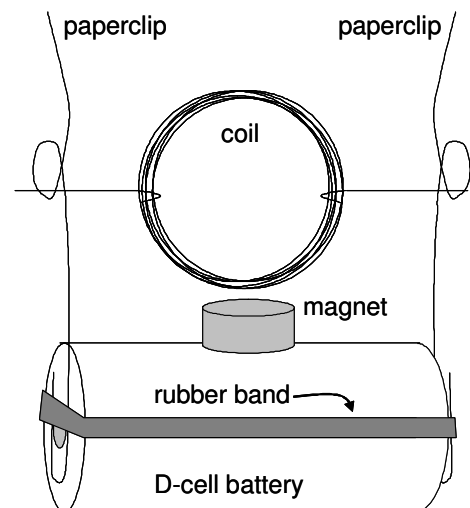
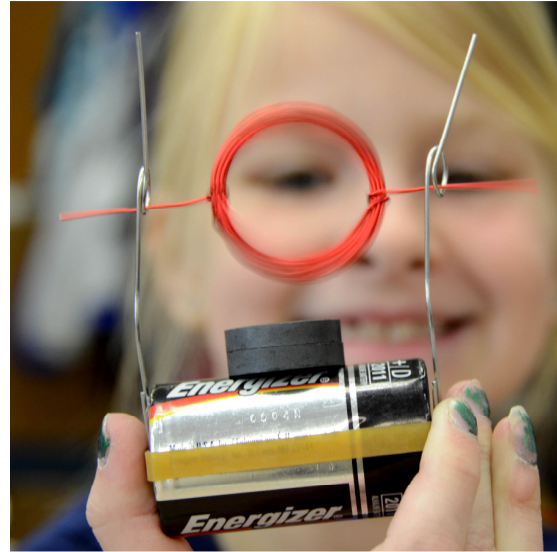
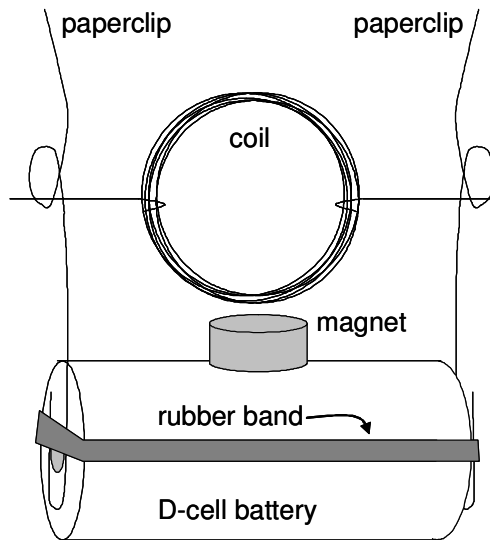


Figure 3

## Instructions for Assembling Your Basic Electric Motor

*If you are starting with completed parts for your motor, use the figure below as a guide to assembling the motor.*



## Instructions for Maintaining Your Basic Electric Motor

*If your motor fails to operate after weeks, months, or years, even with a new battery, you can take the following steps to repair it.*

1. Replace the pair of bent jumbo paperclips with a new pair by following the *Instructions for Building a Basic Electric Motor*, indicated under item 3.
2. Each protruding end has the insulation scrapped off of one side, as described in the *Instructions for Building a Basic Electric Motor* under item 2. Re-scrape those sides as described so that they once again appear as shiny copper.