

Light-Up Paper Circuits

Adapted from the book *Paper Inventions* (Maker Media, 2015)
by Kathy Ceceri

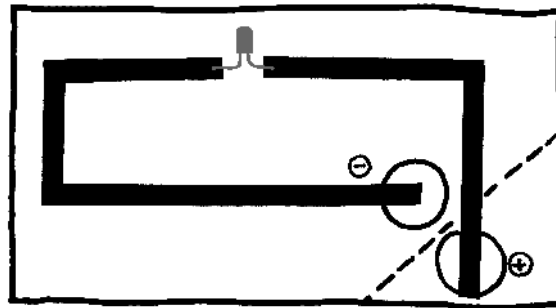
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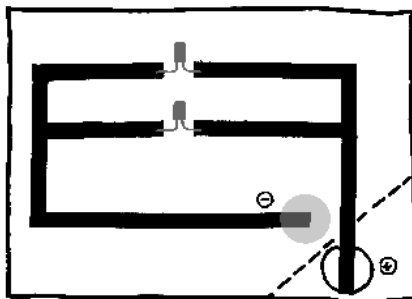
How Light-Up Paper Circuits Work

A circuit is a path of conductive material that allows electrical charge to flow. By creating a circuit, you can direct the electricity to the components you want to run. To make a circuit, you need four things:

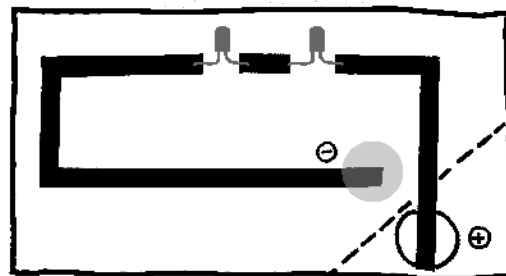
A power source: A 3-volt coin battery (CR2032) will light up most LEDs, or several LEDs if they are connected in parallel, not series. You can also use two AA or AAA batteries in a battery holder. You may use a 9V battery with a poor conductor like pencil lines by touching it BRIEFLY to the circuit.



Simple Circuit



Parallel Circuit



Series Circuit

Conductive material: Conductive materials let electrical charge move. They include metal, salt water, and your skin! For paper circuits, you can use:

- peel-and-stick copper tape (best has conductive glue on the back)
- aluminum foil
- peel-and-stick aluminum tape (like duct tape, but metallic; can be cut into thin strips; use kind with white paper, not brown)
- electrical wire
- graphite (like the lead in pencils)
- conductive ink (like Circuit Scribe)
- conductive paint (like Bare Conductive)
- mirrored window film (like Mylar)
- metallic paper

A load: The part of the circuit that does work is called the load. For paper projects, these are usually low-power components like lights, small motors, or speakers. You can also use Shape Memory Alloy (SMA) wire to make paper projects that move.

Insulating material: A circuit without a load is called a short circuit. It can cause the power source to overheat quickly. Avoid short circuits by always including a load and using insulation to keep two conductors from touching where needed. Paper and tape are useful insulators for our circuits.

Circuit Building Tips:

- Make sure positive end (+) of your LED is connected to the positive end of your power source.
- A circuit needs to be connected in a closed loop to work. Use this to create an on/off switch and even special effects like blinking lights.
- Wherever you want electrical current to flow, make sure that metal (or other conductive material) is touching metal.
- Don't forget to leave a gap in the circuit for your LED and your battery. You want the electricity to flow *through* them, so don't give it a detour around them!
- Avoid accidental breaks in your circuit by bending your conductive tape instead of cutting it whenever possible.
- How to make a corner: Carefully peel back the paper protecting the glue as you press the tape over the black lines. Stop when you reach a corner. Gently bend the tape backwards at an angle, opposite the direction you want it to go (glue side up). Then fold the tape over as you go forwards and continue along the circuit path.
- If you DO have to attach two separate pieces of conductive tape, fold under a tiny bit at the end of one piece and stick it over the other piece. This helps keep metal touching metal. (Some kinds of glue are conductive, so you can test whether this is necessary.)

Where to Get Materials:

- adafruit.com
- makershed.com
- sparkfun.com
- jameco.com
- cheap-batteries.com
- Radio Shack stores?
- hardware stores (like Home Depot)
- art supply stores (AC Moore, Michael's, JoAnn Fabrics, WalMart, bead stores)
- Amazon and ebay