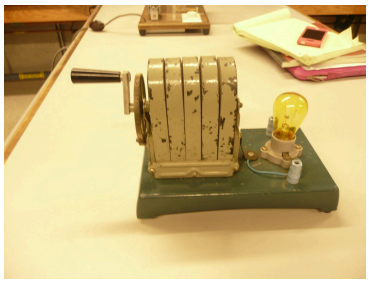
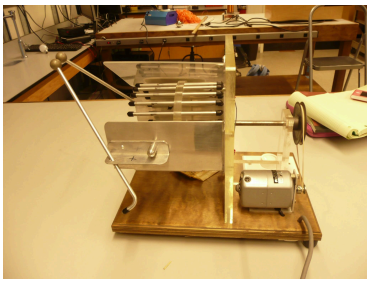
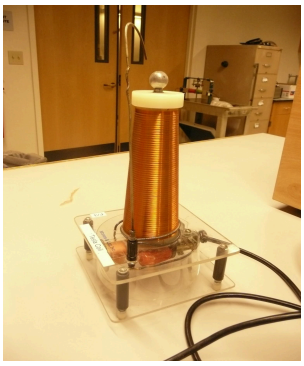
Station 1: Electricity & Magnetism

Goals

- Explore ways in which electricity is generated,
- Draw connections between electrical devices and electricity in nature (lightning, static electricity)
- Discover how much electric power is needed for common electrical devices
- Deduce a connection between electrical energy and heat energy




Equipment:

A. Hand-crank motor with light bulb
B. Wimshurst Machine
C. van de Graaff generator
D. Tesla Coil
E. Jacob's Ladder and stepstool

Safety issues:

- always discharge the van de Graaff generator with rod after turning it off
- set Tesla coil to lowest setting before turning on, and return to lowest setting before turning off
- make sure phones, cameras, etc are not close to vdG and Tesla coil
- be sure to spot students when they go up step ladder for Jacob's ladder

Suggested rotation:

Hand-crank motor -> Wimshurst -> van de Graaff -> Tesla coil -> Jacob's Ladder

Suggestions for questions/prompts for exploration:

Hand-crank motor

- Try to get the light bulb to light up by turning the handle; how hard do you have to work to make it glow brightly?
- Do you think you could light your house by turning a crank like this? how about your TV or a computer?
- Look inside the motor as it turns; notice the coils of wire and the magnet attached to the handle. describe what you think makes this light bulb go on (hint: how does a light bulb work when it's plugged into an electric socket?)

Wimshurst Machine:

- spin the wheel (counterclockwise) - what do the sparks remind you of? what does the popping sound remind you of?
- how does the frequency and strength of the sparks change as you move the arms apart?
- what substance do you think makes up the spark? a lightning bolt?

van de Graaff generator:

- What shape of rod (pointy or round) makes the best sparks?
- What happens when you bring both rods to the generator?
- If you wanted to prevent lightning from striking a house, which shape of lightning rod do you think would be best?
- Place the "wig" on the generator and watch what happens. What do you think causes this? (can also do with your own hair)
- How does the spark for the generator compare in brightness and sound to that from the Wimshurst Machine? (you can explain that the basic principles of the machine are the same)

Tesla Coil

- How is this spark different from lightning?
- Have the students adjust the current flow through the coil. At what point do the sparks stop?
- Place a fluorescent tube near the coil. What is causing the bulb to light up? (Hint: what causes the bulb to light up when it is in the ceiling?)
- How are the hand motor and tesla coil related?

Jacob's Ladder

- What is happening to the spark arc?
- Encourage them to blow gently on the tube from above, and show they can stop the progress of the arc. Why does this work?
- Feel the air above the tube; is it unusually warm?
- Smell the air above the tube; what you smell is a gas called ozone that is created when oxygen is exposed to high energy discharges (here) or UV light (in the atmosphere)