

PAPER CIRCUITS

Goal / Making Mission: Use everyday materials to promote a basic understanding of circuits and then encourage students to complexify their thinking by using iterative design to create different types of circuits

Scientific Significance

Understand electricity principles, learn about conductivity, and explore different types of circuits and switches.

Key Terms

LEDs: light-emitting diode, a semiconductor device that emits visible light when an electric current passes through it.

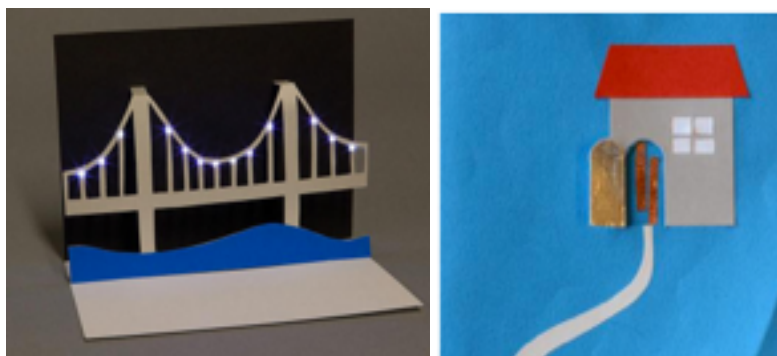
Circuit: uninterrupted path made from conductive elements that lets electricity flow between positive and negative sides of a power source

Copper tape: our conductive material

Conductor: material that allows electricity to pass through it

Parallel circuit: a circuit with two or more paths for electrical current to flow through

Series circuit: a closed circuit in which the electrical current follows one path

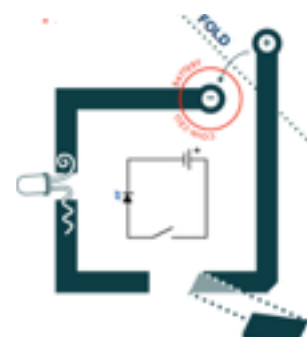


What are Paper Circuits?

Paper circuits use simple (or complex) electrical circuits on a piece of paper using copper tape and LEDs to light up a greeting card, origami animals, or a 3-D pop-up paper sculpture.

Directions:

- 1) Share any examples with students while explaining the activity.
- 2) Ask students to sketch their design for the simple *circuit* schematic and placement of the components of their circuit on their cardstock using a pencil. (Remind the students that they should draw the design of the card, and then on the back draw the design of the circuits. Where will the LED go on the front? How will that translate to the circuit on the back?)
- 3) During the sketch, have the students fold over one corner of the paper and trace the coin battery on either side of the fold as seen in the photo. (Remind the students that the



Supplies

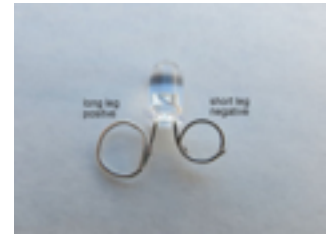
- ◆ LEDs
- ◆ Copper Tape
- ◆ Coin-cell batteries
- ◆ Tape
- ◆ Glue
- ◆ Scissors
- ◆ Cardstock
- ◆ Pencils and Markers

Facilitator Tips

- ◆ Could you make a battery holder somewhere else on the paper besides the corner? Or a switch that turns your lights on and off when pushed?
- ◆ Show different examples and explain how components work together but in different ways depending on the example
- ◆ Encourage students to make several basic designs before moving on to more complicated designs

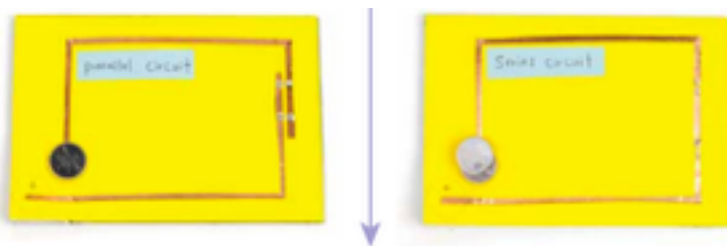
coin battery needs to be touching the copper tape on the paper, and on the other side of the fold to be conductive.)

4) Show the students how to curl the ends of the LEDs using needle nose pliers so they can be connected to the *copper tape* (make sure to mark which is the positive and negative side).



5) Have the students test the LEDs with the copper tape by placing some copper tape in the corner fold of the paper with the LEDs at the end, then placing the battery on top of the copper tape. (If the light doesn't turn on, try flipping the battery or pushing on the light. Remind students that this isn't the final design, but testing the conductivity of the tape).

6) Following their design, use the copper tape to follow the circuit path, using scotch tape to tape down the LEDs.



7) If the students are making a card with more than one LED, explain *parallel circuits* as creating two copper tape paths that are very close together but don't touch and the LEDs will be the bridge between the two paths.

8) After the copper tape and other components have been secured, the students can begin decorating their paper.

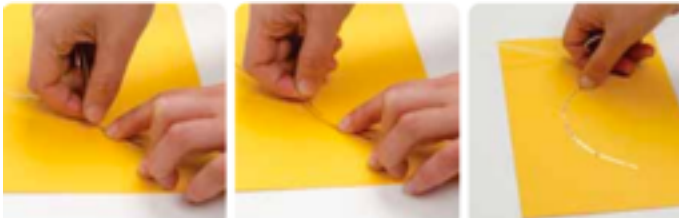
Troubleshooting Tips:

- Binder clips are a great tool for holding the battery in place to keep the light turned on when displaying your circuit.
- Make sure your LEDs are all oriented in the same direction, with all the positive leads touching the positive path, and vice versa. (TIP: Many times if a light isn't working, it's oriented backwards.)

- To make sharp corners, fold the copper tape back on itself, making a sharp crease, then turn the tape the direction you would like it to go and flatten it down.



- To make a curve with the copper tape, guide the tape along with curve you'd like to make. With the other hand, push down the tape to secure it to the paper. You might notice tiny puckers in the tape; you can smooth those out with a popsicle stick.



References:

http://tinkering.exploratorium.edu/sites/default/files/Instructions/paper_circuits.pdf