Shake Flashlight

by **KJMagnetics** on September 9, 2015

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We are a supplier of neodymium, rare earth magnets. We also love to conduct experiments with our magnets and build unique projects with them! We have several engineers on staff who are always thinking of new projects and figuring out cool ways to use magnets.

Intro: Shake Flashlight

How can you generate electricity without batteries? With magnets of course! In this Instructable, we will show how a magnet and some electrical components can make a simple shake flashlight that never needs batteries! This type of flashlight is great for hiking, camping, or emergency situations. Taking away the need for batteries means this flashlight is already ready to go and can last a long time!

Materials needed: Small cut of PVC pipe, magnet wire, neodymium magnet, LED's, 4 diodes or 1 diode bridge, capacitor, resistor, wire, breadboard, and electrical tape.

Image Notes
1. Just one small LED outputs a nice amount of light.

Step 1: Cut PVC and wrap wire around it

The first step is to cut a piece of PVC pipe (or other non-magnetic material). The inner diameter of the pipe will determine the size magnet you need to use. We used a pipe with a 3/4" inner diameter, schedule 40, and cut it to 6.5" length. The length doesn't matter as much, but keep in mind that you want the magnet to have a short distance to travel when you shake it. We used a 3/4" magnet, our part DCX0 to go inside of the flashlight.

After cutting the PVC, it is time to wrap the wire around the tube. When doing this, make sure to leave the end out at the start and an end when finished. These ends will later attach to other wires. We used thin, 30 gauge wire, our product MW30-4.

We used a drill to spin the tube around while holding the wire and wrapping it back and forth in the center of the tube. How many turns? We forgot to count, sorry! A couple hundred should do the trick. The output voltage generated is directly related to the number of turns. Doubling the turns should double the voltage (in a perfect system). I would say around 300 turns. Turning slow can help you get a nice, tight coil. We simply used some tape to hold the ends down so it didn't unravel.

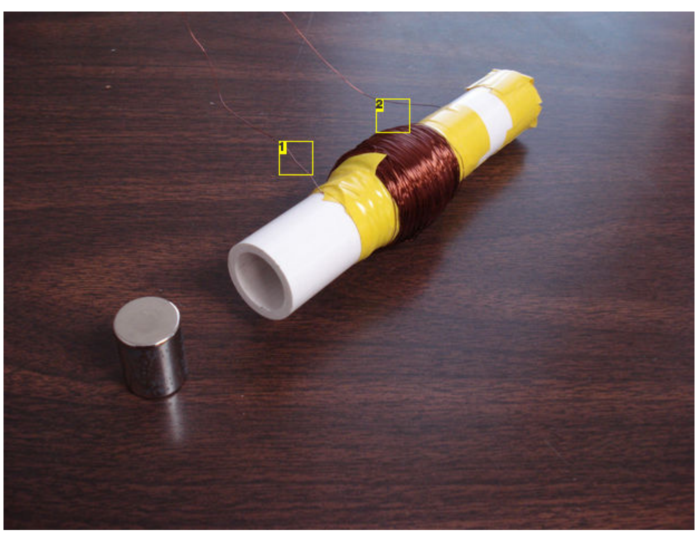


Image Notes
1. Leave end out before turning.
2. Leave enough wire when finished turning.

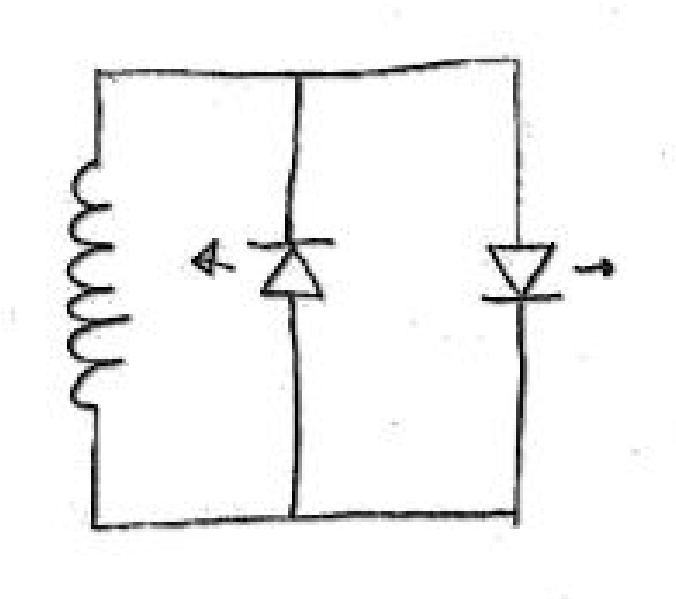
Step 2: Wire Testing

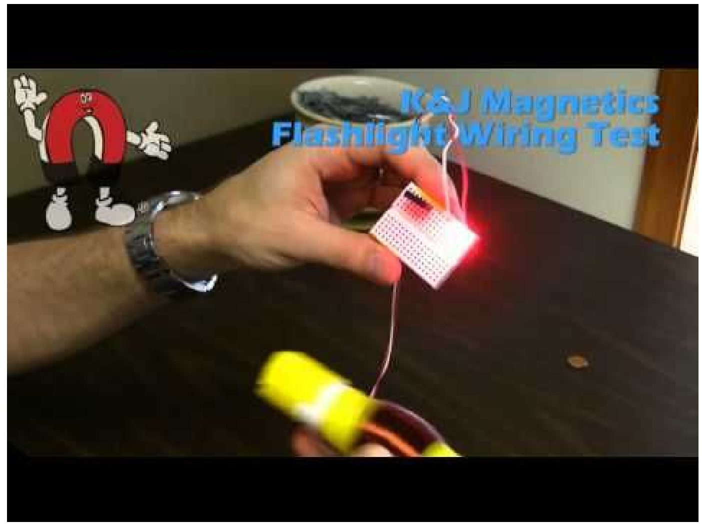
Before spending the time creating a circuit, we wanted to test the system to make sure it would work. LED's, like all diodes, only allow flow in one direction. So in this simple circuit, we used two LED's to test the coil assembly to see if it makes any electricity.

Using our breadboard, we hooked up the power supply (the coil) and the two diodes in parallel. We connected the wires from the coil to insulated wire, which we then inserted into the breadboard.

Check out this very informative Instructable on using a breadboard if you are having some trouble.

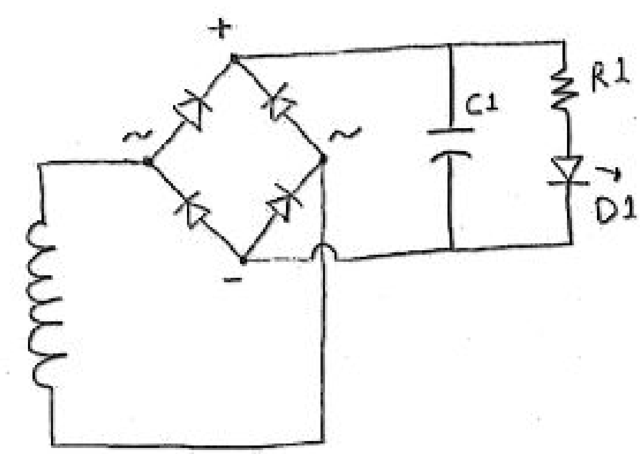
If you are confident in your wiring abilities, you can skip this step and head right to making the circuit!

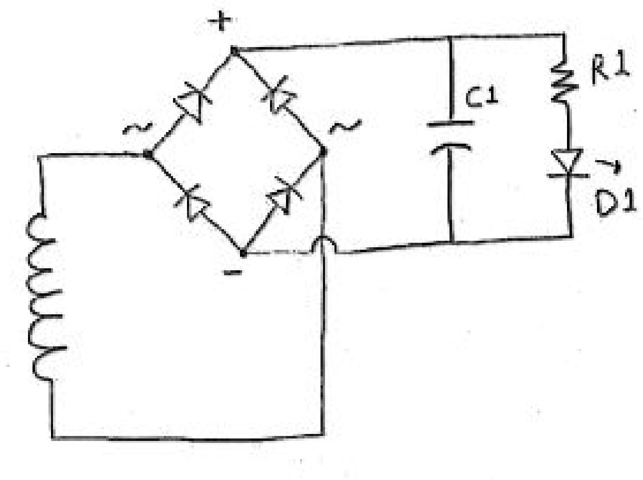




Step 3: Create your circuit!

Now, let's add a few more things to our circuit to transform the blinking light into a steady, usable light source.





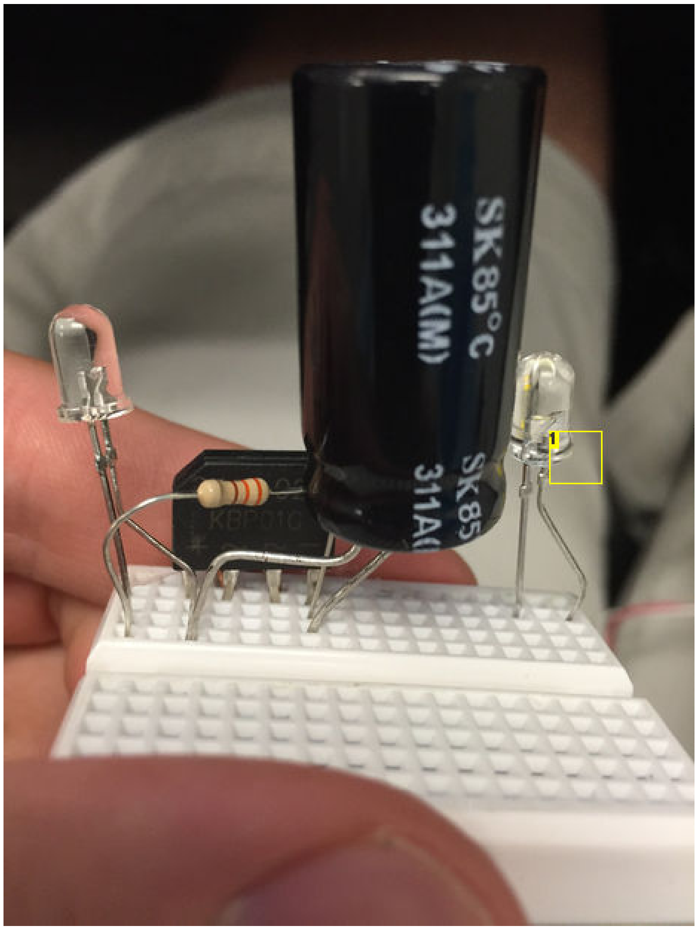
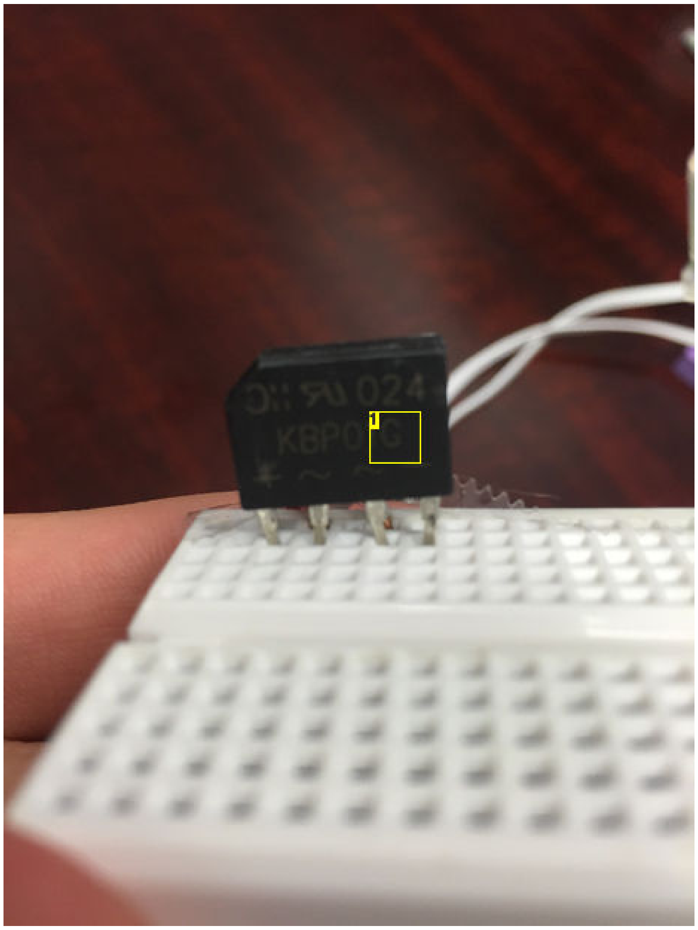


Image Notes
1. This diode isn't doing anything here...just getting it out of the way.

Step 4: Add a diode bridge

This diode bridge will take the alternating electrical output of our coil and get it flowing in one direction. You can make a diode bridge out of four individual diodes, but we chose a package that combined them into one unit. With this diode bridge, we can light just one LED since all the electricity will flow in one direction. Or, if you want, you can add an LED in parallel to light more than one.

For a good description of how a diode bridge is setup, see this page on Wikipedia.



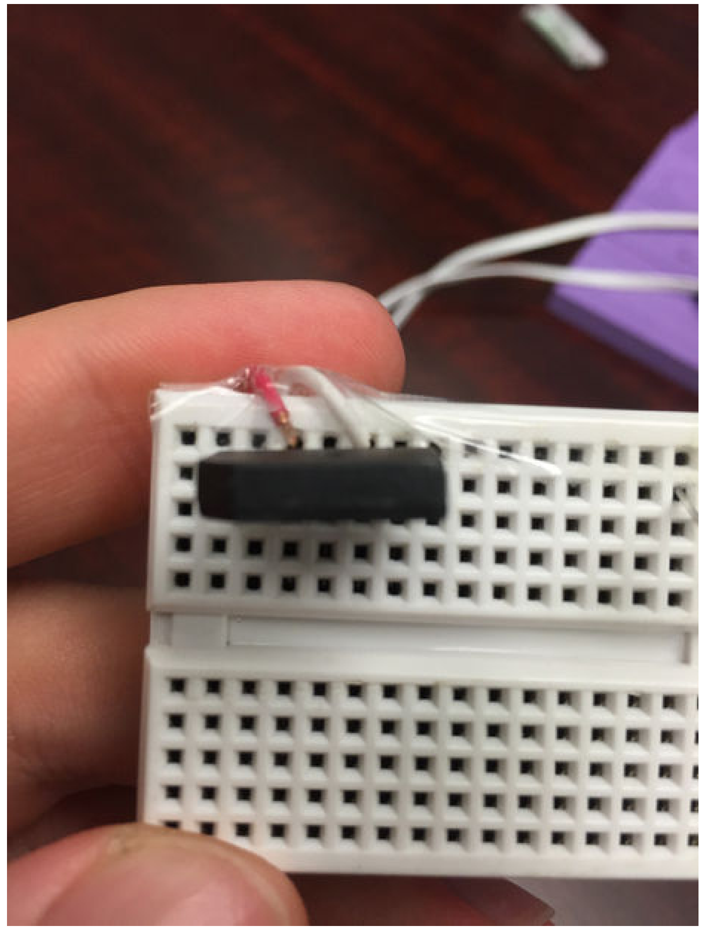
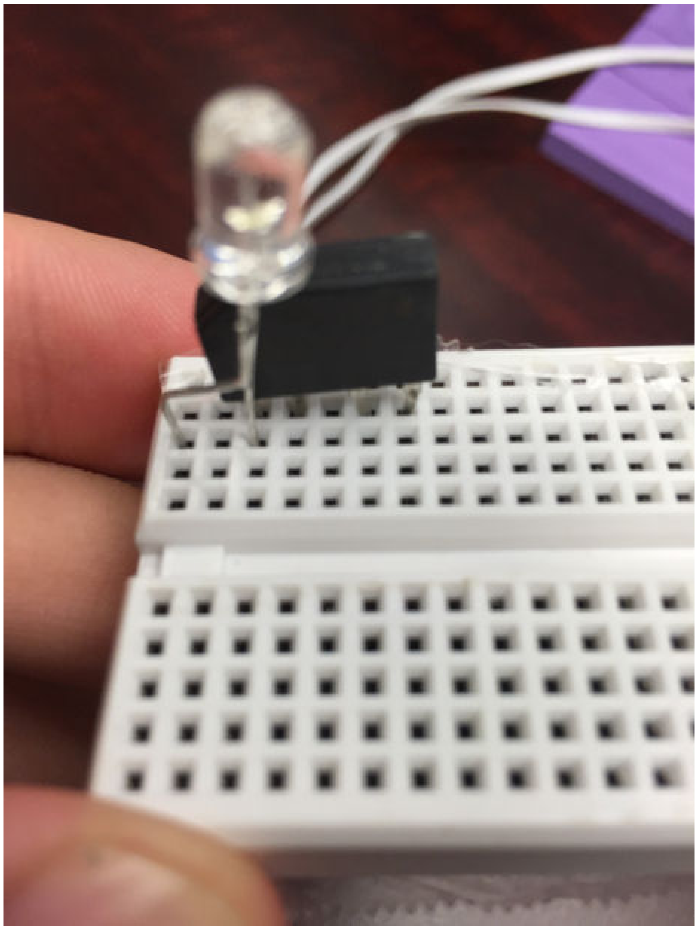


Image Notes
1. Diode bridge device



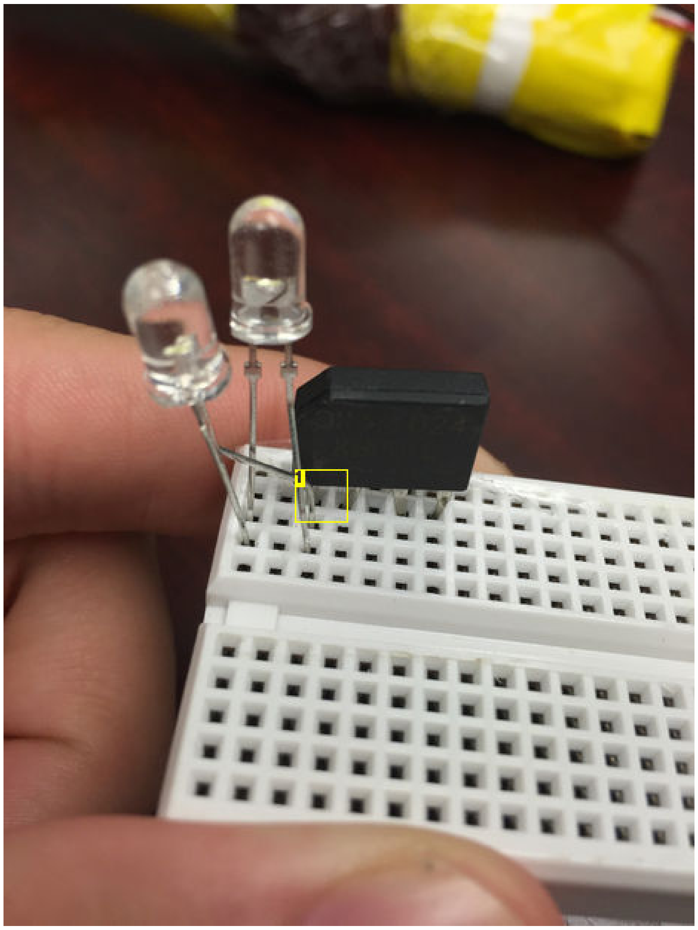
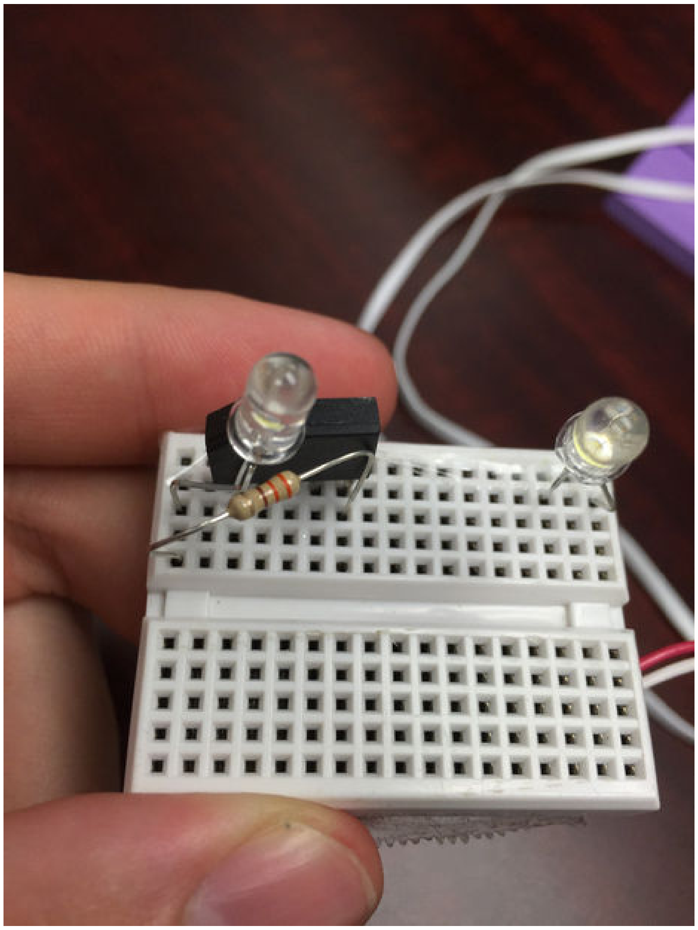


Image Notes
1. Two diodes in parallel will light both up, if so desired!

Step 5: Add resistor

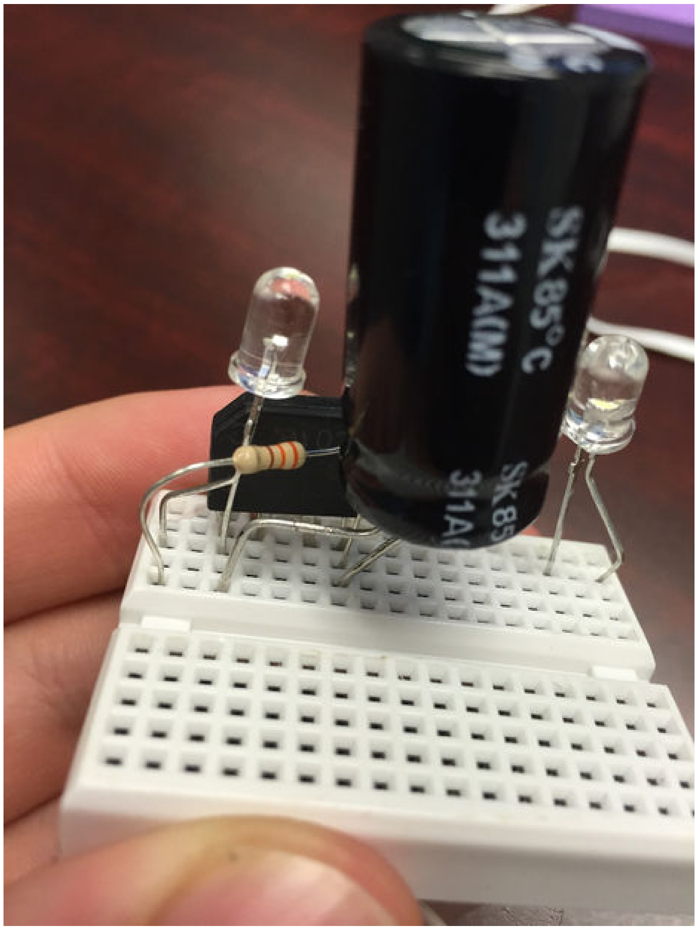
We also used a resistor (R1) in series with the LED (D1). In this case, we used a 300 ohm resistor. This limits the flow of electricity through the diode.



Step 6: Add capactior

What we need now is a storage device to smooth out the current and provide a steady flow of electricity instead of the short bursts provided from our coil. A capacitor (C1) functions exactly this way. Without the capacitor, the LED would blink on and off like a strobe light.

Some human-powered flashlights use rechargeable batteries to store more power. We just used a 4700uF 16V capacitor, to keep things simple and cheap.

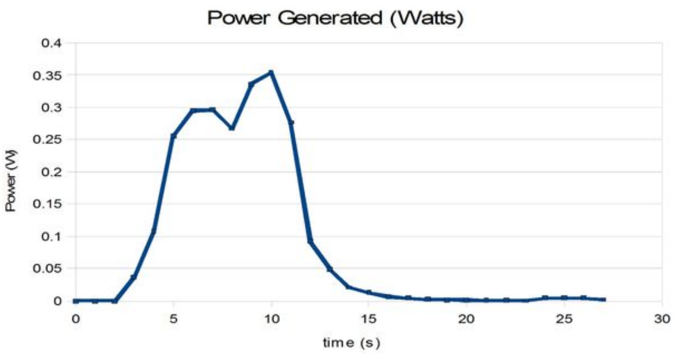


Step 7: Test it out!

With the circuit now complete, we put some finishing touches on our flashlight. We used some fancy mechanical packaging (not really fancy) to enhance this device. We added thin DC2 magnets on either end of the tube, repelling the magnet inside. These magnets act as springs on either end of the tube to keep from wasting energy, slamming into the ends of the tube.

We've also included a graph of the power generated by our circuit. Yours could vary depending on the size of resistor or capacitor.

Image Notes
1. DC2 magnet placed on the end of the tube, repelling the magnet inside.

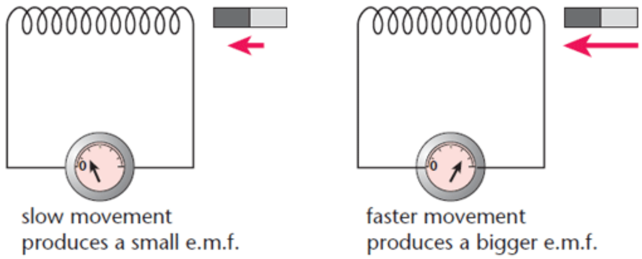


Step 8: Nerd stuff: How does this work?

As usual, we always like to include a short blurb about how the things we make work. In this case, the answer is Faraday's Law. Faraday was an English scientist who studied electromagnetism. He discovered that moving magnets near a coil of wire yields electricity.

Here is a more specific definition of Faraday's Law: Any change in the magnetic environment of a coil of wire will cause a voltage (emf) to be "induced" in the coil. No matter how they change is produced, the voltage will be generated. The change could be produced by changing the magnetic field strength, moving a magnet toward or away from the coil, moving the coil into or out of the magnetic field, rotating the coil relative to the magnet, etc.

In this case, we're going to move a magnet back and forth through a coil of wire. Each time the magnet moves from one end of the tube to the other, the magnetic field inside the coil will reverse direction (twice). The voltage generated is proportional to the quick change in the magnetic field direction, multiplied by the number of turns of wire. Voltage generated = (number of wire turns) x (change in magnetic field strength per second).



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