

## PAPER CIRCUITS

Duration: 25-45 Minutes

Institution: COSI

Skill level/Age Level: 3<sup>rd</sup>-5<sup>th</sup> Grade

Group size: Varies based on materials and facilitators

## INTRODUCTION

Using self-adhesive tape made from conductive copper, create a working light circuit on plain paper, or incorporate electronic elements into art, games, or paper crafts.

## KEY CONCEPTS AND/OR SUBJECT AREA

Electricity flows when a circuit is closed, meaning the electrons have a closed path in which to flow. Some surprising materials may be conductive.

## MATERIALS AND TOOLS

*Essential Materials:*

- 3V Batteries (Holders optional)
- Binder clips (if no battery holders are available)
- Clear Tape
- Copper Tape
- LEDs (Light Emitting Diodes)
- Piezo Buzzers
- Pager Motors
- Paper (can be heavier stock for more stability)

## SET UP



- Lay out circuit on paper with pen(cil) first.
- Special folds are required to make sure the copper tape maintains conductivity over right angle bends and when creating a “T”. To make the circuit as reliable as possible, try to minimize these types of junctions.
- Clear type helps hold components in contact with the conductive copper tape, and can also act as an insulator to prevent shorts. White glue can be used as well,

but is messier and easier to get in between components and the tape, thus breaking the circuit.

### HOW TO OR STEP-BY-STEP

#### *Simplest Circuit:*

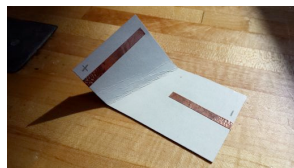
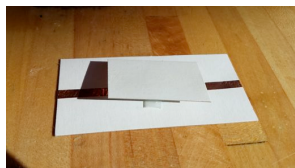
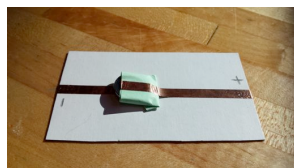
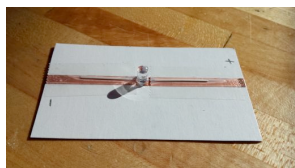
The simplest circuit to build consists of an LED, battery, and copper tape. When building paper circuits, the possibilities are endless. There are countless geometries and possibilities. See what you can do, and have fun. To build this circuit:

1. Lay out a simple square design on paper with a break in the square for the battery holder and another for the LED.
2. Next firmly tape down the battery holder with each lead touching one side of the gap in the copper tape.
3. Do the same with the lead from the LED
  - a. Be sure that the short lead of the LED is connected to the negative terminal of the battery.

### FACILITATION QUESTIONS

- What is a circuit?
- How could you add a “switch” to your circuit?
- Can you figure out how we created the existing circuits? (We had premade flashlights and other circuit designs that some participants wanted to reverse-engineer)

### DESIGN CYCLE



For the purposes of a design based learning activity, we have found that starting with a few basic circuit components (i.e. battery connection, LED, and basic switch) premade on modular cards works well to explain the process of building those elements without impeding the creative process. These modular components can be connected with alligator clips test leads to show different configurations and challenges. We have also experimented with presenting some basic circuit design (like a paper flashlight) and asking participants to creatively

improve on it. In general, it seems like the latter approach caused participants to struggle, and many simply copied the presented design and left with a working paper circuit. Presenting individual elements and then challenging the participant to arrange those elements and perhaps invent new ones for their own design seemed to result in a more creative experience, with the facilitator helping and guiding, rather than the reproduction of an already developed circuit.

#### **MATERIALS SOURCES**

Copper (conductive) tape can be found through various sources and in various lengths/dimensions. A Google search for “copper tape” or “conductive tape” is helpful.

#### **KEYWORDS**

- Conductivity
- Circuit