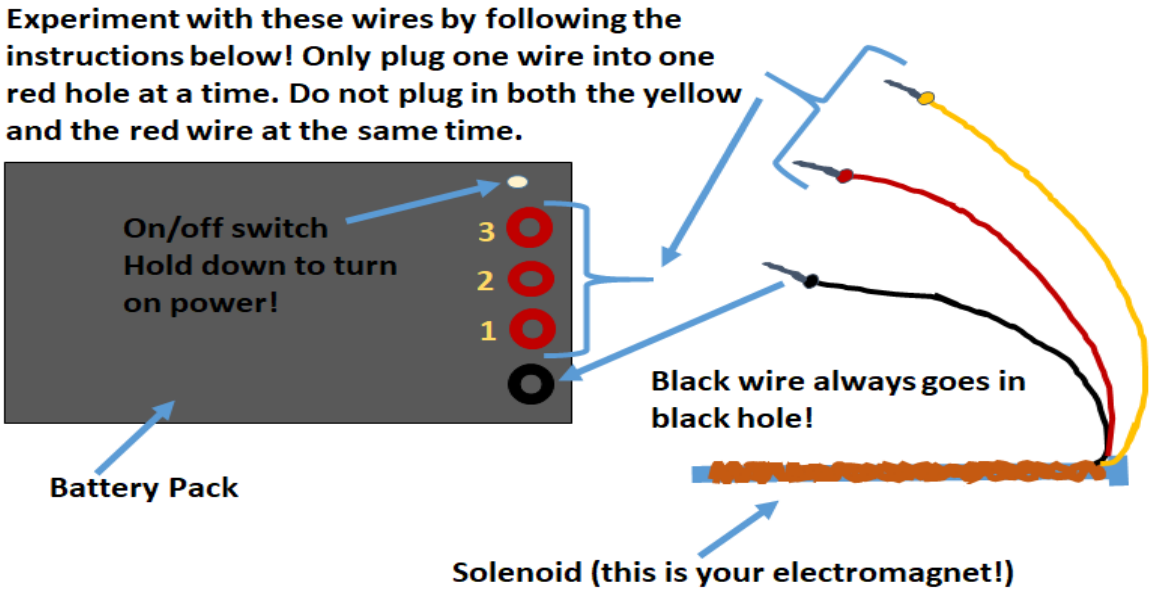
Electricity and Magnetism – Student Sheet

Activity 1: Solenoids

Student groups/pairs will receive one of the blue boxes.
Included: 1 battery pack, 1 solenoid with 3 wires already attached, 1 baggie of washers, and 1 donut magnet



1. Begin by plugging the **black wire into the black hole** and the **red wire into red hole #1**. (Do not use the yellow wire for anything yet.)
   Try to pick up the washers! (Press and hold power button and then drop them by removing power/finger.)

   Each hole you use adds another battery to the series.

   How does the strength of your electromagnet change as you plug the **red wire into red hole #2 and then into red hole #3**? Does the number of washers you can pick up change?

   Record your observations.

2. The yellow wire is connected to less loops or coils on the solenoid, while the red wire is connected to more loops.

   Experiment by plugging the **yellow wire** into **red hole #1, then red #2, and then red #3** to see how this affects the strength of your electromagnet. (Do not plug the red wire into anything.)

   Record your observations.

Compare the number of washers you were able to pick up to the number of batteries used. Remember, each hole you use adds another battery to the series. (1st hole = 1 battery, 2nd hole = 2 batteries, 3rd hole = 3 batteries)

Can you explain the differences?

3. Have the **black wire plugged into the black hole** and the **red wire into red hole #3**. Take out the donut magnet.

   While keeping the electromagnet "off" (do not push the power button) touch the electromagnet to the red side of the magnet, sticking it to the nail tip.
   What happened?

   Now, push the power button.
   What happened?

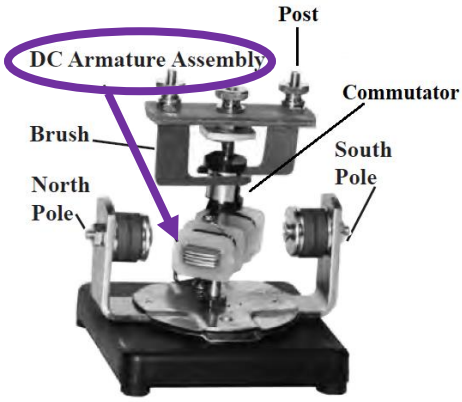
   Still using the red side of the magnet, let's show the pull of the electromagnet. *Do not touch the nail tip to the magnet*…leaving a gap between the nail and the magnet. When the power button is pushed on, can you direct the magnet to move?

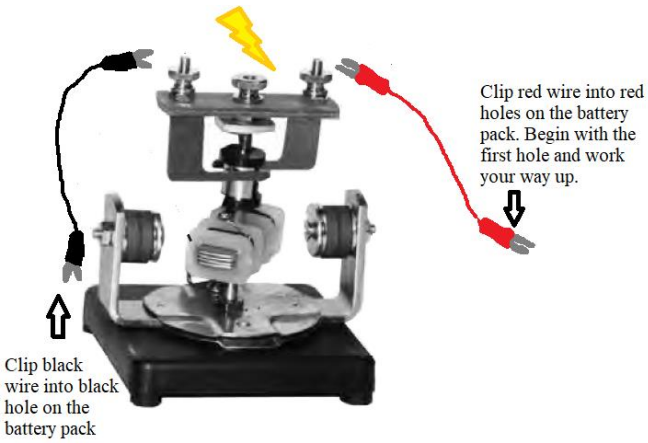
   When did the magnet attract? When did it repel?

Please put the solenoid, washers, and magnet back in the box.
Keep the battery pack out.

Activity 2: St Louis Motors

Student groups/pairs will receive 1 St. Louis motor, 1 red double-ended alligator clip, and 1 black double-ended battery clip. You will already have a battery pack.



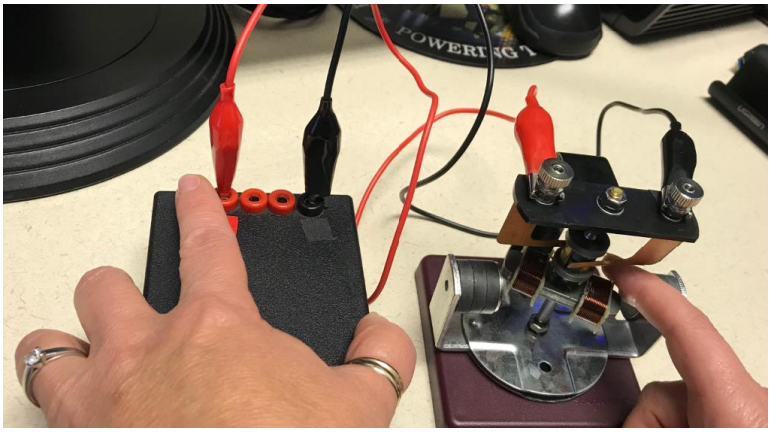


1. How is this motor similar to the solenoid you just experimented with? Can you use the previous experiment to explain how the motor might function?

2. Use the alligator clips to connect the motor to the battery pack. Clip the **black wire into the black hole** on the battery pack. Clip **the red wire into red hole #1** on the battery pack. (Change it to **red hole #2** and then **red #3** as you continue to test.)

Clip the other end of the **black wire**, and the other end of the **red wire** to the posts on the St. Louis motor. Match the color of the wire to the color of the tape on the motor.

To start the St. Louis motor, push the power button on and give the DC armature assembly a *gentle push*.



3. Repeat with **red hole #2** and then **red #3**; how does increasing the number of batteries alter the behavior of the motor? Which direction is the assembly rotating?

4. Switch the North and South pole magnets on the St. Louis Motor. Start your motor again. How does the behavior change? (Switch the end of the black wire, and the end of the red wire to the opposite posts on the St. Louis motor. This time, do not match the color of the wire to the color of the tape on the motor.)

TURN IN ALL MATERIALS BEFORE RECEIVING THE HAND CRANK FOR ACTIVITY 3.

PLEASE DO NOT CONNECT HAND CRANKS TO ST LOUIS MOTOR OR BATTERY PACK.

Activity 3: Hand-Crank Generators

Student groups/pairs will receive one hand crank generator, one light bulb mechanism, and one bell mechanism.

Caution: Please be gentle with these cranks.

Do not crank generators when they are not connected to a circuit or load.

- Turn handle at a reasonable rate, not excessively.
- Start slowly and build up so they do not break.

Take a close look at your generator, how is it similar to the motor? How is it different?

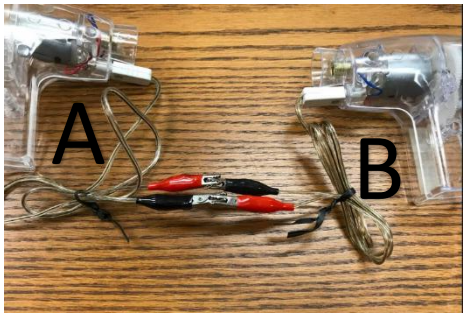
1. Work with another group and connect the leads of the two generators.
   - The **black alligator clip** of generator A should connect to the **black alligator clip** of generator B.
   - The **red alligator clip** of generator A should connect to the **red alligator clip** of generator B.

Have **one person** turn the handle on **one** of the generators. What happens?

2. Switch the leads and connect to the opposite alligator clip.

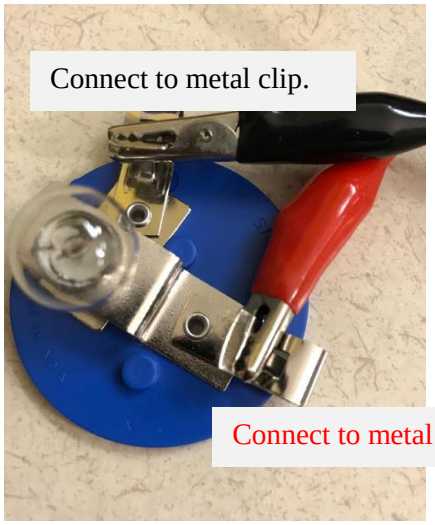
- The **black alligator clip** of generator A should connect to the **red alligator clip** of generator B.
- The **red alligator clip** of generator A should connect to the **black alligator clip** of generator B.

Have one person turn the handle on **one** of the generators. What happens?

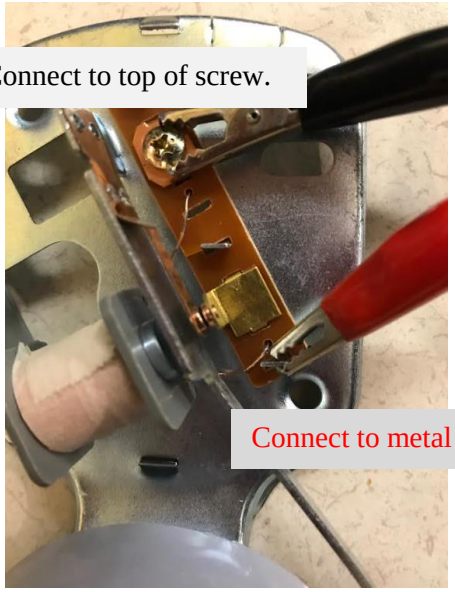


3. Disconnect the generators and connect the leads to your lightbulbs.

One student should hold the lightbulb mechanism to the table, while another student gently turns the crank. Observe.
How does the rate in which you turn the handle affect the bulb?



4. Disconnect the bulb and connect the leads to your doorbell.
   Turn the crank and make an observation. One student should hold the lightbulb mechanism to the table, while another student gently turns the crank. Observe.
   How does the rate in which you turn the handle affect the bell?



Please return all of the materials to your teacher.

Thank you!!

graphics credited to: https://sciencefirst.com/wp-content/uploads/2017/05/24-1155-10-155-615-4700-st-louis-motor.pdf; https://www.teachersource.com/product/hand-cranked-generator/electricity-and-magnetism