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## Light-Up Card

Make a small piece of art or a greeting card with a design that lights up, using paper circuits made with conductive fabric tape and LED stickers.



## Ingredients (Included):

- 2 pieces white cardstock
- 1 small square copy paper
- strip of conductive fabric tape
- 1 3v coin battery
- 3 LED stickers (Chibitronics)
- Mini binder clip
- Paper circuit templates

## You Supply:

- Crayons, markers, colored pencils, etc.
- Ruler
- Scissors
- White glue

## Templates:

The three templates from Chibitronics free educational materials are included as a guide to help you plan your own paper circuit while designing your own card. You can follow them exactly, or use them as a jumping off point. The templates included are for a simple circuit with one LED, a parallel circuit with three LEDs, and a paper switch template. **I used a variation of the paper switch template for my card example. Once you understand the basic principles, feel free to do something different!**

## Directions:

You have two pieces of card stock, folded in half. Take one and cut at the fold with scissors so we have two similarly sized pieces. Choose one to be the front of your card. This is the one you will draw on.

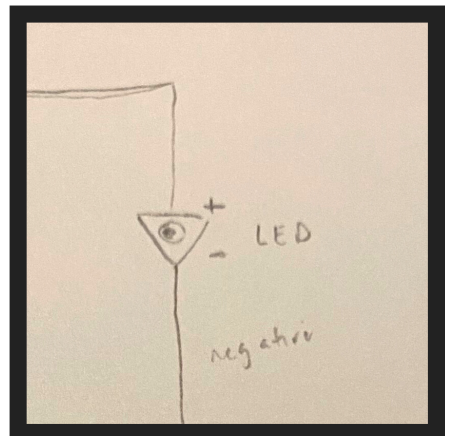
Trim the second piece evenly around the edges so that it is smaller than the other piece. This is the one you will build your circuit on. It will eventually be glued on as the back of card.



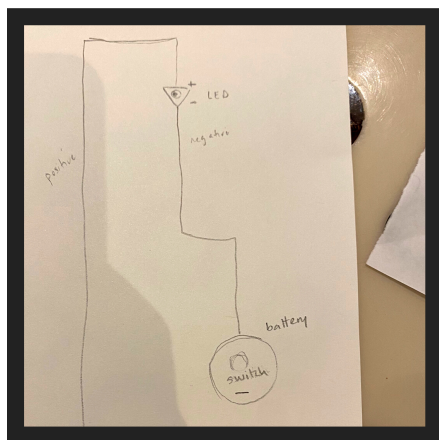
Start by coming up with a card design, drawing it, and deciding where it should light up. In my Narwhal example, I wanted the tip of the horn to light up.

Place the second piece of card stock behind your drawing, keeping it roughly in the center. Using a pencil, carefully poke a hole in the card for the LED light to shine through.

The pencil should leave a mark on the back piece, showing you where to place the LED. I drew a rough triangle around the dot to mimic the shape of the LED sticker and labeled the positive and negative side.

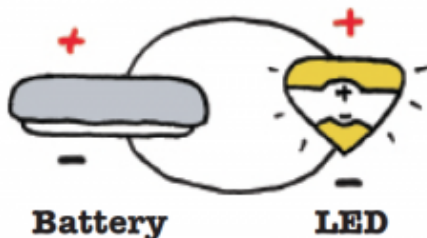


Next you want to plan out and draw your circuit on the back piece. Use a pencil and keep your lines light while you figure out the best layout for the conductive fabric tape, LED, and battery.



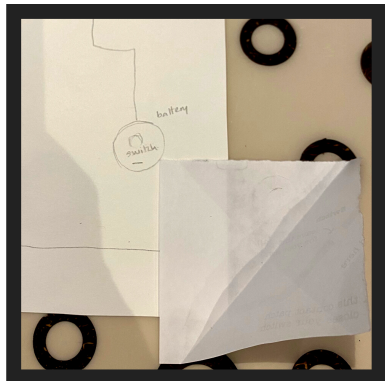
Use the templates as a guide, but don't get stuck on replicating them exactly.

**A Note About Circuits:** The battery has a plus (positive) and minus (negative) symbol on each side. The LED stickers also have positive and negative sides -- the wide part of the triangle is positive, and the pointy part is negative. To make an LED light up, you'll use the conductive fabric tape to connect the negative side of the battery to the negative side of the LED, and the positive side of the battery to the positive side of the LED.

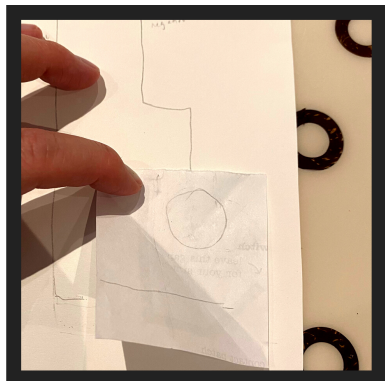




I wanted to make my card with a simple pressure switch, where I could press down on the card (I chose the tail as the location) to make the light go on. But I didn't want to have to fold over part of my card like in many of the examples.



I decided to use a small square of thin copy paper to act as my switch. If you want to follow along, trim the square to fit your design better if needed. Using a little white glue ONLY at the top corners, adhere the square of copy paper over the diagram, right where the battery would be. Make sure it will fold diagonally over the battery.

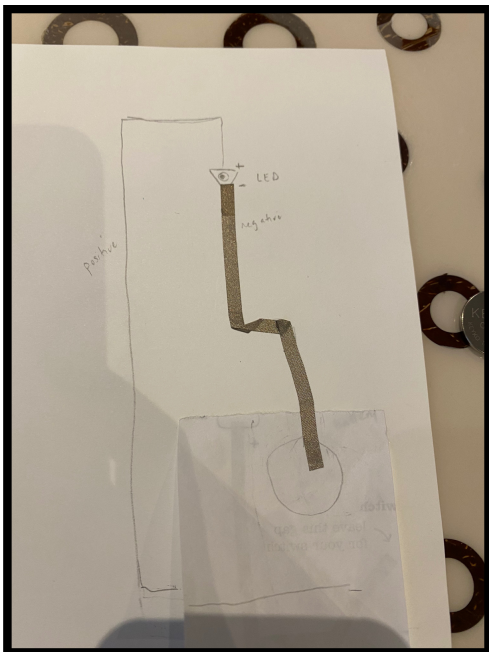
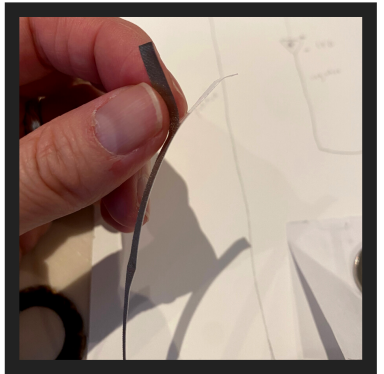


(Here's a sneak peak of what that will look like, since this can be tricky to explain.)



Next, tape down your conductive fabric tape over the lines you drew, carefully folding the tape to "turn" any corners. (The circuit works better if the tape is an unbroken line.)

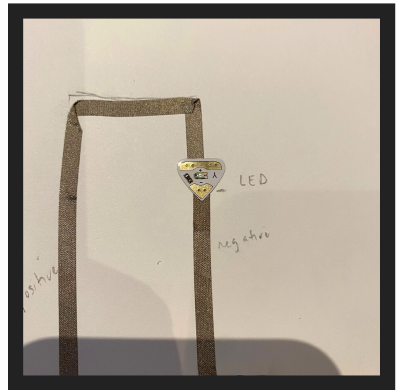
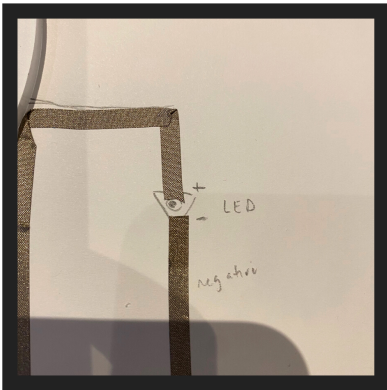
Leave space between the positive line and the negative line for the LED. The positive and negative lines should not touch each other.



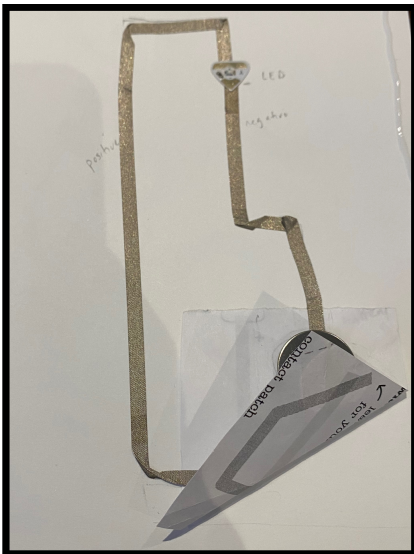
Turning the corners is hard, but do your best!

Here is a tutorial with pictures:  
<https://chibitronics.com/2014/05/10/copper-tape-tutorial/>

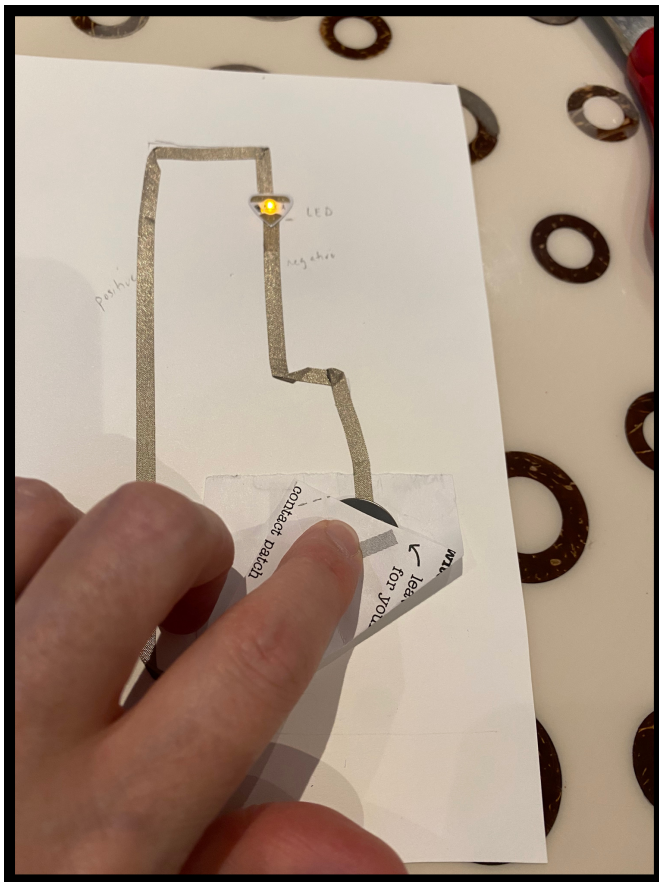
And here's a video:  
<https://youtu.be/ywtllvGvu6E>



Once you have the positive and negative lines covered with the conductive tape, place your LED in the space you left, making sure that the positive and negative sides are in the correct place and that the metal pads of the LED are touching the conductive tape. Place the battery negative side down.

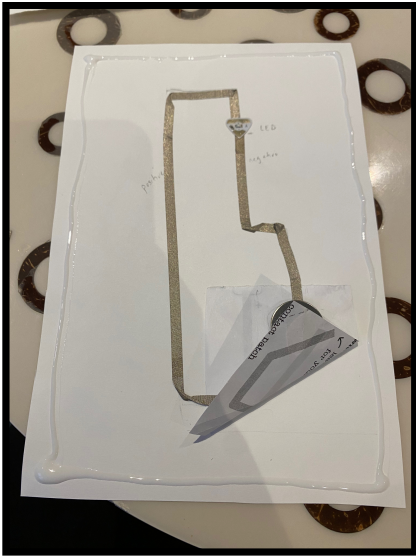


Here is the completed circuit. Notice that the conductive tape and battery continue on top of the copy paper we glued on. Then, when we fold over the paper, the positive line connects with the positive side of the battery and completes the circuit, lighting up the LED.



Like this!

To stop the battery from shifting around, use a small drop of white glue to hold it in place.



Next, the back of the card has to be adhered to the front piece with the picture, oriented so the light shines from the hole made earlier.

Using white glue, carefully attach the front and back piece together, leaving a gap where the switch is that isn't glued down. If you glue that section down, you may end up with a card that is lit up all the time.

You can also use double-sided foam tape (dimensional tape) in place of the white glue. It works great to keep the front card elevated enough for the pressure switch to work properly.





How did your card go? If you followed along, you should still have two LEDs and some conductive fabric tape left. All you need is another coin cell battery and some paper to keep experimenting!

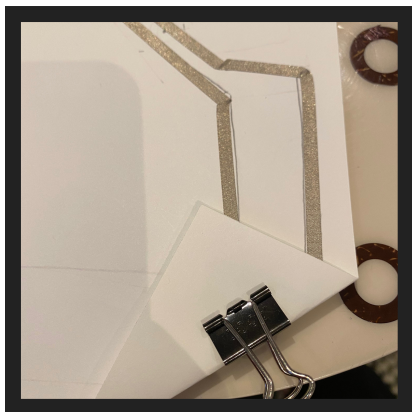
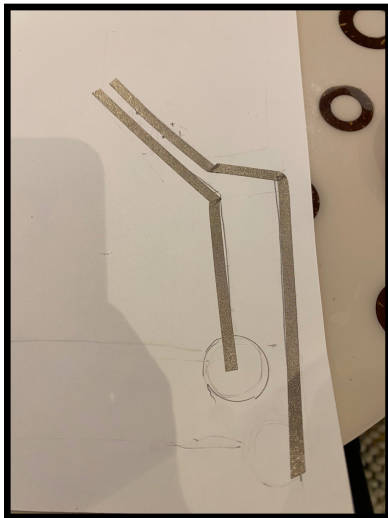
Here was my second sample, with a parallel circuit using two LEDs. I placed the LEDs so they would light up like stars in the unicorn's mane.





Here's a peak at the placement of the conductive fabric tape, the battery, and the LEDs.

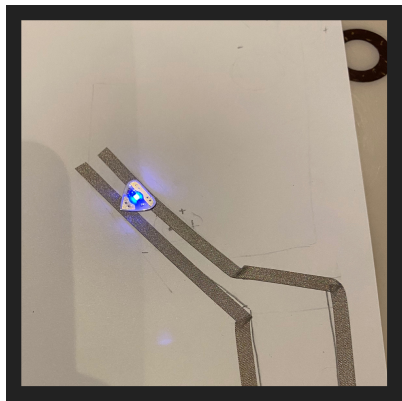
For this card, I made sure the battery was in the bottom corner so that I could fold it up over the battery with a binder clip.



With a parallel circuit, you don't need to leave space for the LEDs. You just position them so that they are oriented correctly, to the positive and negative lines of conductive tape.

I used the blue and red LED to start. Notice how one LED is lit and the other isn't?





The blue LED worked fine when not paired with the red LED. It turns out that different colored LEDs working in parallel do not always agree. The red LED has a lower operating voltage than the blue LED, meaning that when connected, the blue LED drops to a value that is too low to allow it to illuminate.

In a parallel circuit, all devices connected receive the same voltage, and it will always default to the lowest voltage required. Blue and white have the highest voltage, red the lowest. Yellow and green are only a little higher than red. I replaced the blue LED with yellow and it worked better, though occasionally the yellow one would go out.

Fascinating, right?

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