The Bronx High School of Science
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Name _____ **Partner(s)** _____

Day/Periods _____ **Date** _____

Motors Activity

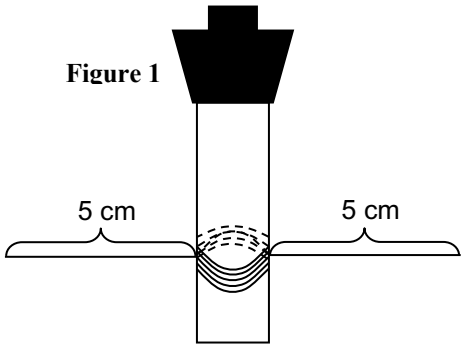
Problem: How do motors work? How can we build a simple motor?

Materials: D cell battery, paper clips, sand paper/coin, magnet wire, magnet, tape

Procedure: Part 1: Constructing a simple motor

a. Wrap a magnet wire (#24) around a marker or your D-cell battery, as shown to the right, to serve as the coil. Leave about 5 cm of wire on sticking out from either side. [Figure 1]

Figure 1

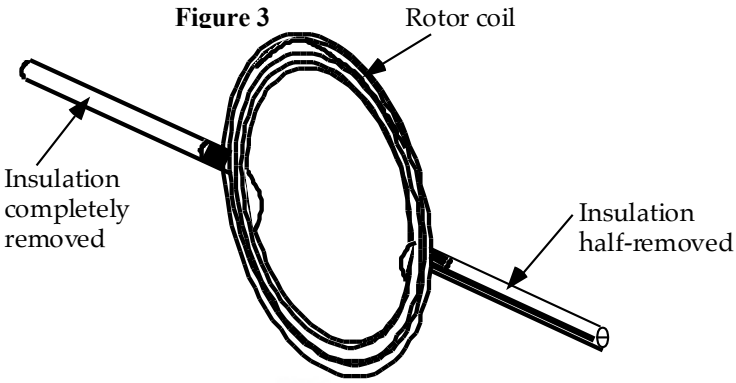


b. On opposite sides of the coil, wrap the two loose 5 cm ends around the coil for 2 turns to keep it tight. You should have some leads sticking out to spin on. To check if it will work (spin), place these ends between thumbs and pointer finger and make sure it will spin evenly. If not, bend leads accordingly. [Figure 2]

Figure 2

c. The leads sticking out must be altered. Use sand paper or the side of a dime to strip off the insulation off one of the leads and only sand the top side on the other. Make sure the stripped side points up when the loop is vertical, not horizontal. [Figure 3]

Figure 3

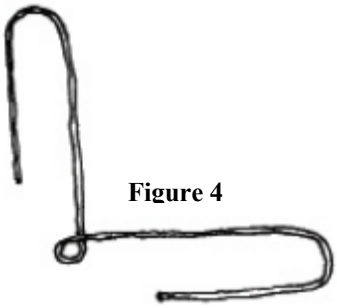


Part 2: Final Motor Assembly.

d. Tape a flat magnet to a D-cell as shown in the figure on the right. (To stabilize the D-cell, you may want to tape it to the desk or to an upside-down foam cup.)

e. Bend the paper clips as shown in the diagram. [Figure 4]

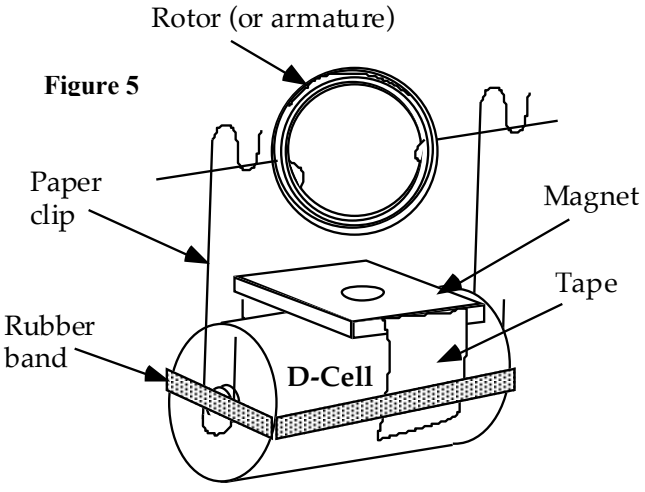
Figure 4



f. Attach the paper clips to the D-cell with tape (or your fingers). Align the notches at the top of the paper clips so that the armature/coil will be level. The bottom of coil should be as close to the magnet as possible without touching the magnet.

g. Place the coil in the paper clip supports. Give the coil a spin to get it started and it should continue to spin by itself – a working motor. [Figure 5]

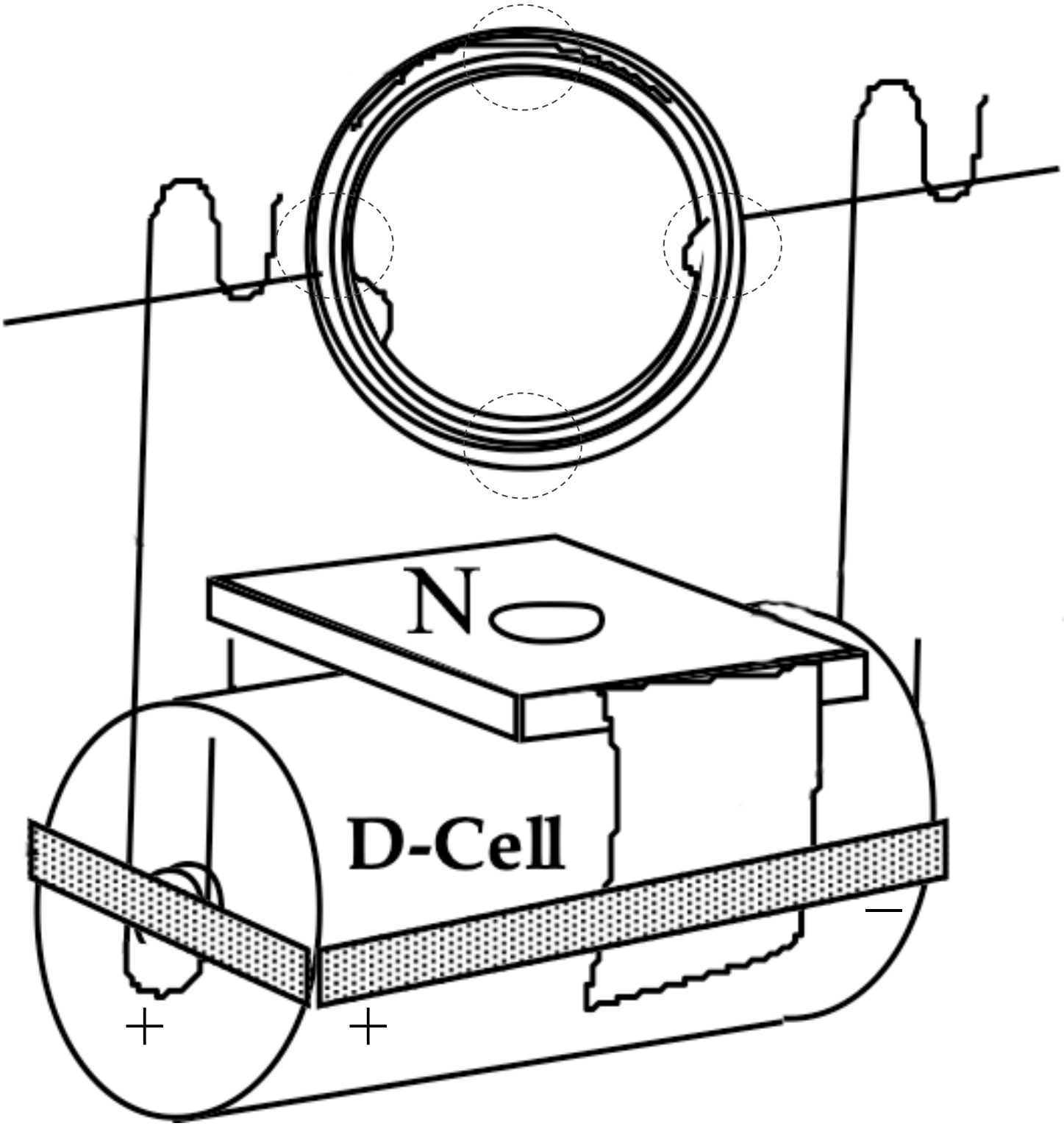
Figure 5



Summary Questions:

1. What changes in energy are happening as the motor operates?

2. On the diagram, label:
a. The direction of the current flow through the paper clips and wire loop
b. The direction of the magnetic field lines due to the permanent magnet. Assume the top face of the magnet is N. (The field should be roughly constant near the wire loop.)
c. The direction of the force on the top, bottom, left, and right points of the wire loop (circled on the picture) [hint: use the right-hand rule]. If the force is zero, write F=0 next to that point.
d. The direction that the wire loop will spin



3. Feel your wire coil. Did it heat up as the motor ran? Why do motors often heat up while running?

4. Examine a picture of a commercially available motor. Compare and contrast your motor and the commercial motor.

5. Identify 2 potential applications for the motor.

6. In class, we discussed how connecting a wire to both ends of a power source can "short" the power source, causing an extremely large current, dissipating an enormous amount of energy in a short time, and ruining the power supply. Why is the wire coil in a motor NOT shorting the battery? (Hint: recall the equations $V=IR$ and $R = \rho L/A$.)

7. Why was only half of the insulation was removed from one side of the coil? (Hint: If we removed all of the insulation from both sides, what would happen?)

8. What would change in the motor if the battery were reversed so the current ran the opposite direction? Explain your reasoning.

9. What would change in the motor if the magnet placement were changed so that the south pole of the magnet was facing upward? Explain your reasoning.

10. Summarize: Write a detailed explanation for how a motor works.