An Electric Current and Its Accompanying Magnetic Field.

The equipment you need:

- A battery or other (low-power) power supply
- A magnetic compass (ideally, more than one)
- Iron filings (optional)
- Electrical tape or other insulating tape, such as duct tape
- Insulated, thin copper wire (18 AWG or thinner)
- Stiff cardboard (size of a standard sheet of paper, large enough to hold compass[es])

Your steps:

1. Fix the cardboard in a horizontal position (stiffer cardboard will make this easier – you could span two towers of books, for example, with a small gap between the supports).
2. Make a small hole in the piece of cardboard, and pass the wire through it vertically.
3. Sprinkle iron filings (if you have them) randomly onto the cardboard.
4. Observe: Initially, is there any pattern to them?
5. Place the compass(es) on the cardboard. If there is a magnetic field present (such as Earth's relatively weak magnetic field), the needle will align with it.
6. Observe: Initially, in which direction does the compass needle point?
7. Connect the ends of the wire to the two terminals of the battery (or your low-voltage power source).
8. Observe: Is there a change in the direction of the compass needle? in the pattern of the iron filings, assuming you have them? Record your observations.
9. Observe: What is the direction of the magnetic field the compass(es) and/or iron filings are experiencing? If you have only one compass, move it around the wire and observe the orientation of the field. Record your observations.
10. Switch the direction of the electric current (by swapping the wire connections on the battery or low-voltage power supply).
11. Observe: Do the iron filings change position or rotate? How about the orientation of the compass needle(s)? Record your observations.
12. Analyze: What is the relationship between what you observe and the right-hand rule for electric currents and magnetic fields?

A Changing Magnetic Field and the Electric Current That It Creates.

The equipment you need:

- Bar magnet
- Insulated thin copper wire – 0.5 meters or so
- A multimeter (or other current-measuring device)
- A paper towel tube

Your steps:

1. Shorten (cut) the tube so that it is short enough that you can pass the magnet through it.
2. Wrap the copper wire tightly around the cardboard tube about 3 turns. (Later, you will be asked to wrap it 9 turns. The purpose is to have a ratio of 3:1 or greater, so 4 and 12 turns, etc., would also work.)
3. Connect the two ends of the wire to the two appropriate terminals of your multimeter, which should be set up to measure electric current. If your multimeter has multiple modes to measure current, as many do, use the most sensitive setting (e.g., "0-300 mA" instead of "0-10 A").
4. Turn on the multimeter.
5. Move one end of the magnet through the tube (wire coils), moving it back and forth along the tube axis.
6. Observe the effect on the multimeter. Does the speed with which you move the magnet change the amount of current? Does the direction of the current depend on the direction of the magnet's motion? What happens if you use the other pole of the magnet? Is there an electric current when the magnet is not moving? Record your observations.
7. Change the number of coils, tripling their quantity. Repeat the experiments and observe the results. How does the amount of current change (with the magnet moving at the same speeds it did earlier)? Record your observations.
8. Analyze: What conclusions can you draw about (a) the speed of the magnet's motion and the amount of current created and (b) the number of loops and the amount of current created?

