

Copper Tape Circuits

Lesson Plan for Grade 8 & 9

OVERVIEW & PURPOSE

Students will learn the basics of electronic circuits and bring life to a 2d robot via copper tape and LEDs.

OBJECTIVES

- Teach students the basics of electronic circuits.
- Create a copper tape based light-up drawing.
- Provide interested students with resources to further explore electronic circuits.

MATERIALS NEEDED

- 2 printed pages
 - One page provides a circuit template
 - One page is a drawing that sits on top of the circuit
- 2 LEDs
 - \$12.99 for 450, 5 colors.
 - https://www.amazon.com/DiCUNO-450pcs-Colors-Emitting-Assorted/dp/B07BWF9P2F/ref=sr_1_1?dchild=1&keywords=small%2Bcircuit%2Bled&qid=1591041528&sr=8-1&th=1
- 1 3V Coin Cell Battery
 - \$5.99 for 10
 - https://www.amazon.com/LiCB-CR2032-Lithium-Battery-10-Pack/dp/B071D4DKTZ/ref=sr_1_1_sspa?dchild=1&keywords=coin+cell+battery&qid=1591041687&sr=8-1-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzVjM4OVk4QU80RlJBjMvuY3J5cHRlZElkPUEwNDg0Mjc3M0UwOFJSTUc0R0k5UyZlbmNyeXB0ZWZlZElkPUEwNzA0MjU3WjNSSVFWSTNFQjVajndpZGdldE5hbWU9c3BfYXRmJmFjdGlvbj1jbGlja1JlZGlyZW50JmRvTm90TG9nQ2xpY2s9dHJ1ZQ==
- 1 47ohm Resistor (Resistance changes if we use LEDs from the lab)
- Green, Blue, and White LEDs do not need resistors
 - \$6.49 for 100
 - https://www.amazon.com/EDGELEC-Resistor-Tolerance-Multiple-Resistance/dp/B07QDXV69F/ref=sr_1_1_sspa?crd=20KR5HIIZ9BLU&dchild=1&keywords=47+ohm+resistor&qid=1591042038&sprefix=47+ohm+%2Caps%2C226&sr=8-1-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEwNzA0MjU3WjNSSVFWSTNFQjVajndpZGdldE5hbWU9c3BfYXRmJmFjdGlvbj1jbGlja1JlZGlyZW50JmRvTm90TG9nQ2xpY2s9dHJ1ZQ==
- 1/4in. Conductive Adhesive Copper Tape
 - \$6.88 for 21.8 yards (65.4 ft)
 - Note: The exact quantity we would give students is currently unknown, but

it won't be a lot. 5-10 feet would likely suffice, though giving them more allows them to continue to explore this in the future. They probably only need a couple of feet to complete the activity, but I want to give them enough for them to make a mistake and still be able to follow along.

- https://www.amazon.com/Zehhe-Copper-Foil-Double-Sided-Conductive/dp/B01MR5DSCM/ref=sr_1_7?dchild=1&keywords=copper+tape&qid=1591042276&sr=8-7
- Tape (non-copper)
 - This is just for sealing the two pages together after the circuit is complete, no special properties are required. Even staples would do here. I think it's safe to assume students will have this on their own, but if we want to send some to be safe, whatever we have lying around is fine.
- Scissors
 - It's likely safe to assume students will have their own pair of scissors.
- Ruler
- Coloring sheets
 - [Copper Tape Circuits Cover Templates](#)

ACTIVITY

1. Guide the students through a slideshow explaining basic concepts.
 - a. Encourage questions from students whenever possible.
2. Demonstrate the project, following the directions found below.
 - a. Please note that the resistor should **only** be used when using the Red or Yellow LED. When using the Green, Blue, or White LED, fill the resistor space with a strip of copper tape instead.
3. Release the students to construct their own circuits using the provided template and materials.
 - a. Assist students when requested.
 - b. If a student wishes to draw their own drawing or modify the layout, they may do so. Be sure to verify their intended circuit is correct. The longer leg of the LED must connect to the positive side of the battery. The resistor can go anywhere. Ensure the positive and negative lines only connect through the LED.
4. Return to slideshow debrief, providing students with access to further materials if interested.

Alternatively, the teacher may combine steps #2 and #3, taking the students along step by step. Whether or not this approach is superior depends on the group of students. Simply asking the students which method they would prefer (show beforehand or guide step by step) is likely sufficient.

- CTS 2022 Slideshow:
https://docs.google.com/presentation/d/1gW_AJ4-FMG9aQZ-6ZFmpkT74t-WjH0eYk0iwkRrnWxM/edit?usp=sharing
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Directions

1. Place template sheet face up on table.
2. Lay copper tape along the designated strips in the template. Do not allow positive and negative sides to cross.
3. Place the LED in the designated location.
 - a. You will need to bend the legs to ensure contact with the tape.
 - b. Ensure the longer leg connects to the positive side, as shown by the +/- on the template.
4. Use two small pieces of copper to tape the LED legs into place on top of the original lines.
5. Repeat the same process with the resistor and other LED.
 - a. The resistor is only used with red, yellow, orange, and chartreuse LEDs. Continue copper tape through the resistor slot if using blue, green white, purple, UV, or warm white LEDs.
6. Place the battery in the designated location on the template, ensuring the negative side is face down (look for the - symbol on the battery).
7. Connect the positive (+) side of the battery to the positive (+) line, as indicated on the template. The copper tape will have to come off the page and on to the top of the battery.



- a.

This picture is not from this project, but indicates the proper way to connect the positive side.
8. Set the circuit page aside, and retrieve your scissors and the other printed page.
9. Cut out the designated battery slot and eye holes, as shown by dashed lines.
 - a. You will need to fold the paper in order to get to the lines. If you cannot reach the eye lines, you may leave them in.
10. Place the cut page on top of the circuit page, lining up the holes. If you were unable to cut the eye holes, use the LEDs to puncture the paper.
11. Tape the edges of the two pages together.
12. Flip the battery up and down to toggle the light, completing the project.

REFLECTION

- *Dylan Nguyen, CTS 2022*
 - This lesson was used as a mini-lesson with a 30 minute time slot. Some major challenges with the lesson were that the circuits would take a lot of tweaking in order to work, and that there was not enough time.
 - **Recommendations:**
 - Have campers make their circuit FIRST. This gets the hardest part of the lesson out of the way and ensures that the campers will have something that works.
 - Have a few coloring sheets or templates for campers to use. This year I used coloring sheets that we already had on hand, but I'd

recommend making a dedicated template printed on a high quality material like card stock.

- ***Lauren Gault, Full STEAM Ahead 2022***

- This lesson was one of four lessons not specifically mini or main with a 35 minute time slot. The biggest issue was group sizes being very large in combination with there not being enough people to help all the students

- **Recommendations**

- Print far more coloring sheets than you think you need, the kids may like one more than another and you don't want to run out
- Have 2 teachers and 2 general helpers there
- Would work much better in a main lesson slot, we went overtime and only got to coloring once
- Make the steps in the slideshow much more individualized and separated so they are more clear