Electric Currents and Magnetic Fields

INTRODUCTION

This activity provides an opportunity to see the effects of an induced magnetic field and to explore some of its properties.

MATERIALS

10 yards of insulated copper wire
Wire strippers
Tape
Sewing needle
Thread
Bar Magnet
Beverage can
Battery

WHAT TO DO

1. Strip a few inches of both ends of the wire and wrap the length of wire around the can, leaving about a foot loose at each end. Then slide the coil off the can, being careful to keep the coil together. Wrap tape around the coil so it will keep its shape, then tape the coil to the table so that it will stand up.
2. Magnetize the needle by rubbing it with the magnet. Stroke the needle with the same end of the magnet in the same direction at least forty times.
3. Tie a piece of thread around the middle of the needle, then tape the other end of the thread to the inside of the top of the coil so the needle hangs in the middle.
4. To illustrate the effect a magnetic field will have on the needle slowly bring the magnet near the needle, so that the needle still hangs freely, but points toward the magnet.
5. Put the magnet away, but see the same effect on the needle by connecting the ends of the wire coil to the positive and negative terminals of a battery. The current flowing through the coil produces a magnetic field. Watch how the needle reacts.

QUESTIONS TO ASK STUDENTS

1. What would happen if the wires were switched so that they touched the opposite terminals of the battery? Make a prediction, then test it.
2. If two batteries were used instead of one, would the needle's reaction to the current be different?
3. Does a non-magnetized needle work?
4. Ten yards of wire is quite a bit. Would a significantly shorter length of wire work? How might it change the experiment?

SUMMARY

Magnetic fields are created by the flow of electricity and by changing electric fields, and changing magnetic fields create electricity. Wherever there is an electric current there is a corresponding magnetic field, and wherever a magnetic field exists, so does an electric field. Every electric field has an equal magnetic field and vice versa. The electric field produced by current flowing through the wire coil must have a corresponding magnetic field, so a magnetic field is induced. The fields cannot be seen, but the effects of them can be by watching the magnetized needle orient itself in the induced magnetic field. The magnetized needle will line up with the magnetic field, which

will be perpendicular to the wire coil. When the wires are connected to the other ends of the battery, the fields are oriented in the opposite direction, so the needle has to respond accordingly. It twists around to point in the other direction.

SOURCES

"Awesome Experiments in Electricity and Magnetism." Michael DiSpezio, Sterling Publishing Company: New York, 1998. p. 100