



No-Sew LED Wristband

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<https://learn.adafruit.com/Learn-Soft-Circuits-No-Sew-LED-Wristband>

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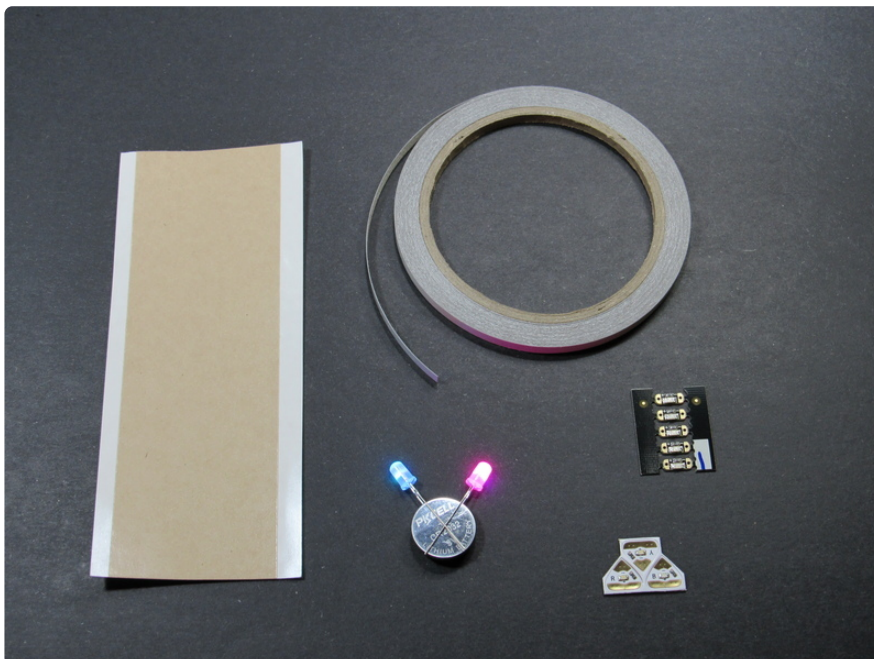
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Overview



The classic light-up LED felt wristband project is a great way for beginners to learn about switches. To turn it on, you connect the ends into a loop that closes the circuit. Traditionally, the fastener is a metal snap connected to the battery and LED with conductive thread. But learning to work with conductive thread can take time, even for those who already know how to sew.

Peel-and-stick conductive fabric tape to the rescue! This no-sew version is quick and kid-friendly. It's also inexpensive enough to do with an entire class, because the battery holder is part of the fabric closure.



Playing with LED Options

Since this project is so simple, you might want to try it with different types of LEDs for different effects. You can even add more than one light to the parallel circuit -- as long as they are all the same kind of LED. I have included directions for standard LEDs (the kind with two long wires, known as leads), Chibitronics Circuit Stickers, and Adafruit Sequins. Here are a few more things to keep in mind:

- If you want to use different color standard LEDs together, give them the "throwie" test first. (A throwie is the simplest kind of LED circuit -- just a light and a battery.) Take the LEDs and slide them over the edge of the coin battery. Make sure the positive lead (usually the longer one) for each LED is on the positive side of the battery (marked with a "+"). If they all light up, you're good. In some color combinations, a few LEDs may look a bit dimmer, but still work. With other combinations, one or more LEDs may not work at all. For the example here, I used flashing LEDs for extra pizzazz.
- Both the Adafruit LED Sequins and the Chibitronics Circuit Stickers have on-board resistors so you can use different colors together. However, you should still test them by placing them on the conductive tape before fastening them down "permanently." (It's not that hard to peel off the tape if needed.)
- Adafruit Sequins can be held onto the project with the peel-and-stick conductive tape, but for added security, use the optional Z-axis tape on the back of each one. (See directions for details.)

Suggested Parts List -- Electronics

For each wristband, you'll need some conductive fabric tape, a 3-volt coin battery like the CR2032, and one or more LEDs (all of the same variety). I also recommend Z-axis conductive tape for holding the battery on when the wristband is open and for attaching Adafruit LED Sequins.

1 x [Conductive Nylon Fabric Tape - 5mm Wide x 10 meters long](https://www.adafruit.com/product/3961) <https://www.adafruit.com/product/3961>

This Conductive Nylon tape doesn't crack when bent or twisted, so you can make all sorts of odd shapes and paths without worrying about broken traces. It comes with conductive glue on the opposite side, so you can tape it directly to capacitive pads. It's low resistance, only a few ohms per foot -- not quite as conductive as copper tape, but you can definitely power small components with it. You can't solder it, but you can sew it!

Inside these LEDs is a little chip programmed to cycle through every color at a fixed rate for a fun flashing effect.

1 x Diffused 5mm Fast Flashing RGB LED - 10 pack <https://www.adafruit.com/product/680>

Inside these LEDs is a little chip programmed to cycle through every color at a fixed rate for a fun flashing effect.

1 x Diffused 5mm Slow Fade Flashing RGB LED - 10 pack <https://www.adafruit.com/product/679>

Same as above, but the colors change more slowly! Inside these LEDs is a little chip programmed to cycle through every color at a fixed rate for a fun flashing effect.

1 x CR2032 Lithium Coin Cell Battery <https://www.adafruit.com/product/654>

This non-rechargeable coin cell is CR2032 sized: 20mm diameter, 3.2mm thick. It has a nominal voltage output of 3V (although it starts a little high at 3.2V and slowly drifts down to 2.5V as it is used. The capacity is 220mAh assuming a draw of constant .2mA.

1 x Adafruit LED Sequins - Multicolor Pack of 5 <https://www.adafruit.com/product/3377>

Sew a little sparkle into your wearable project with an Adafruit LED Sequin. They only show a single color and they don't have digital control, but that makes them easier to use. You get one each of the following colors, matched with a resistor: warm white, ruby red, royal blue, emerald green, and rose pink.

1 x Chibitronics Color LEDs Add-On Pack <https://www.adafruit.com/product/1976>

Circuit stickers are an imaginative and easy way to make fun electronics projects without coding, soldering, or experience. The stickers are super lightweight, thin, and flexible. They're perfect for educators, artists, and novices. This pack contains 10 Red, 10 Yellow, and 10 Blue LED stickers.

1 x 3M Z-Axis Conductive Tape <https://www.adafruit.com/product/1656>

Z-axis tape by 3M can bond two conductive surfaces together and allow a small (under 100mA) current to flow through the tape. But here's the cool part: it's only conductive across the thickness of the tape itself, not along the length or width! Each order comes with a strip of 2" x 6" tape, enough for several projects. Just cut out the size you need and save the rest.

Suggested Materials List -- Household and Crafts Supplies

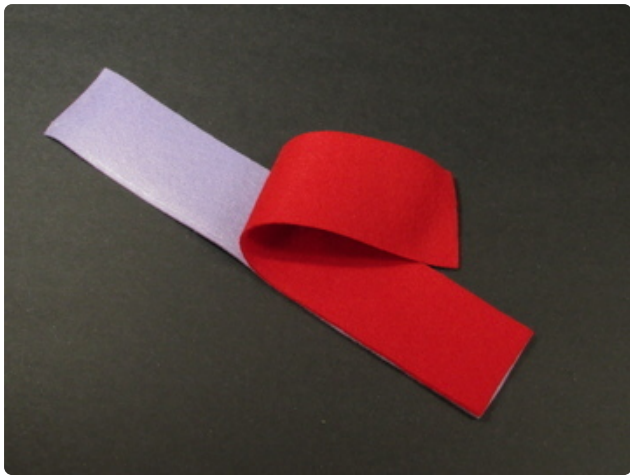
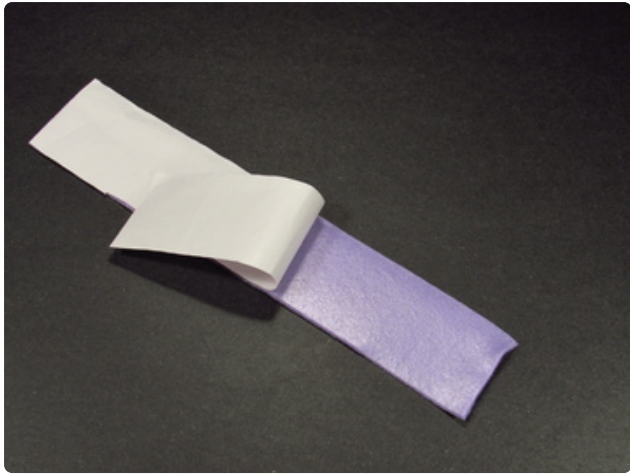
I used felt to make the wristband itself because it's easy to find, cheap, and doesn't fray. To make the wristband thick enough to stay closed, I doubled it with a layer of peel-and-stick felt. (See the directions for details.)

- strip of felt about 2 inches wide and long enough to fit loosely around your wrist, adding about 1.5 inch of overlap (generally between 6 and 10 inches long)
- strip of peel-and-stick felt the same size
- adhesive dots (non-conductive -- like the kind used in scrapbooking)
- electrical tape
- extra scraps of felt for decoration

Make the Felt Wristband



The felt is doubled (making two layers) by attaching another layer of felt, using peel-and-stick felt or iron-on adhesive.

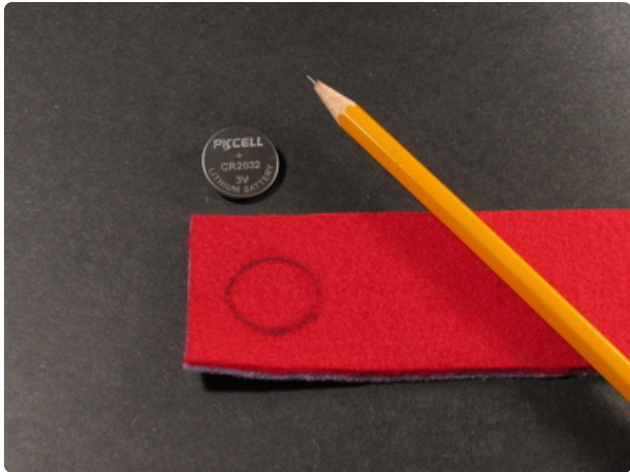


Double the felt by attaching another layer of felt, using peel-and-stick felt or iron-on adhesive.

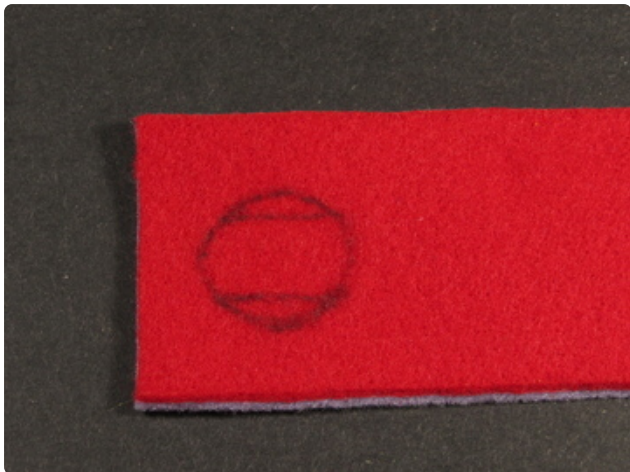


Make the Battery Holder

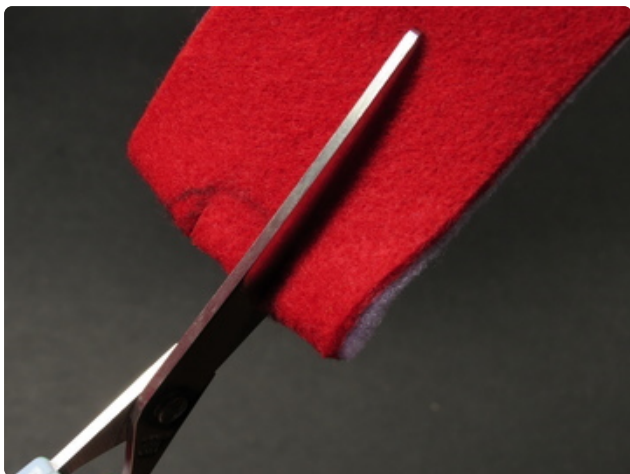
Slits in the felt will hold the battery in place.



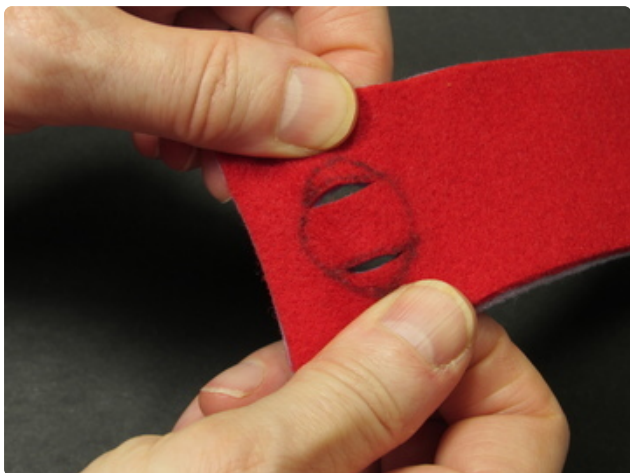
Position the battery about 0.5 inch from one end and trace around it.



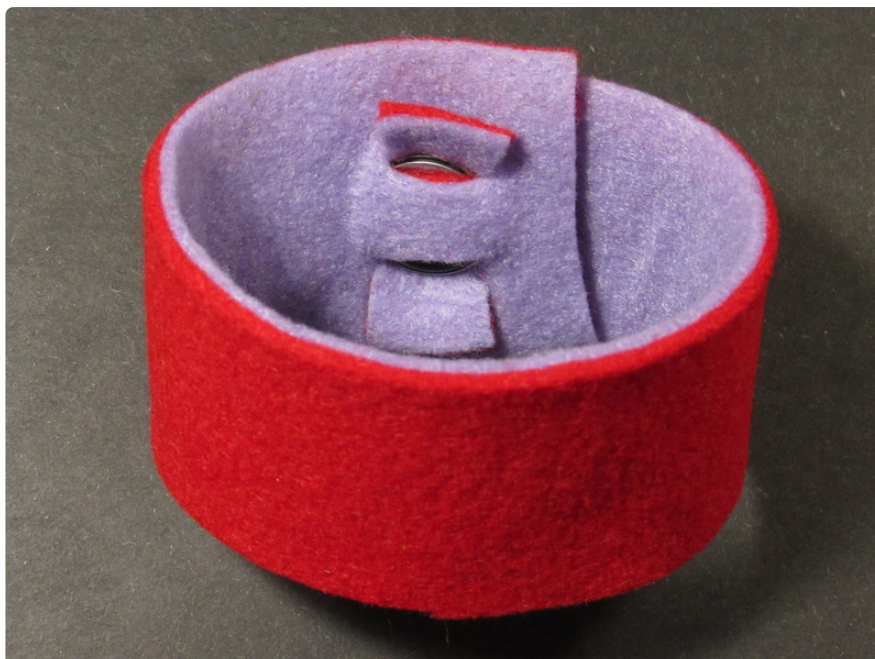
Draw lines across the top and bottom of the circle. You will cut along these lines to make slits to hold the battery.



To cut the lines, fold the end of the felt band down so the circle is folded in half. Carefully cut each line.



Insert the battery into the slits to make sure it fits. Adjust the slits if needed. Then remove the battery.

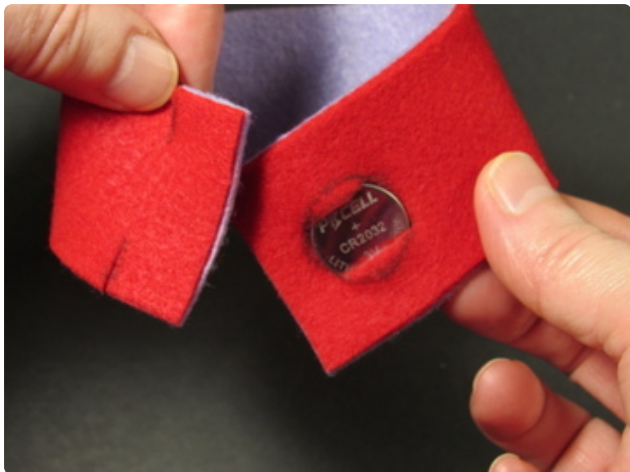


Cut Tabs to Close the Wristband

Two tabs fit into the slots over the battery to close the circuit and hold the ends of the wristband together.

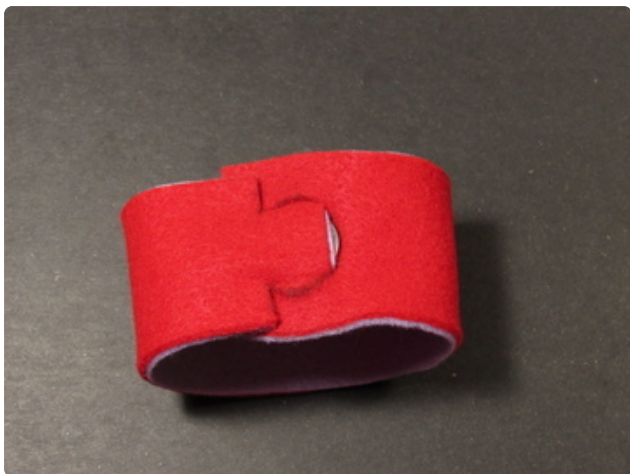


About 1/2 inch in from the other end of the wristband, draw a line about 1/2 inch long. Do the same on the other side.



You have just made tabs that fit into the slits that hold the battery.

Re-insert the battery into the slits. Curve the ends of the wristband together so the tabs overlap the slits. Slide each tab into the slit on the corresponding side -- right over the battery.



Pull the tabs tight. This is how you will close the wristband when it is done. For now, remove the battery again so you can add the circuit lines, known as traces.



Build the Soft Circuit



Some Quick LED and Circuit Basics

Time to build the circuit and add the LED(s)! Keep these things in mind as you go:

- A circuit is a path for electricity to travel along. The current will only flow when the circuit is closed, meaning the path goes all the way from the positive side of the battery (marked with a "+") to the negative side without a break. That's why the LED will only turn on when the wristband circuit is closed.
- Since you will insert the battery with the positive side facing up, the top piece of tape -- which wraps around to connect to the top of the battery -- is the positive trace.
- The bottom piece of tape -- which is touching the negative side of the battery -- is the negative trace.
- By running the positive and negative traces in parallel lines next to each other, you can create a parallel circuit. In a parallel circuit, every LED is connected directly to the battery. This allows you to run several LEDs off of one 3-volt battery.
- Like other kinds of components, LEDs have a positive and a negative side. In addition, LEDs have polarity, which means they only work when the positive side is connected to the positive side of the battery, and the negative side is connected to the negative side. Make sure you connect your LEDs in the right direction!

- Avoid creating a short circuit, an accidental connection between two parts of the circuit. Make sure the positive and negative traces cannot touch unless you close the circuit.

Never close the circuit with only a battery connected to it. If there is no LED, you will short-circuit the battery, causing it to heat up and burn out quickly. A hot battery can be a fire hazard!

To protect the battery from a short circuit, cover the ends with electrical tape as shown on the Add the Battery page.

Create the Traces with Tape



For the first trace, take a strip of conductive tape at least half as long as the felt band. Lay it out above the bottom slit so it goes across the spot where the battery fits and ends past the middle of the felt.

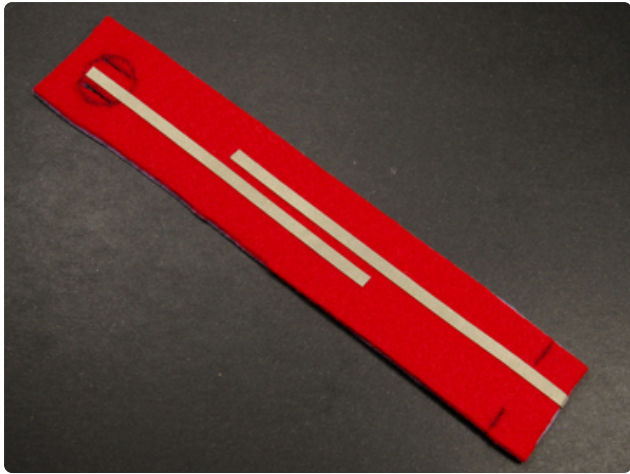


Tip: To attach the tape neatly, peel off just a little of the backing paper to start. Press the adhesive securely onto the felt. Then keep peeling the paper off slowly you press the rest of the tape onto the felt.



For the second trace, take another strip of conductive tape long enough to go from about the middle of the band to the other end and over onto the back for about 1 inch.

Be sure to leave a gap of about 1/4 inch between the two pieces of tape!



Connect the LEDs

Each type of LED gets attached a little differently, and some need a bit of advance prep. Here's how to connect each type to the circuit:

You can test your LEDs by inserting the battery and BRIEFLY touching the other end of the band to the top, just long enough to see if the LEDs light up.

Don't close the wristband for more than a second or two until you protect the battery as described on the Add the Battery page.



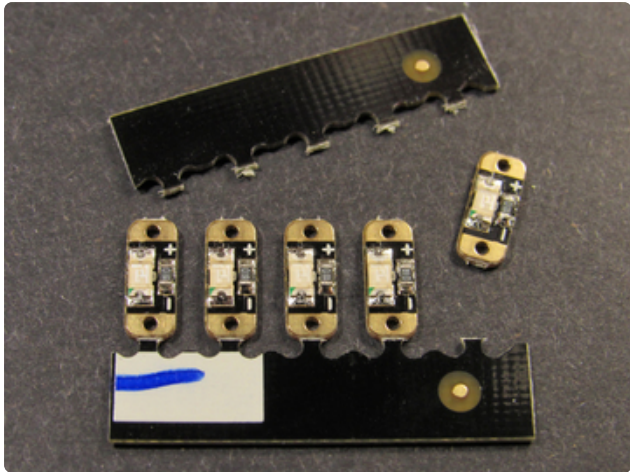
Circuit Stickers

If you look closely at the Circuit Stickers you will see that the rounded side is marked positive (+). The pointy end is negative.

The Circuit Stickers need no preparation. Just peel one of the stickers off the backing paper and press it firmly onto the traces.

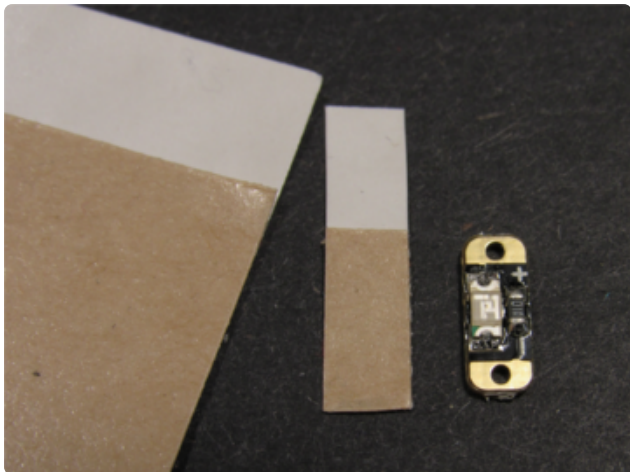


For extra security, you can add short strips of conductive fabric tape over the top and bottom of the Circuit Stickers.



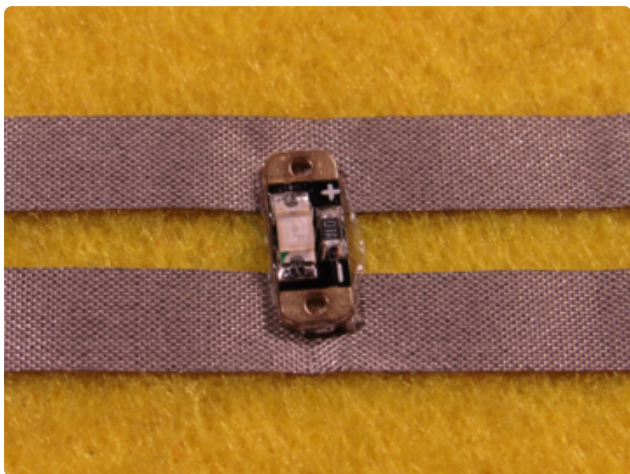
Adafruit LED Sequins

The positive and negative ends of the sequins are clearly marked (+ and -). The LEDs come attached to a board. Snap one off.



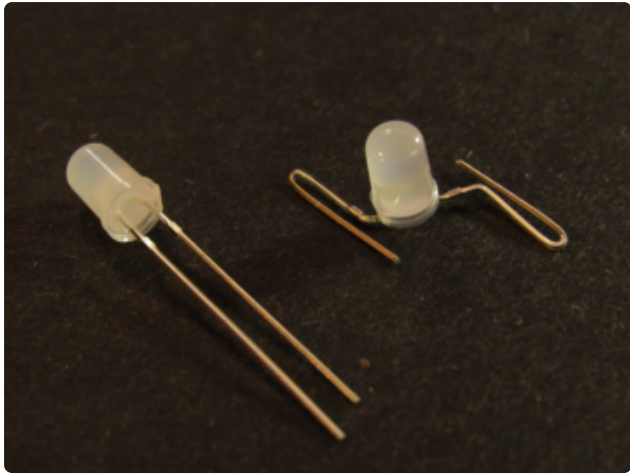
If you have Z-axis tape, cut a piece roughly the size of the sequin. Peel the paper off one side of the tape, and press the back of the sequin to the adhesive. Then peel the remaining paper off the back.

Press the sequin onto the traces so the positive end is connected to the top piece of conductive tape and the negative end is connected to the bottom trace.



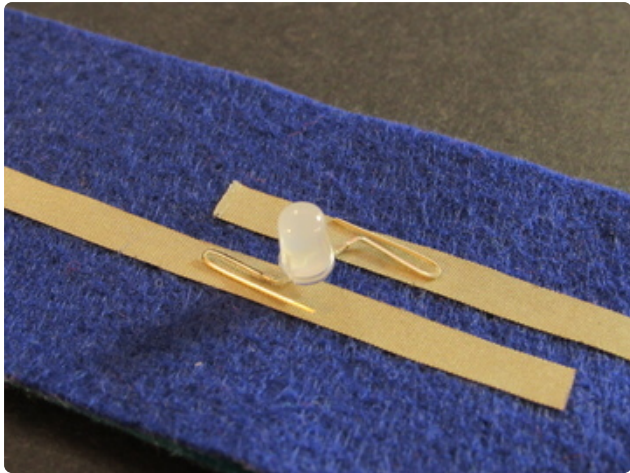
Just like the Circuit Stickers, you can also attach strips of conductive tape over the ends of the sequins to hold them in place.



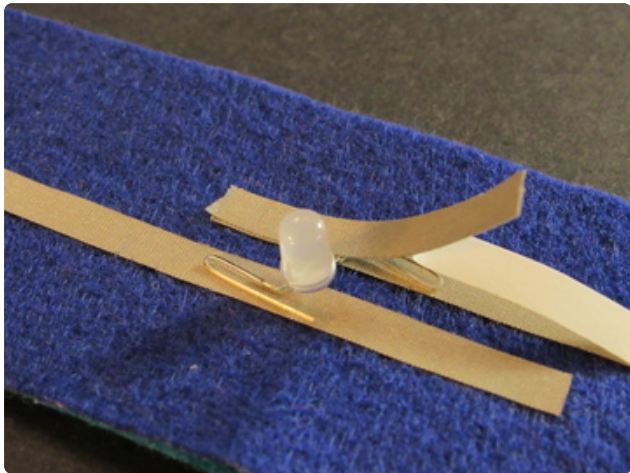


Standard LEDs

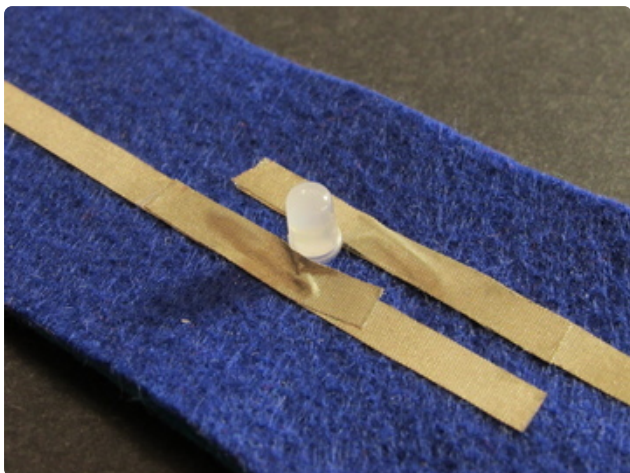
As you saw if you performed the throwie test, the longer wire on a standard LED is usually the positive lead. The side of the LED bulb near the negative lead also usually has a flat spot.



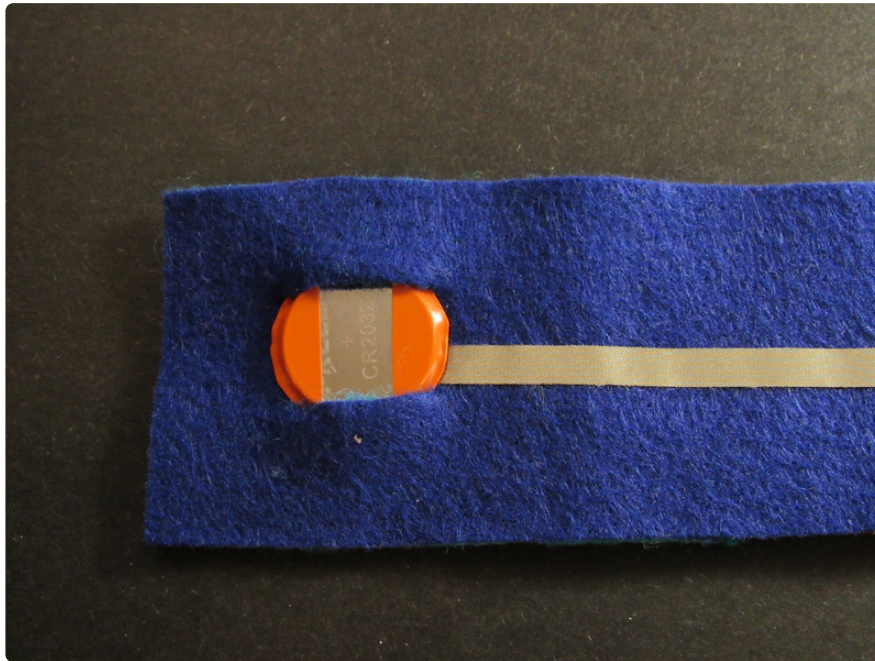
Bend the legs of the LED out to either side. (A pair of [needle nose pliers](http://adafru.it/146) (<http://adafru.it/146>) can help.) Then bend one lead facing front and one facing back. If they are very long, you can bend them in half again.



Place the LED so the positive lead is sitting on the positive trace and the negative lead is sitting on the negative trace. Attach each lead to the trace using additional pieces of conductive tape, pressing firmly.



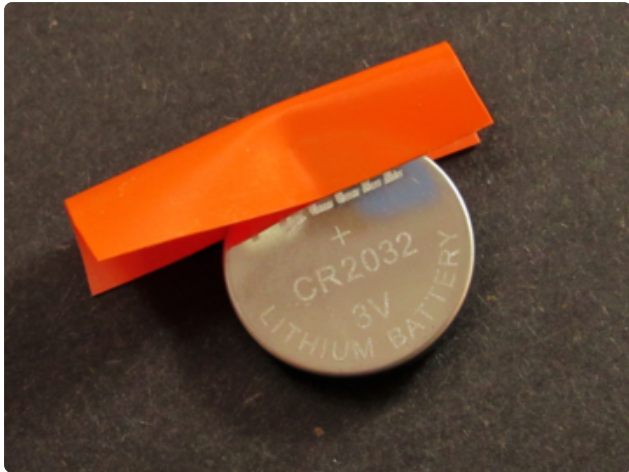
Add the Battery



With the LED(s) connected to your circuit, your wristband is almost finished! There are just a couple more steps to go:

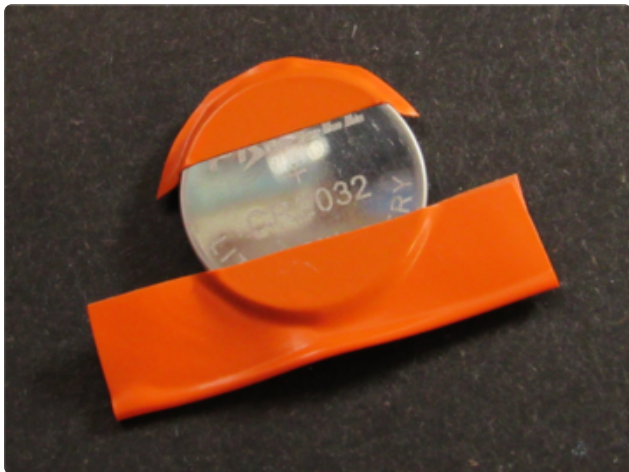
- protect the battery from an accidental short circuit
- make sure the battery makes a good connection with the leads.

As I discovered when creating this guide, the felt of the wristband is soft enough to sometimes allow the conductive fabric tape to bend around the battery enough for the positive and negative sides to connect -- causing a short circuit that can make the battery heat up, burn out, and possibly start a fire. Here's how to make sure that doesn't happen:



Protect the Battery

Cut a short strip of electrical tape and fold it over one end of the battery. Make sure it covers both the front and the back.

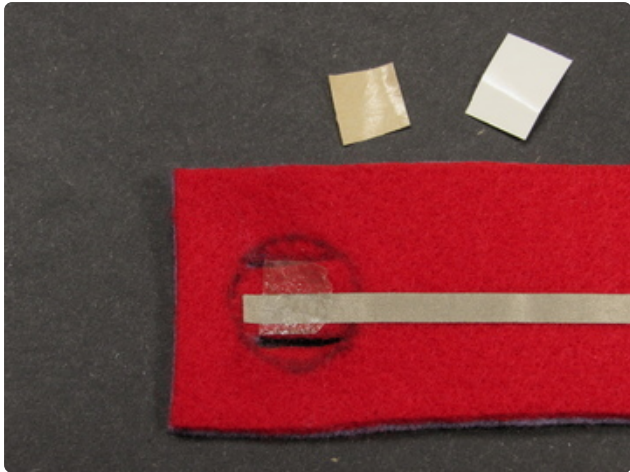


Pinch the excess tape tightly around the edge of the battery. Then trim the extra off. Repeat with the opposite end of the battery.



Make sure to leave the middle of the battery uncovered so it can touch the the conductive fabric tape traces.

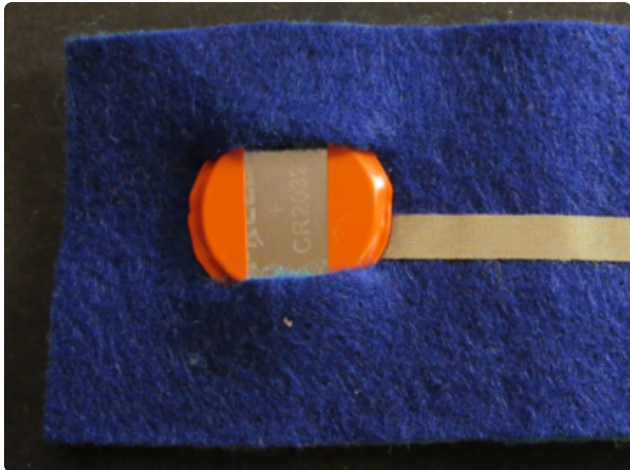
To make sure the battery makes good contact with the conductive fabric tape, and to keep the battery in place even when the wristband and the circuit are open, use a piece of the Z-axis tape.



Connect the Battery

Cut a piece of Z-axis tape to fit on the battery between the slits.

Peel the paper off one side and press it firmly onto the felt.



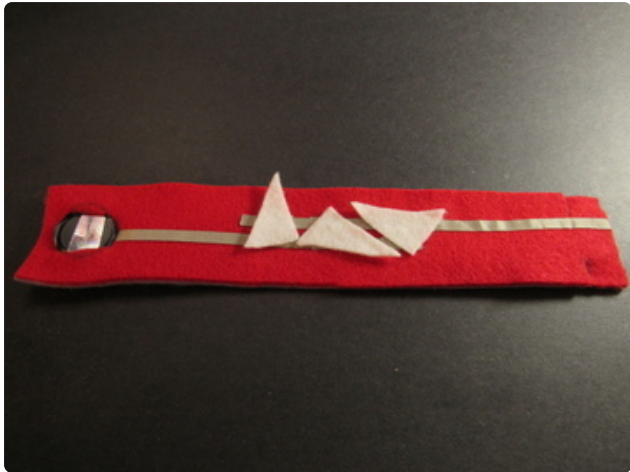
Then insert the battery into the slits, pressing it firmly onto the adhesive.

Make sure to orient the battery so that the electrical tape is on the left and right sides.

Dress It Up!



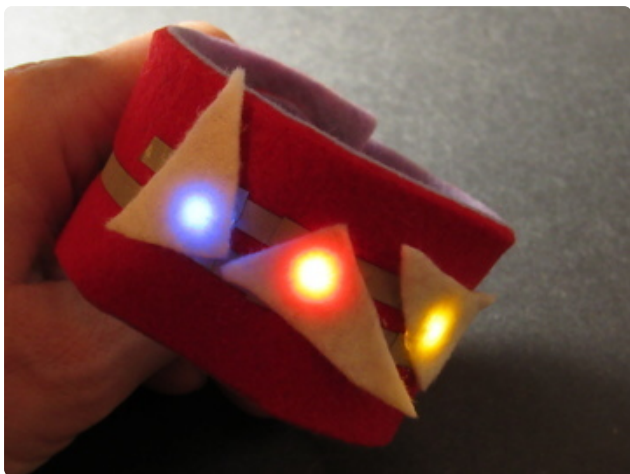
To make your wristband even more awesome, decorate it with additional shapes cut out of felt. Create a cool design that draws attention to your lights!



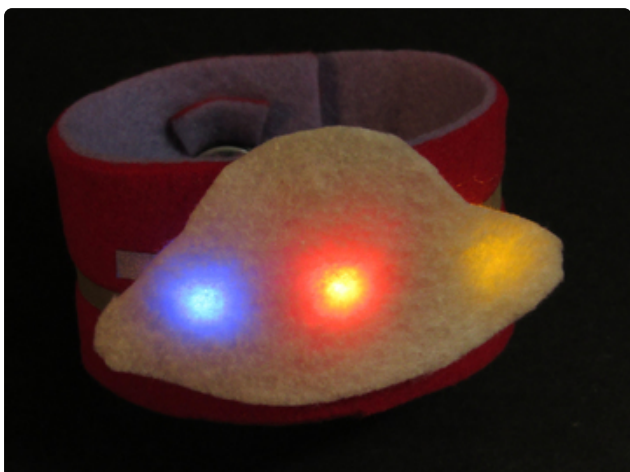
Flat LEDs like those on the Circuit Stickers and the Adafruit LED Sequins look really good when you diffuse the light by covering them with a light-colored piece of felt.



To cover a flat LED, take an adhesive dot (the kind used in scrapbooking) and press it right over the LED. Then press a felt shape onto the adhesive.



You can also add decorative felt pieces to a standard LED. Just cut a small hole in the center of the felt piece and slip it right over the LED bulb. If the bulb is tall enough, you can layer two or more felt shapes over it.



Troubleshooting and Maintenance

Here are some tips for wearing your wristband:

- If the LEDs don't light, make sure the lights and the battery are making good connections with the conductive fabric tape traces.
- If you accidentally put the LEDs wrong side up, just flip the battery over in the holder. (But remember none of the LEDs will light up unless they are all facing the same way!)
- You may find it easier to close the wristband first and then slip it over your hand. Tighten the tabs again after you put it on to make sure the traces are still touching the battery.
- Open the wristband to turn off the lights when you are not wearing it. Leaving the LEDs on overnight may drain the battery.
- When you need to replace the battery, just prepare a new battery as described on the Add the Battery page. Peel the old battery off the Z-axis tape and attach the new battery the same way.

Now wear your wristband with pride. It's proof you know how to make an electrical circuit!