Curiosity Guide #804
Electric Motors
Accompanies Curious Crew, Season 8, Episode 4 (#804)

Make a Simple Electric DC Motor
STEM Challenge

Description
Design, test, and adjust your own DC motor!

Materials
- C- or D-cell batteries
- Rubber band
- Electrical tape
- Needle nose pliers
- Neodymium or ring magnets
- Clay or Play-Doh
- Paper clips
- Safety pins
- Sandpaper
- #20 copper magnet wire
- #28 copper magnet wire
- #42 copper magnet wire
- Tachometer
- Reflective tape

Procedure
1) Choose what size battery and what gauge wire you want to use.
2) Wrap the wire around the battery at least ten times. You can choose to make more loops with different numbers of windings to compare.
3) Twist the ends around the loop to hold the loop in place, but leave a tail that extends out on each side at least 2 cm.
4) Hold the coil vertically and sand off the enamel coating on the upper face of each tail, leaving the underside of the tail insulated.
5) Decide what you will use for the loop supports. You could choose straightened paper clips with loops on the end, or tall safety pins. These will need to attach to the ends of the battery and stand upright when the battery is lying flat on the table.
6) Decide how to secure the metal loop supports. You can choose either tape or rubber bands. Fasten the supports on the battery’s poles with your chosen material.
7) Decide on how to keep the battery still and set the battery up. Here are some choices: You can tape the battery to the table, place the battery in a bed of clay, or sit the battery on a disc magnet.
8) Place a neodymium magnet on the top side of the flat battery, centered between the metal supports.
9) Carefully slot the loop ends through the metal support eyes and give the loop a gentle push.
10) What do you notice?
11) Place a piece of reflective tape on one side of the loop and measure the rotation speed with a tachometer.
12) How does the speed of your different designs compare?

My Results
Explanation
The loop is called the armature or rotor. Placing the rotor into the metal eyes completes a short circuit that allows electricity to flow through the coiled wire. The flow of electricity generates a magnetic field, the loop reacts to the permanent magnet, and the loop moves. Each time the loop rotates, the insulated part of the wire stops the flow of electricity. The momentum of the rotating loop carries through the turn, makes electrical contact again, and turns the magnetic field back on. The process repeats. The limited friction allows the loop to rotate quickly.

Check out these ideas! We made some great little motors, but if we need more turning force, we need more torque. To increase that rotational force, we could use a more powerful permanent magnet, increase the current flowing through the wires, or use thinner wire with many more windings instead of thicker wires with fewer turns. Curving the permanent magnets and moving the magnets closer to the coil could also increase the rotational force from the motor. Ready for liftoff!

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