LESSON 9:

Electromagnetism, Part 2

CONCEPT: Students use the principle that electricity flowing in a coil of wire generates a magnetic attraction to construct a simple electricity meter (galvanometer). They then move a magnet near a coil of wire, using the galvanometer to show that this action creates an electric current.

DIRECTIONS/LAB: Students work in groups of 2 or 3 to construct a sensitive galvanometer (instrument used to measure electricity). Hand each group 2 straws, a pair of scissors, a thumbtack, a plastic cup, tape (masking or transparent), two relay coils (these are simply coils of wire wrapped many times around a metal core), a magnet, and two hookup wires.

Students tape two straws together at right angles to one another (see diagram on page 28). Tape the end of one of the straws to the body of the other at a distance just less than the height of the cup. Push a thumbtack through the side (as viewed by looking along the length of the other straw) of the short end of the bisected straw. Set the result on the rim of the cup so that the tack hangs down close to the table and swings freely from side to side.

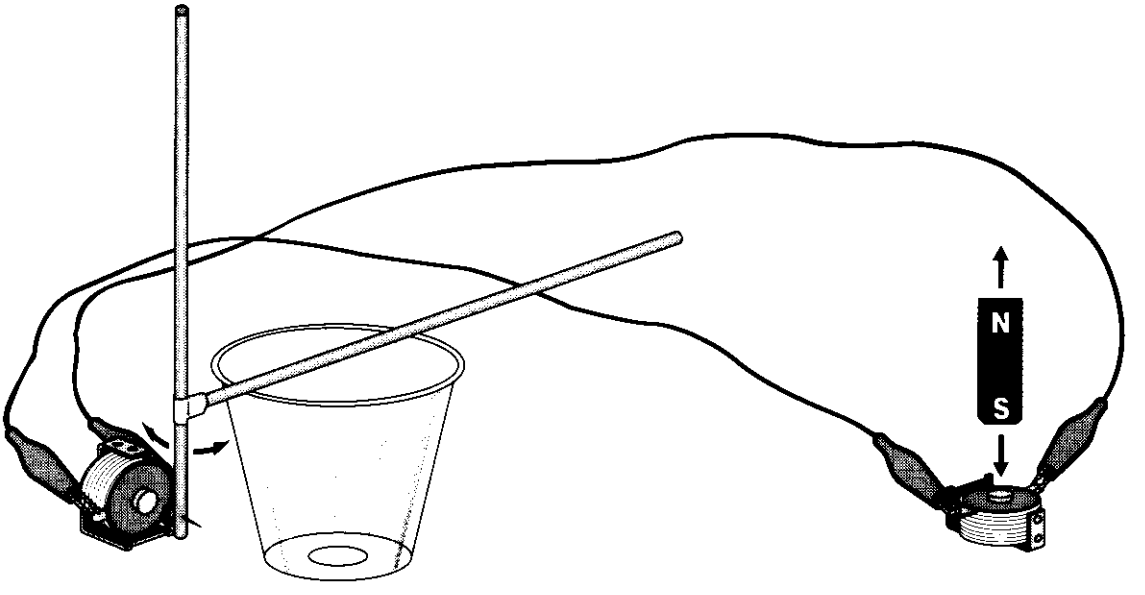
Set one of the relay coils so that the metal button on the end of it is two or three millimeters from the tack hanging from the straw. Ask the students what will happen if electricity is applied to the ends of the wire (the coil will become a magnet and attract the thumbtacks, moving the end of the straw). Can the students think of other ways to measure electricity?

Moving a magnet past a coil or vice versa produces electricity. How can students use the galvanometer, a magnet, and a coil, to generate electricity (connect the ends of the galvanometer coil to the ends of a second coil, wave a magnet near the end of the second coil)? Have students design on paper the experiments they will do to answer the questions posed in the Inquiry.

INQUIRY: What effect does the orientation of the magnet and coil have on the production of electricity? What effect does distance between the two have on the production of electricity? Do you have to move the magnet or the coil or both or neither to make electricity? How does using different poles (the two ends or sides of the magnet that show the greatest magnetic effect) of the magnet affect what happens? How does the rate of movement affect what happens? (This is particularly important because the galvanometer has a natural rhythm. The effect is most noticeable if the students move their magnets in the same rhythm— can they discover this?)

CONCLUSION: Just as electricity can be used to produce magnet-like qualities in a coil of wire, a magnet can be used with a coil of wire to produce electrical energy.

ADDITIONAL ACTIVITIES: Students can take an inexpensive dc motor and connect it to a small light. These motors are made up of coils of wire and magnets. Normally a battery is connected to the coils which are pulled and repelled by the stationary magnets. The coils are fixed to the shaft and spin around. The same device can be made to generate electricity simply by turning the shaft. The coils spin past the magnets and pick up an electric current. The current can be carried over wires to a small light. It may be necessary to try reversing the wires (or turning the shaft in the opposite direction) to light the light.



MATERIALS: Coils, electric meters (optional), magnets, connecting wire, dc motors, small lights.