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# THE CANE INSTITUTE FOR ADVANCED TECHNOLOGIES

Hello ADHUS and FAUHS Students (and Parents)!

Happy Holidays from The Cane Institute! We are excited to provide your seventh TCI STEM@Home mailer. This mailer is designed to teach you a little about the concepts of circuits!

**Background:** This kit will walk you through making a simple paper graphite circuit. We are going to put our electricity science to the test and see if we can make a closed circuit and turn a light bulb on using just a battery, pencil, and light.

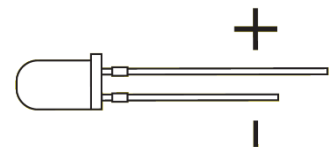


### Make an Electric Circuit with a Graphite Pencil:

Did you know you can make a circuit of electricity using a graphite pencil? This might be one of the coolest science activities we've shared because the possibilities are endless! You can draw anything from a circle to a tree; just use your imagination! We've included a festive holiday template for you to try on the back of this page. Enjoy!

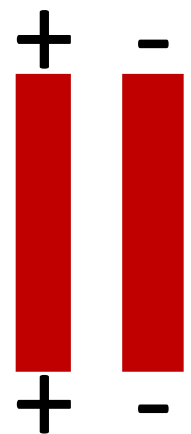
### Supplies:

- 1 pencil (a graphite art pencil is best, but any No. 2 pencil will also do)
- Paper
- Tape
- Mini LED Light Bulb
- 9V Battery



### Instructions:

- Plan your graphite circuit design on a piece of paper. You can use the red lines here as practice! Be sure to create a shape outline with TWO openings at each end. This is going to be crucial in making our graphite circuit.
- **Create a THICK line of graphite over your shape. Scribble LOTS of pencil to create a thick layer until you can't see any red!** Add a positive and negative symbol to the two open areas as guides (we've done this for you on this example).
- Tape the wires of your LED bulb to the graphite opening **aligning the long wire with the positive side of the opening and the shorter wire with the negative side of the opening.** Tape the bulb in an upright position. This is where those + and - symbols we drew earlier come in handy!
- Place your 9V battery on the opposite end over the positive and negative sides of the graphite. The light bulb should light up! We have completed our graphite circuit and created an electrical current! If it doesn't work the first time, add MORE graphite from your pencil!



### How Does It Work?

Electricity has the ability to flow from one place to another along a path. A circuit is a closed path from one place to another like a loop. The graphite from your pencil acts as a semiconductor and creates a path for the electrical energy. When the battery is placed on the graphite, energy flows from the battery, along the graphite path, through the wires of the bulb, continuing back to the battery completing the circuit. IF the battery is removed, the circuit is broken. This is also true if you remove the light bulb. We used the light bulb to show us the electricity that is flowing along the path.

## Energy, Energy, Everywhere!

Energy exists in many different forms. In fact, the First Law of Thermodynamics states that energy CANNOT be created or destroyed but CAN change forms. In our experiment, we started with chemical energy stored in the battery which was converted to electrical energy along our graphite pencil "wires" which was then converted to light energy by the LED light bulb. Some energy is also given off through this experiment in the form of heat.

### You be the scientist!



**How does the thickness of the graphite path you create effect the brightness of the bulb?** To set this up, you will need two 9V batteries and two LED bulbs that are the same color. Make two pairs of lines that are the same length. Make one pair of lines really thick, and the other pair of lines thin. Which bulb is brighter? See picture below for an example.

**How does the length of the graphite path effect the brightness of the bulb?** To set this up, you will need two 9V batteries and two LED bulbs that are the same color. Make two pairs of lines that are the same thickness. Make one pair of lines about 1" long. Make the other pair of lines 4" long. Which bulb is brighter?

Can you figure out how to hook up multiple lights in series to make a festive Holiday card? Try these examples!!!



Hint: If you would like your light to be brighter, make the lines THICKER by adding more graphite! Be creative! What designs can you create?

**We want to hear from you!** Are you enjoying your TCI STEM@Home kits? Please let us know! Remember to share your photos on social media and tag @FAUCanelInstitute on Facebook or Twitter. Feel free to email us at [aphipps@fau.edu](mailto:aphipps@fau.edu).

# HAPPY HOLIDAYS!!!