Another FREE SAMPLE LAB from TOPS LEARNING SYSTEMS!

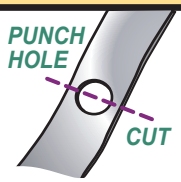
This **TOPS Idea** is taken from an original series of black-and-white line masters, adapted to stand alone as an independent mini-lesson. Please purchase our original book to get the whole in-depth program.

on-off motor

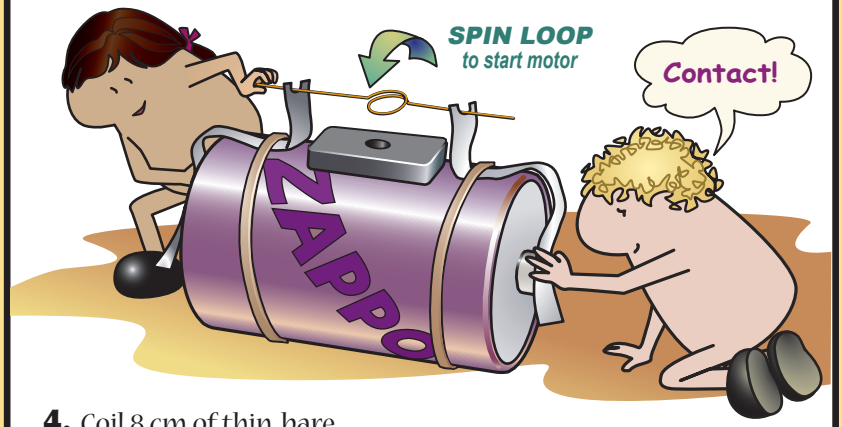
…adapted from **Magnetism #20** by TOPS Learning Systems

1. Cut aluminum foil as big as an index card. Fold it in half three times lengthwise.

2. Paper-punch a hole in the middle. Cut the strip in half across this hole to make two "saddles."



3. Rubber-band each strip, as shown, to a size-D battery. Set a magnet between them.



4. Coil 8 cm of thin, bare wire around a pencil $1\frac{1}{3}$ times. Adjust the arms so it spins easily when resting in the foil saddles.

5. Press the foil ends to the battery terminals. Give the coil a spin to kick-start your motor. Explain why it keeps spinning!

OBJECTIVE

To build a motor that spins by turning on and off.

LAB NOTES

Copy the lab for each student or lab team.

Step 3. The magnet should cling to the battery. If not, use a bit of tape.

Step 4. Wire that circles $1\frac{1}{3}$ times yields a loop that is fairly evenly balanced. Natural spring in the loop prevents the bare wire from contacting itself and shorting out the coil.

Step 5. The tiny coil tends to spin in fits and starts, often reversing direction. A well-balanced coil may spin with impressive speed.

ANSWERS

5. Electricity flows around the wire loop, creating associated electromagnetic poles perpendicular to the plane of the loop. These poles rotate into alignment with the field of the permanent magnet, causing the loop to turn. But before these electromagnetic poles can lock into stable alignment with the permanent magnet, the wire bounces 'off' then back 'on' in random ways, allowing the loop to keep on turning.

EVALUATION

Q: Will your on-off motor work without the permanent magnet attached to the battery? Explain.

A: No. Without the permanent magnet, the magnetic poles created by electricity flowing through the loop would have no strong field to align with. So there would be no attractive or repelling forces to turn the coil.

MATERIALS

- Aluminum foil; an optional index card to use as a pattern.
- A hole punch; scissors; a metric ruler.
- Two rubber bands.
- Small ceramic magnet, about $1 \times \frac{3}{4} \times \frac{1}{8}$ inches, with poles perpendicular to faces.
- 8 cm of bare thin copper wire. The thinner the better. Heavier wire will not work. Discarded household appliance cords may be braided into suitably thin strands. Almost sever the cord with cutting pliers, then pull off the insulation to inspect.
- A fresh size-D battery.

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