

MAKER GUIDE

WEARABLE ELECTRONICS

BEGINNER



WHAT ARE WEARABLE ELECTRONICS?



*Android Apparatus by Little Dada
(Lindy Wilkins and Hillary Predko,
littledada.ca), modeled by Vanita
Butrsingorn*

Wearable electronics are, put simply, technology you can wear. This can be a smart watch or VR glasses or slouch sensor. In the maker community, wearable electronics mostly refer to circuits embedded into clothing with some venturing into 3D printed pieces.

Articles about each of the pictured pieces can be found on the Makezine website through the wearables category: makezine.com/?cat=25610



*Inflatable Manifestation Dress
by Kristin Neidlinger*



*Screen Dress by Anouk
Wipprecht*



LED Pendant by Caleb Kraft

GATHER YOUR EQUIPMENT

YOU WILL NEED

Sewing equipment

- Scissors
- Needle
- Unpicker (optional)
- Needle threader (optional)
- Nail polish or fray check (optional)
- Tailors chalk (optional)
- Embroidery hoops (optional)

Sewing consumables

- Thread (optional)

Electronics consumables

- Conductive thread
- LED sequins

Electronics equipment

- Multimeters (optional)
- Alligator Clips (optional)

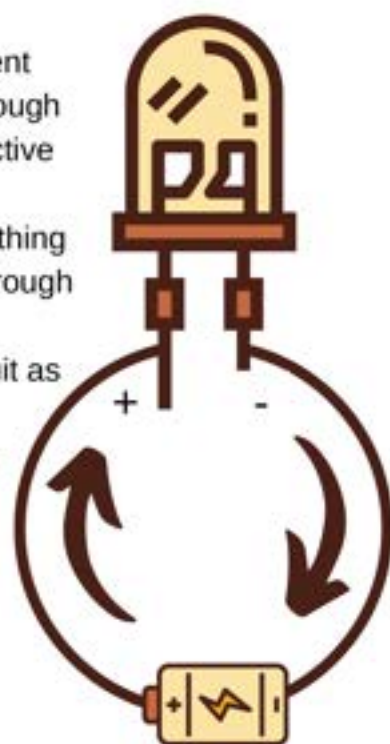
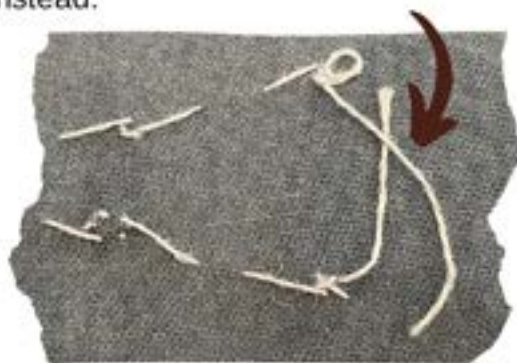


WHAT IS A CIRCUIT?



A circuit is a path through which electrical current flows. The battery pushes electrical current through the path. This path must be made up of conductive material connected to the battery; the more conductive, the easier the path. If we put something in that path, say an LED, the current will run through that and light it up!

Electrical current wants to get through the circuit as fast as possible, so if you give it a shortcut it will take it! If the two lines of your thread touch, your LEDs won't turn on because the electrical current will be speeding through that thread 'bridge' instead.



When making circuits, you can use more than just conductive thread. There are a lot of conductive materials you can find, including:

Conductive fabric tape

Conductive fabric

Conductive ribbon

Conductive Velcro



YOUR FIRST CIRCUIT

1



Collect your materials

Before we start sewing we're going to make a simple parallel circuit. To begin, collect your battery holder, two LEDs and four alligator clips.

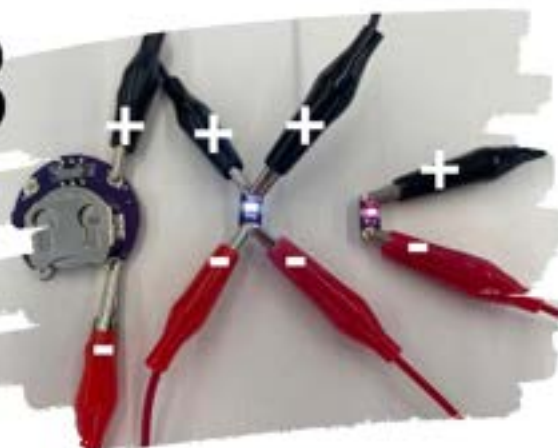
2



Connect up your first LED

Connect one head of the alligator clip to the negative terminal of your battery holder, and the other head to the negative side of your LED. Repeat for the positive side of the battery holder and LED.

3



Create a parallel circuit

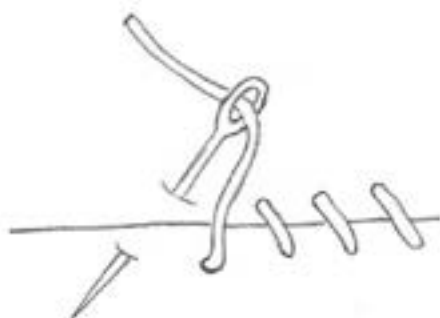
Extend the circuit by connecting the positive side of the first LED to the positive side of the second LED. Then repeat for the negative side.

SEWING 101



Running stitch:

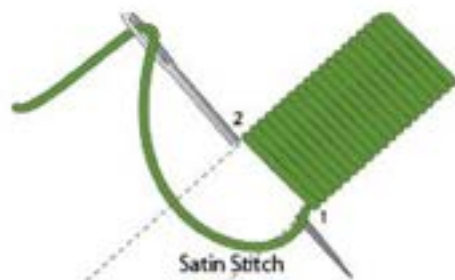
This is a simple 'in-and-out' stitch. Keep the stitches and the space between them the same length.



Whip stitch:

This stitch can be used to join together two pieces of fabric with flat edges.

Go around the edge of fabric and poke the needle in the fabric directly under where the thread is coming up at the end of the first stitch. Angle the needle diagonally so that the thread comes up through the fabric next to the last stitch at a small distance.



Satin stitch:

This stitch can create a smooth block of colour with satin-like finish.

To start, bring the needle up to the right side of the fabric and back down on the other side of the area that you want to cover. For the next stitch, bring the needle up right next to where you started the previous stitch.

Diagrams taken from StitchPiece'N'Purl:
<https://www.stitchpiecenpurl.com/>

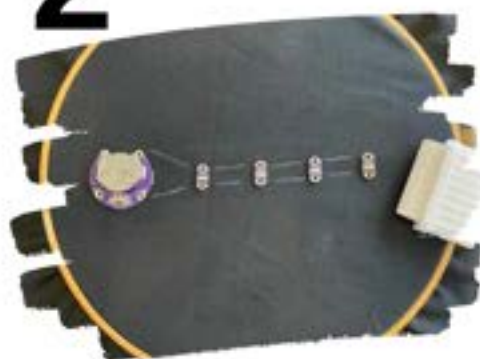
START SEWING CIRCUIT

1



Secure your fabric in an embroidery hoop
The use of an embroidery hoop is optional. It may be helpful to use as it stretches the fabric for easier sewing.

2



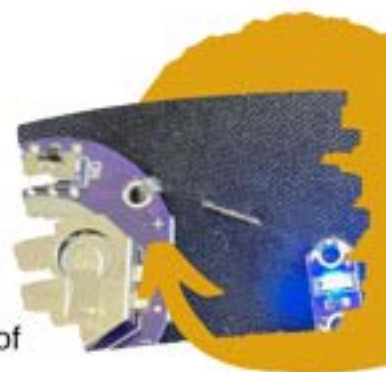
Draw your circuit with tailors chalk
Plan out your circuit of your chosen design, and then draw your circuit connecting the positive sides together, and the negative sides together.

3



Sew in the positive side of your battery holder

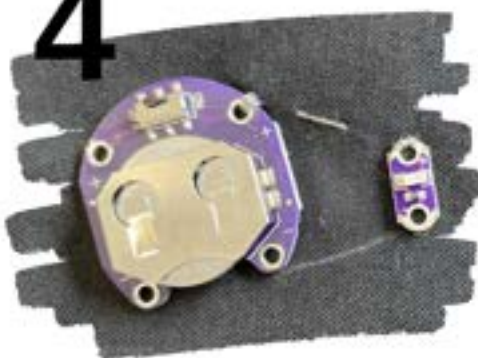
Now start your circuit by securing the positive side of the battery board with at least three stitches.
You'll be starting your circuit from here so sew in the side closest to the positive side of your first LED.



START SEWING CIRCUIT

4

Sew in the positive side of your first light
Stitch towards your first LED and then secure your first light, the same way you sewed the battery holder.



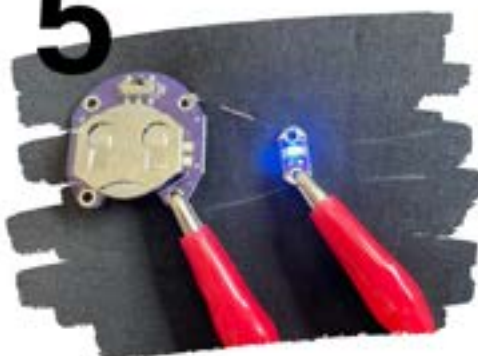
Pro Tip

Conductive thread is a little harder to work with – try to secure it carefully to your project



5

Check your light with an alligator clip
Connect one head of the alligator clip to the negative terminal of your battery holder and the other head to the negative side of your LED.



6

Continue sewing and checking each light
Continue on, sewing one LED at a time and making sure you check that each one works before continuing on.



START SEWING CIRCUIT

7



Start sewing in the negative side, checking each light as you go

Next it is time to sew in the other side of the circuit. This time you do not need to use the alligator clip to check the LEDs, just ensure that each one lights up before sewing in the next one.

Pro Tip

Cut the conductive thread tails so that they're not too long



If the threads touch it will short the circuit

8



Use the nail polish to seal the loose end and avoid fraying

Once you've finished your circuit, apply a layer of nail polish on all the loose ends to avoid fraying.

COIN BATTERY POUCH

1



Measure around the 3V button battery.

Mark and cut out two pieces of felt that will fit snugly around the battery, with two little "ears" on top to fit the metal snap.

2



Sew a few loops of conductive thread in the centre of each felt piece. This is to make contact with each side of the battery.

It will look better if the conductive thread doesn't go all the way to the other side of the felt piece.

Remember to sew the conductive thread so the "ears" are on either side when the pouch is sewn together!

3



Using cotton thread, sew a pair of metal snaps onto each "ear". Leave one thread-hole of each metal snap free.

Make sure that the snaps will be facing the same direction once the pouch is sewn together.

COIN BATTERY POUCH

4



Using conductive thread, sew a few loops around the centre thread, and then up to the metal snap. Secure the final thread-hole of the metal snap.

Make sure there is good physical connection between the conductive thread and the metal, as this will conduct current from the battery.

5



Put the two pieces of felt together, so that both the centre conductive threads are inside the pouch, and that the metal snaps face the same way.

Sew the two pieces of felt together with regular cotton thread.

Check that the battery fits snugly in the pouch. If there is too much space, sew around the felt again so the battery is held tightly in place.

6

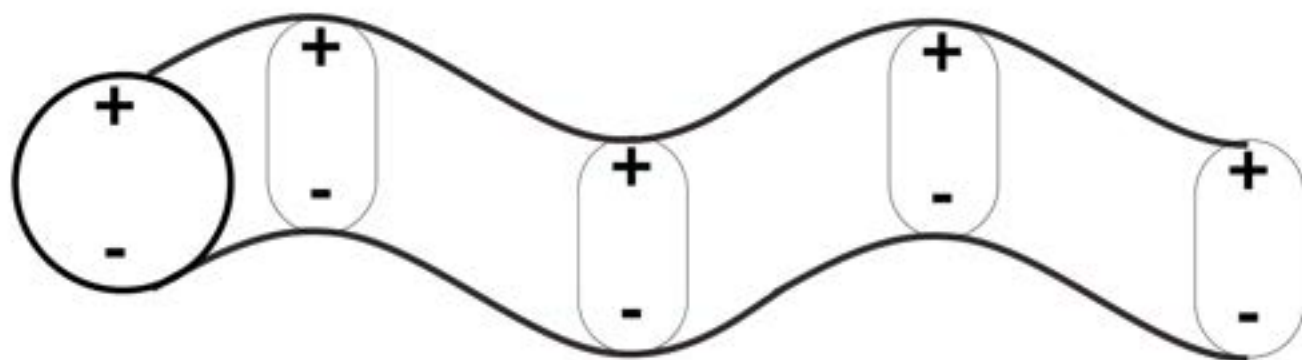
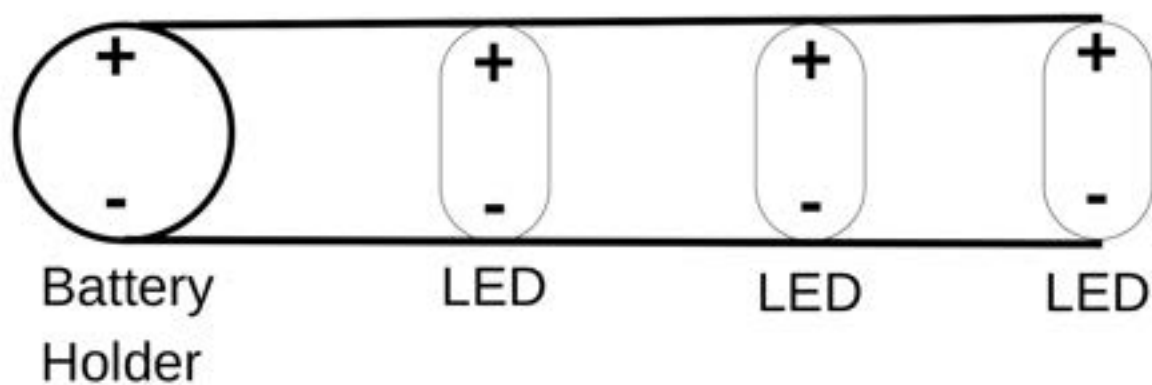


Insert battery into pouch with the positive (+) side of the battery facing towards you.

Test your battery pouch! Place the legs of an LED on each metal snap, with the positive (+) leg connecting to the metal snap at the front.

Now you're ready to connect your battery to an electronic textile circuit.

CIRCUIT TEMPLATES

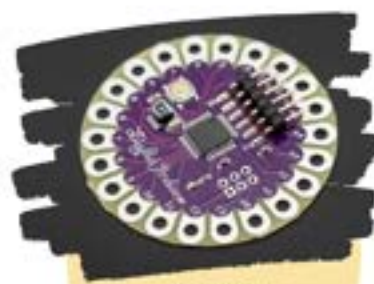


WHERE TO NEXT?



Lily Twinkle

Once you've conquered the basic sewable circuit, what next? There are plenty of ways to expand on your wearable projects. There are several programmable boards you can incorporate into a circuit with spectacular results. The following pages are filled with inspiration and beginner projects to get you started.



Lilypad

To see how far you can take wearable electronics, check out these inspirational people & places:

CuteCircuit – Fashion house that specialises in wearable technologies

cutecircuit.com



Gemma MO

Afroditi Psarra – Artist who works in e-textiles, DIY electronics, and sound. Check out the sewn synthesizers (lilytronica)!

afroditipsarra.com



Flora

Make Magazine - A magazine that features interesting makers and their projects

makezine.com/category/technology/wearables/

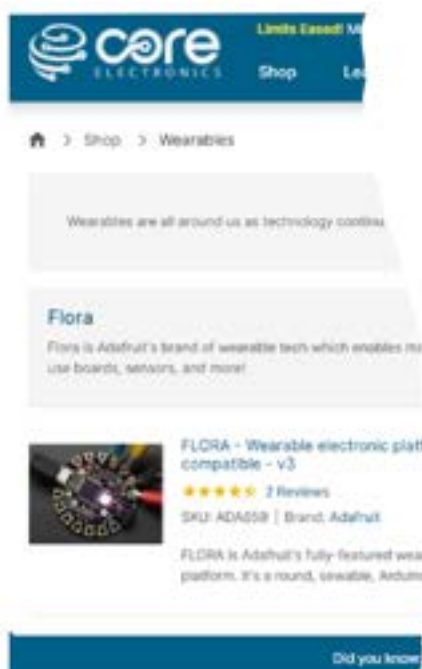


Mermaid Hair piece by Becky Stern



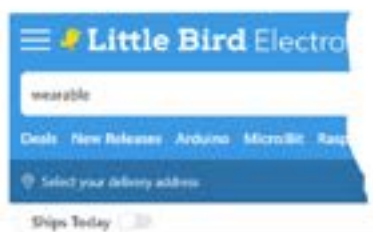
Moon Bag by Grace Kim

RETAILERS



Core Electronics

core-electronics.com.au/wearables.html



Wearables

Little Bird electronics

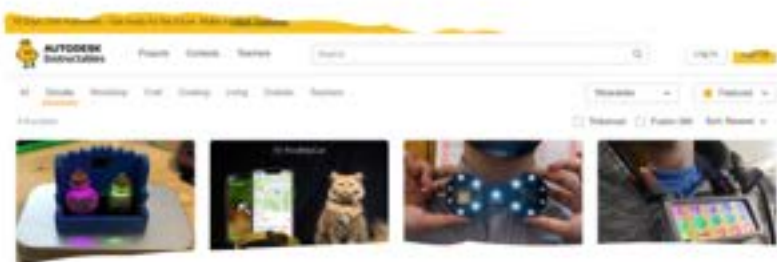
littlebirdelectronics.com.au/products?hidden=&q=wearable



TUTORIAL SITES



Makezine
makezine.com/?cat=25610



Instructables
instructables.com/circuits/wearables/projects/
instructables.com/Wearable-Electronic-Intro-Projects/



Kobakant
kobakant.at/DIY/



Sparkfun
learn.sparkfun.com/tutorials/tags/wearables



Adafruit
learn.adafruit.com/category/wearables

RECOMENDED BEGINNER TUTORIALS



LilyTiny Monster

highlowtech.org/?p=2760

Board: LilyTiny

No coding



Make an Iron-on Textile Circuit

makezine.com/projects/make-an-iron-on-textile-circuit-and-learn-all-about-wearables/

Board: Flora

Coding Language: Arduinio



LED Masquerade Masks

learn.adafruit.com/led-masquerade-masks

Board: Gemma M0

Coding Language: CircuitPython or Arduino



Flashing LED Strand with MakeCode

learn.adafruit.com/flashing-led-strand-with-makecode

Board: Gemma M0

Coding Language: MakeCode