

Paper Circuits- Electrical Engineering Lesson Plan

Objective

Students will design and build a functional paper circuit using conductive materials, a power source and LEDs. They will demonstrate their understanding of how electricity flows through a closed circuit.

Learning Outcomes

Students will learn:

- Introduce basic concepts of electricity: voltage and conductivity
- Encourage creativity- integrating circuits into art, cards, interactive designs
- Open vs. Closed Circuits- a complete path is needed for electricity to flow and that conductive materials (copper tape) allow current to pass.
- Short circuits- if students find that their LED is not lighting up they will realize they have a short circuit. Students will explore what happens when connections are made incorrectly, leading to overheating or draining the battery.

Essential Questions

- What is a short circuit and how can you avoid it?
- How do you close the circuit?
- When multiple LED's are next to each other it is called what? *Parallel Circuit*
- Why does copper tape work well for paper circuits?
- How can you design your paper circuit to light multiple LED's?
- What is a series circuit?
- If your LED does not light up, why is that the case?

Time Required (Itemized)

- Introduction- 5-7 minutes
- Activity- 30 minutes (this is a rough approximate time span. Younger students will require more time due to assistance being needed versus older kids)

Scaling the Activity

Our example is a great beginner paper circuit for students to do, if making the activity more rigor you can do the following:

1. Parallel copper strips and have the LED light prongs separate and tape the a side each to the copper tape. This action can be continued to make a design such as a rainbow, christmas tree, etc.
2. Flowers or bouquet by having the copper tape go to the center of the flower.
3. For more advanced students they can create a three-dimensional folded structure such as a birthday cake, where the candles are the LED lights.

4. Electric Play-dough circuit. Make the playdough into shapes desired and have wires go through each shape to light up the LED. Same idea but it is using play-dough as the copper tape.

Materials

- Copper Tape (typically 5-6 strips)
- Battery (1)
- LED light (1)
- Paper and a design that is of interest to you and/or the class. Engineering focused websites has many designs that include printable designs for teachers.



This is our example of the Paper Circuit Design. When creating your own design, please make sure that where the LED is placed is aligned with the image you want. This is a great design for younger students or beginners. If you would like to have more advanced designs, create parallel strips, series or three-dimensional designs.

Lesson Description

U of U Circuits Instructions: The example

1. You need 1 LED light, copper tape and 1 battery
2. On the diagram, place copper tape along all the lines on the (-) negative side. Make sure it overlaps the copper tape. **See image 1**
3. Place the battery negative side down where shown. Make sure it overlaps the copper tape.
4. Add copper tape to the (+) positive side of the battery. Make sure to continue tape to cover the battery. **See Image 2 for assistance**
5. Insert LED through the FRONT of the card with the longer wire (+) to the left. On the side of the card, bend wires so the bulb is flat to the paper and the wires lay on top of the copper tape.
6. Add copper tape on top of the wires to secure.
7. Close the card and press the battery. If your LED lights up, you are creating a closed circuit that allows electricity to pass from the battery to the LED.

Notes from the Price College of Engineering

Safety notes:

Adult supervision is recommended for all electricity-related projects. There are choking hazards, please be mindful of the age group you are doing this activity with.

Here are some tips that might be useful.

1. Keep copper tape paths continuous and smooth, overlaps helps maintain conductivity
2. If the LED does not light up check polarity. Positive lead to positive battery side
3. For complex designs try series (one after another) or parallel (side by side) circuits
4. Put the copper tape over the battery so the battery does not get lost and is attached to the paper. This will make it easier to get the LED to light up.
5. Check the LED and battery are working.
6. Reverse battery if needed.
7. Make sure (+) and (-) copper tape strips are not touching

Image 1

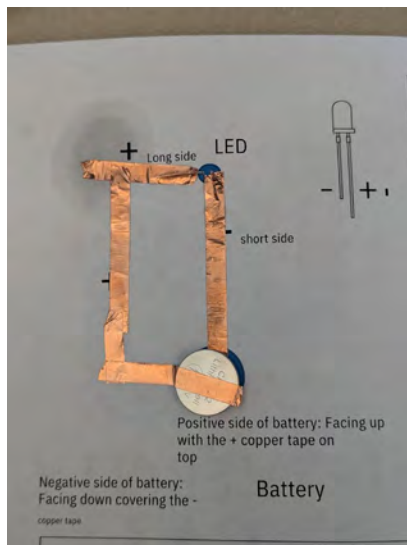


Image 2

