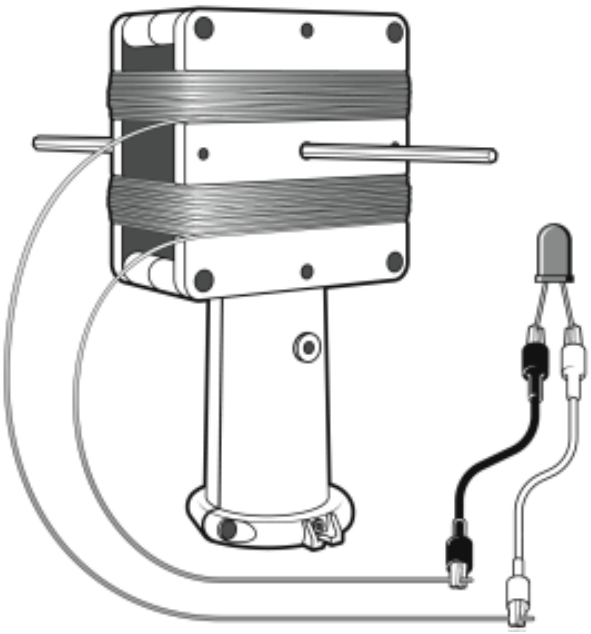
Lab 24 Generators

Name: _____ Lab Partner(s): _____

Driving Question

How is electrical energy made? Electricity is seen in nature on a large scale as lightning, but lightning is not "harvested" to light buildings, run air conditioning, or power computers and mobile devices. Instead, electricity has to be generated by converting it from another form of energy.



A device called a generator is often used in the process of converting energy from one form to another. Generators can vary in size and shape, but all generators are composed of a few essential parts: a coil of wire, one or more magnets, and a frame to hold everything in place. To produce electricity, the generator is designed so the magnet and/or coil moves (either the coil is stationary and the magnet moves, or the magnet is stationary and the coil spins).

In this activity, you will build a your own generator and then explore how different variables affect how much electricity you can produce.

Objectives

- Generate electricity using magnets and coils of wire.
- Compare the voltages produced by spinning magnets within different numbers of turns of wire.

Materials

- Chromebook, computer, or mobile device
- Graphical Analysis 4 app
- Go Direct Energy
- SimpleGEN Kit or strong magnets, magnet wire (enameled copper wire), axle rod, open box (cardboard or PVC) with holes for axle, and sandpaper
- 100 Ω resistor
- 2 wires with clips
- drill
- small incandescent light bulb (holiday-light style)
- red LED
- tape

Preliminary Questions

1. What are the primary sources of energy that are converted to electricity in the United States? Can you think of some sources that are not thermally driven and do not require the burning of fuels?

2. What components make up a typical electrical generator?

3. What are some variables that may affect generator performance?

4. What are some of the ways we can move magnets and coils relative to one another?

Procedure

Part I: Preliminary Activity

1. Set up the equipment.
   (a) Tape one end of the wire to the housing.
   (b) Wrap the wire so it creates a clean coil, winding the wire in the same direction each time (see Figure 1). Note: Your instructor will tell your group how many "wraps" or "windings" of wire to use on your generator. Different groups will use a different number of windings.
   (c) Sand the ends of the wire until they are a bright copper color.
   (d) Insert the magnets into the magnet holder.
   (e) Position the magnet holder inside the housing and slide the rod through the housing and magnet holder so the magnet holder can spin freely.
   (f) Connect the red LED to the free ends of the coil.
2. Spin the axle by hand so that the magnet assembly turns inside the coils of wire. Does the LED bulb light when you spin the magnet? Replace the LED bulb with the small incandescent holiday-light style bulb. Can you light the incandescent bulb? Record your answer in the data table.
3. If you have access to a drill, connect the drill chuck to the axle rod. Spin the drill, starting slowly. Can you light either bulb using the drill? Record your answer in the data table.

Part II: Quantitative Analysis

4. Open *SPARKvue* and build a page with one graph.
5. Connect the voltage sensor.
6. Display a graph with Voltage on the y-axis and Time on the x-axis.
7. Set the switch on the voltage sensor to External Load.
8. Set up the data-collection mode.
   (a) Click or tap Mode to open Data Collection Settings.
   (b) Change Rate to 60 samples/s. Click or tap Done.
9. Connect the red and black voltage sensor source wires to your copper coil. Make sure the metal clips are attached to the area of the copper wire that you sanded in Step 1c.
10. Connect the voltage sensor external load terminals to a 100 Ω resistor.

11. Click or tap Collect to start data collection.
12. Collect data for 30 seconds. Spin your generator by hand several times over the course of data collection.
13. When data collection is complete, examine your graph of Voltage vs. Time. Click or tap graph Tools and choose View Statistics. Record the maximum and minimum voltage in the data table.
14. If you have access to a drill, repeat Steps 11-13, spinning the generator with the drill instead of by hand.

Data Number of coil windings: _____

	Hand-spin trial	Drill-spin trial
Light LED bulb		
Light incandescent bulb		
Minimum voltage recorded (V)		
Maximum voltage recorded (V)		

Processing the Data

Share your results with the class to compare the generators used by each group.

Analysis Questions

1. Does the number of coil windings affect the voltage output of the generator? Support your answer with your data.

2. Does the speed at which the magnets rotate affect the voltage output of the generator? Support your answer with your data.

3. What other factors may affect the power output of an electric generator?

4. If you were able to light the LED bulb, why did it flicker on and off?

Extend

1. Using your own materials, make a homemade generator that will light more than one bulb wired in series. Document your project and compare it to the generators made in this exploration.
2. Turn your generator into a motor.
3. Turn your generator into a wind turbine. Can you get your device to spin and generate electricity when the wind blows on it?
4. Test generators with smaller or larger gauge wire. Does it affect voltage output of the generator?
5. Test different magnets in the generator. How does that affect voltage output?