



OVERVIEW

Creating paper circuits is a great way to learn about electrical circuits! A paper circuit is a low-voltage electronic circuit that uses copper tape, a 3V coin battery, a few LEDs, and paper. You can create simple or complex circuits to liven up your artwork.

GRADES: 4-12

STANDARDS: NGSS 4-PS3-2

MATERIALS: Copper tape, LEDs, 3V coin battery, scissors, clear tape, paperclip, craft supplies

TERMS: *Circuit* in electronics is a complete, continuous path where electrons can flow.

Voltage is an electrical force that moves electrons.

Conductivity is the ability of a material to allow electricity to flow.

For more terms related to electronics, checkout *E is for Electronics!* By Adafruit Industries here: https://adafruit-coloringbook.s3.amazonaws.com/coloringbook_9-17-2012.pdf



DO

1. Print out the following template: <https://www.makerspaces.com/wp-content/uploads/2016/08/paper-circuit-printable-template.pdf>
2. Using copper tape, lay the tape down following the brown path.
3. Locate where the LED needs to be placed. It will look like a tiny light bulb. Take the LED and bend both legs at a 90-degree angle. Place the legs on top of the copper and secure with clear tape. Make sure the long leg is on the positive (+) side of the copper path.
4. Locate where the coin cell battery will be placed. It will look like a circle with a minus sign. Place the coin battery with the negative (-) side down.
5. Fold the corner of the template so that the copper tape's positive side will meet the battery.
6. Secure the fold and battery with the paperclip. Did you see the LED light up?



REFLECT AND APPLY

1. Observe the paper circuit we just created. How do you think it works? Draw the circuit and explain it using the terms circuit, voltage, and conductivity stated above, or some of the terms from *E is for Electronics*.
2. If the LED didn't light up, why do you think that is? Write down your observations.



- a. Troubleshoot (or tinker) with your circuit to get it to work. Use your knowledge of how circuits work to get the LED to light up.
3. Ready for more complex circuits? Create your own design or checkout these templates below:
 - a. Chat Bubble: <https://iastate.box.com/s/5tfmrut5fv911z9tibg0srgagnwbwn5s>
 - b. Van: <https://iastate.box.com/s/52zyxfpbrnraxpurg52b0bqkti4iurt>

MAKER CHALLENGE

Understanding how circuits work is a great way to lighten up your artwork. How can you integrate what we've learned into projects? You can do something as simple as making holiday cards, using new materials such as conductive paint, or move on to other electrical components like switches. Once completed, email a photo of your work to inventstem@iastate.edu with an adult's permission.

CAREER CONNECTIONS

Electrical engineers work with electricity in its many forms—from the electrons to the large-scale magnetic fields. In addition to designing new products, they construct, operate, and maintain a wide variety of electrical systems and equipment. Some specialize in electronics, others in even more specific areas, like space communications or industrial robotics.

To learn more about specific careers, go to <https://www.engineergirl.org/6071/Electrical-Engineer>

LEARNING EXTENSIONS

Want to learn more about paper circuits? Check out the following links:

- <https://www.makerspaces.com/wp-content/uploads/2017/10/Paper-Circuits-For-Makerspaces-Ebook.pdf>
- <https://www.exploratorium.edu/tinkering/projects/paper-circuits>
- <https://learn.sparkfun.com/tutorials/the-great-big-guide-to-paper-circuits/all>

This activity is adapted with permission from a workshop presented and created by the Electrical, Computer, and Software Engineers as Leaders (ECSEL) program at Iowa State University created for Iowa State University's Women in Science and Engineering (WiSE) Go Further Conference.



We welcome your feedback! Please use this QR code or link to contact us. <https://form.jotform.com/isu4h/ResourceFeedback>

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