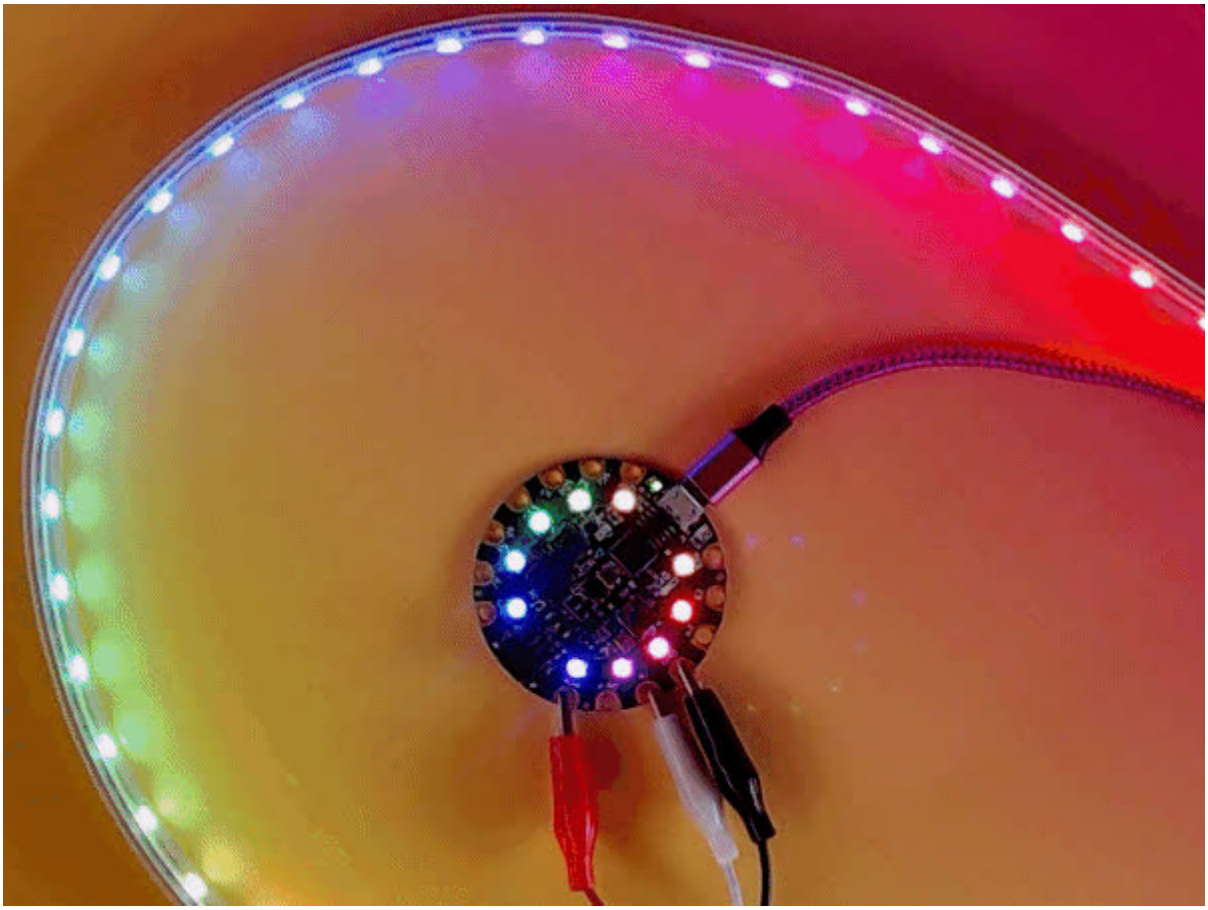
Make It Glow - Your First NeoPixel Project

Created by Erin St Blaine



https://learn.adafruit.com/make-it-glow-your-first-neopixel-project

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Overview

Add animated programmable lights to your costume or project. This first-timer guide will walk you through the basics and get you up and running in minutes.

You don't need any fancy soldering equipment or programming knowledge -- Adafruit's Circuit Playground Express makes it really simple, so you can spend your time on making your project amazing and unique.

We'll be using NeoPixels in this guide. NeoPixel is a fancy name for lights you can program.

What You Need

- A Circuit Playground Express
- A battery (unless your project can plug in via USB)
- Some NeoPixel lights
- A bolt-on kit for attaching the lights
- Wire strippers
- A USB cable for programming (some cables are charge-only, you'll need a good one that can pass data)

Adafruit's Circuit Playground Base Kit (http://adafru.it/3517) already comes with a battery holder and batteries, plus a USB cable for programming, so it's perfect for first-timers.

Circuit Playground Express - Base Kit
It's the Circuit Playground Express Base Kit! It provides the few things you'll need to get started with the new
https://www.adafruit.com/product/3517

As for the lights: there are so many different kinds to choose from, so it's really up to you! I'll go into more detail later on, but here's a great one to start with.

Adafruit NeoPixel LED Strip w/ Alligator Clips - 30 LEDs/meter
Adding glowy color to your projects has never been easier: no more soldering or stripping wires, clip 'em on and glow! This Adafruit NeoPixel LED Strip with Alligator...
https://www.adafruit.com/product/3812

If you get parts separate from the Base Kit, be sure to get a good quality data+power USB cable. 75% of issues with a microcontroller are a poor or incorrect USB connection.

USB cable - USB A to Micro-B
This here is your standard A to micro-B USB cable, for USB 1.1 or 2.0. Perfect for connecting a PC to your Metro, Feather, Raspberry Pi or other dev-board or...
https://www.adafruit.com/product/592

Adafruit's bolt-on kit is an easy way to securely attach the lights to the Circuit Playground. If you have a soldering iron, you can always solder them instead -- but the bolt-on kit works just as well, and at a bargain price.

Bolt-On Kit for Circuit Playground, micro:bit, Flora or Gemma

You have a Circuit Playground Express, and want to connect some wires to it for adding LEDs or sensors or speakers? You can use our...

https://www.adafruit.com/product/4103

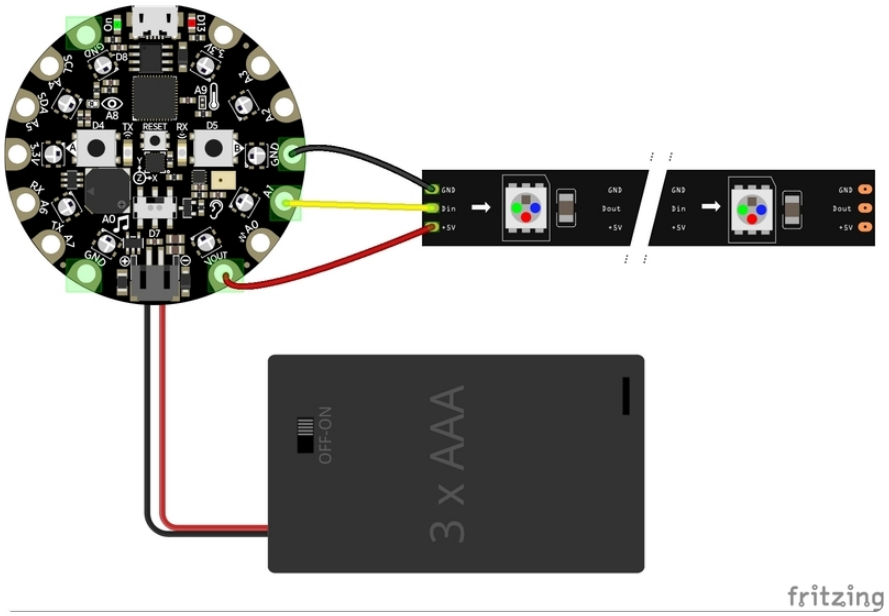
You'll also need some wire strippers. These will both cut and strip wires of varying sizes. You can't do electronics without wire strippers, and it's amazing how often they come in handy.

Hakko Professional Quality 20-30 AWG Wire Strippers

These are the finest wire strippers we have used, and if you have to do a lot of wiring, you will agree! They have soft rounded grips - very comfortable to use, and precision ground...

https://www.adafruit.com/product/527

Quick Start

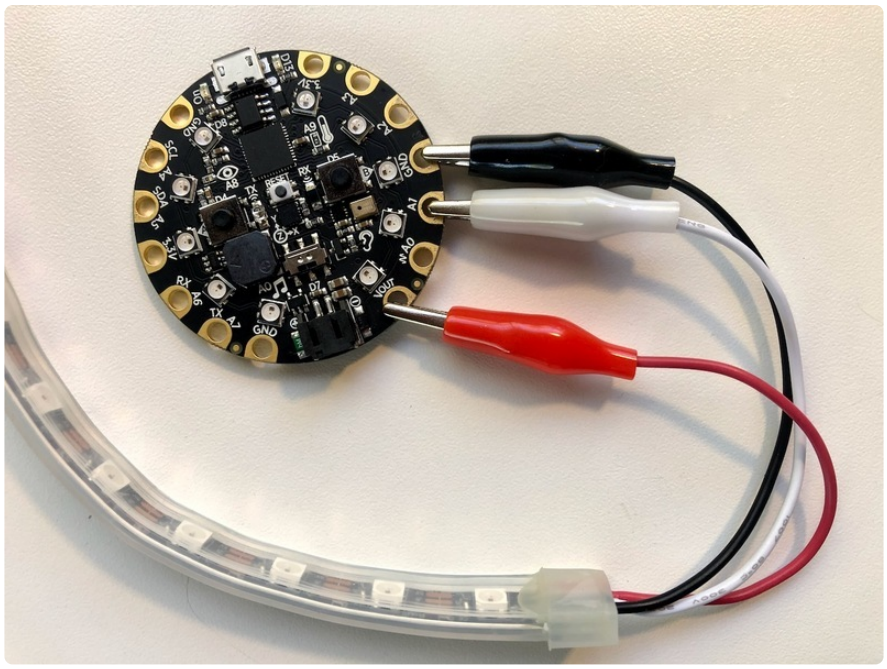


There are three wires we need to attach: red for power, black for ground, and yellow (or sometimes white) for data.

- Red goes from **VOUT** to +**5V**
- Black goes from **GND** to **GND**
- Yellow goes from **A1** to **DIN**

You can plug a battery pack into the battery connector, or plug into the USB port to power your project.

Note: A0 is connected to the speaker, so we suggest using the other pads that are free, like A1.



Program with MakeCode

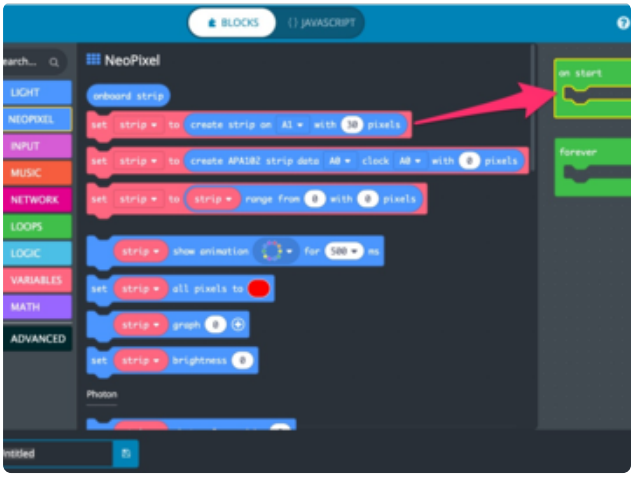
First we'll get a rainbow animation set up, so when we plug in our lights, they'll do something.

Point your browser at makecode.adafruit.com (https://adafru.it/wmd) and then choose **New Project**.

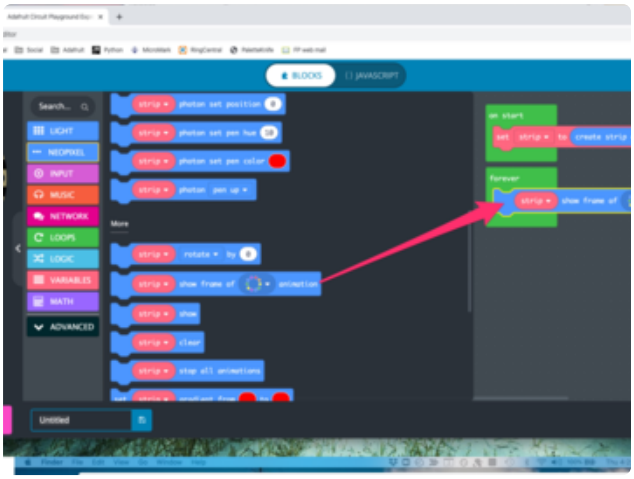
From here, you can click on any of the colored tabs and drag blocks of code onto your workspace, then preview it using the Circuit Playground Express pictured on the left.

Set Up the Lights

Click **LOOPS** and drag an `on start` block into your workspace.

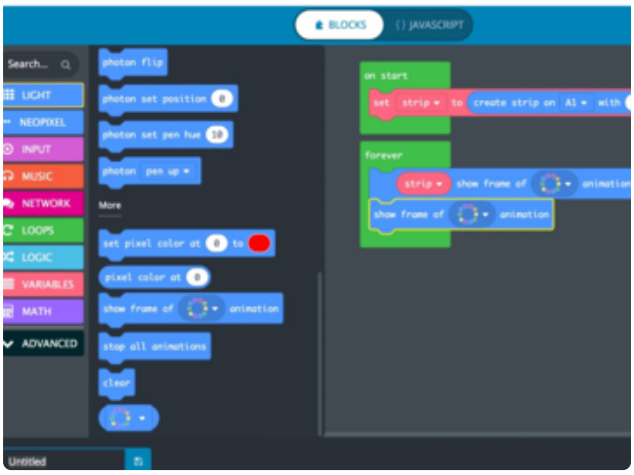


Click **LIGHT**, and a new tab appears that says **NEOPIXEL**. Click **NEOPIXEL**. Drag `set strip to create strip on A1 with 30 pixels` out and put it inside your `on start` block. If you have more pixels than 30, change this number to however many you have.



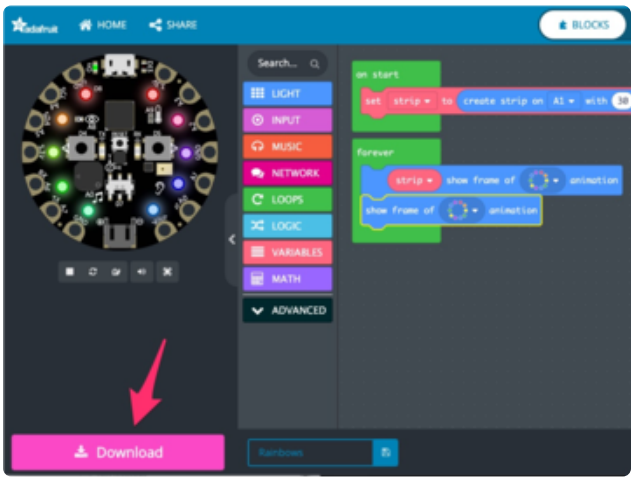
Scroll down a bit in the **NEOPIXEL** tab and find `strip show frame of animation`. Drag this into the `forever` block.

Now, whatever animation is selected will play on your strip. Let's do one more thing: we have lights on the Circuit Playground too. It's easy to make those light up at the same time.



Under the **LIGHT** tab, find `show frame of animation` and drag it into your forever block.

Anything in the **NEOPIXEL** tab applies to your attached strip. Anything in the **LIGHT** tab applies to the lights on the face of the Circuit Playground.



Click **DOWNLOAD**. The file will download to your computer. Plug in your Circuit Playground with a USB cable, and it appears just like a USB thumb drive -- look for **CPLAYBOOT**. Drag the file you just downloaded onto the **CPLAYBOOT** drive, and you're done!

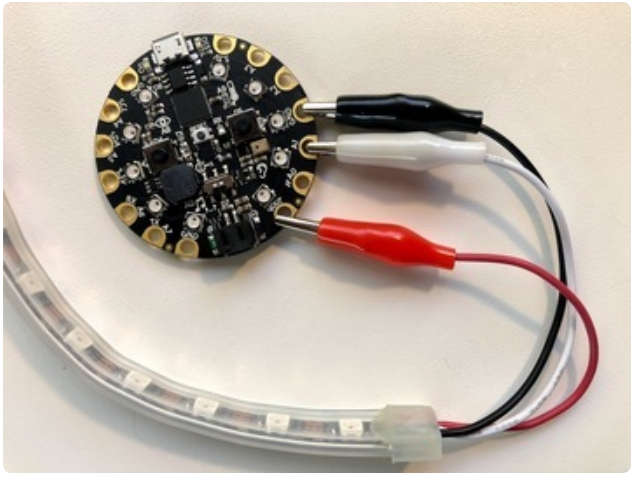
If you don't see **CPLAYBOOT**, try pressing the tiny black reset button in the center of the board. You're looking for all-green-lights on the face of the board, that's how you know you're in the right mode.

Note: If you see a drive called **CIRCUITYPY** then press the reset button again (or twice in a row) to get to **CPLAYBOOT**. If you don't seem to get **CPLAYBOOT** showing, be sure you have a known good USB cable that has power and data (not the power only ones that come with phone rechargers).

Head over to this Intro to MakeCode (https://adafru.it/AEp) guide for more info on getting started with MakeCode. Or, check out the Code Samples page later in this guide for some more project ideas and tutorials.

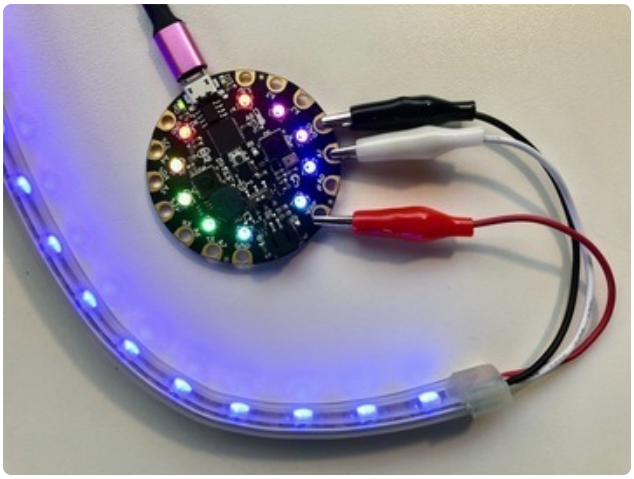
Connect the Lights

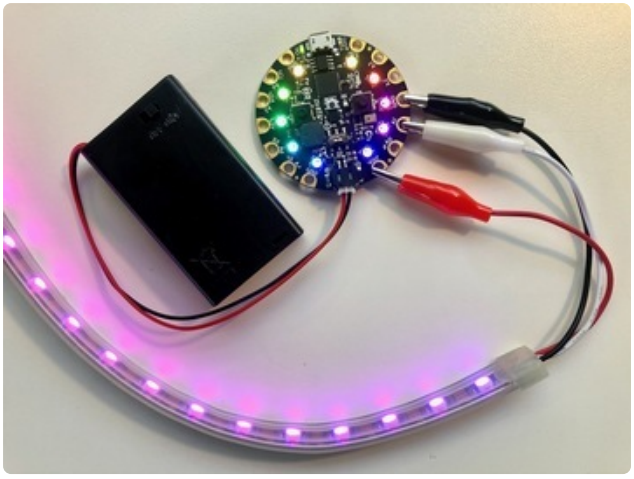
Alligator Clip Strip



This is the easiest way to hook a light strip up to your Circuit Playground Express.

With the Circuit Playground powered off, hook the red clip to **VOUT**, the white clip to **A1**, and the black clip to **G**.





Now, power up the Circuit Playground via the USB port or by plugging in your battery. Did the lights come on? If so, hooray! Now we can start making stuff.

Troubleshooting

If the lights did not come on:

1. Is your battery switch turned off? Turn it on!
2. Are all your clips firmly on the correct pads, and not touching each other?

If that's not the problem, head back to the MakeCode page and re-upload your code - it might not have worked correctly.

NeoPixel Dots & Strips

The alligator clip strips are great, and absolutely foolproof, but they aren't really the best LEDs to use in a costume. They'll wiggle right off the first time someone hugs you. They're like kindergarten: easy peezy and fun, but you don't need to stay there too long.

Once you're ready for first grade, you'll need to learn about data flow direction.

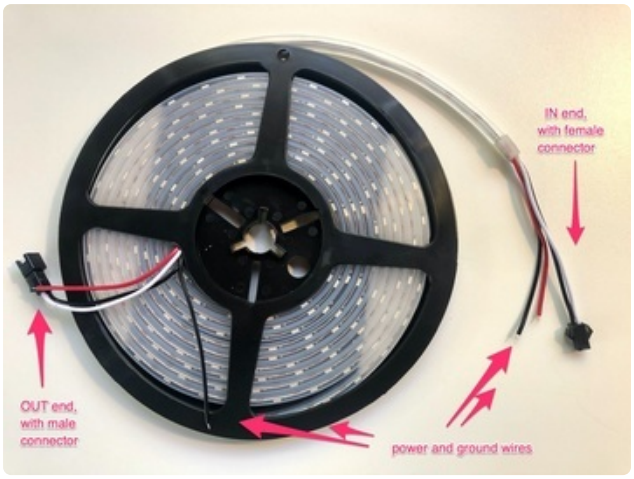
Data Flow Direction

Remember how we clipped the white wire to **A1**? Well, pin **A1** is telling the pixels things like what color to be, how bright, and how fast to change colors.

The NeoPixel strips "listen" for this data and then pass it down the strip. However, it can only pass the info in one direction: from **IN** to **OUT**. This means that if you hook up the wrong end of the strip, it won't light up.

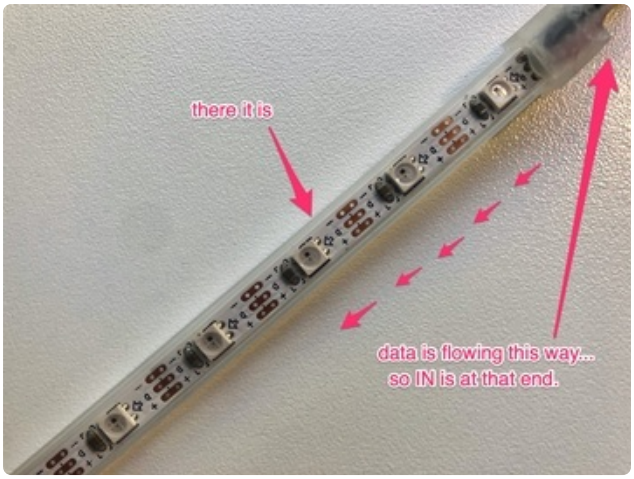
You won't break your strip if you do this -- we've all done it, there's nothing to be afraid of except a whole bunch of extra work. But it's best to get it right the first time, yes?

Interestingly, the red and black wires don't have this issue -- power and ground can connect to either end of the strip (or somewhere in the middle, if you like). However, it's a wee bit dangerous to have just one of them hooked up and not the other, if the project is powered on, so be sure you're not connected to your battery or computer while you're messing with these wires.



Most of Adafruit's strip-style NeoPixels come with a 2-pin connector and a loose red wire and black wire sticking out of the casing. The spools are generally wound with the **IN** end on the outside, with a female connector, and the **OUT** end near the center of the spool, with a male connector.

This is not always the case! For example, the neon strips have completely different 3-pin connectors with the male on the **IN** end. The NeoPixel dots also have a 3-pin connector, but the **IN** connector is female. This is why it's always important to check which direction they go -- if you hook them up backwards, they won't work.

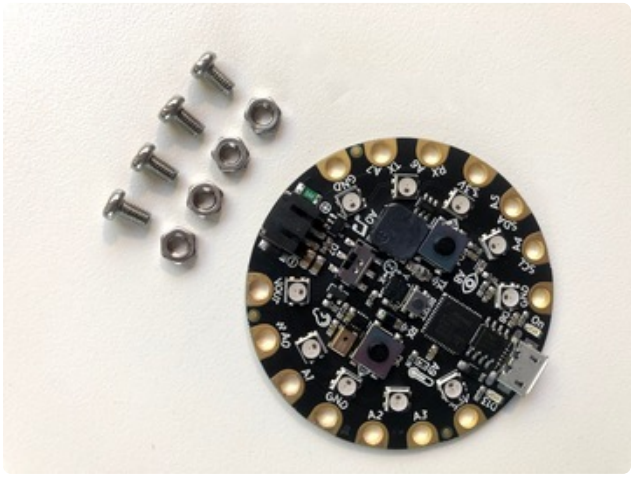


NeoPixel strips have a little arrow on them showing the direction of data flow. Connect to the end the arrows are coming from, and your data info will follow the flow of the arrows.

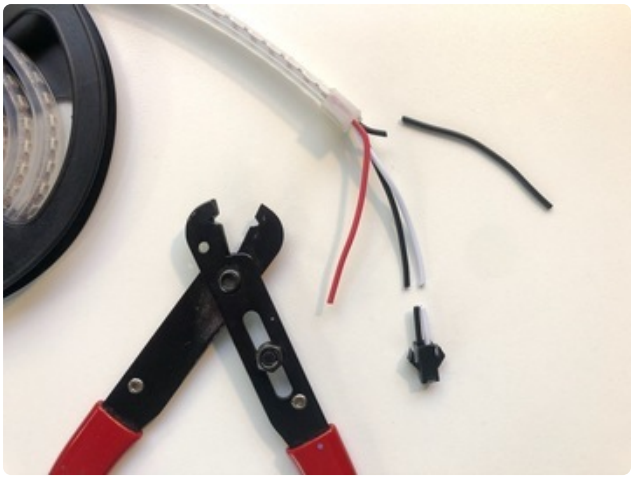
NeoPixel dots have the word **IN** printed on the back of the pixel on one side. It's hard to see. If you can't tell, and you're just not sure, lay the pixel dots face up with the strip flowing away from you. If the red wire is on the left, you're holding the **IN** end. If it's on the right, you're holding **OUT**. Or look for the male connector, it's usually on the **IN** end.

The Neon strips have no indicator whatsoever, so you just have to guess. But it doesn't hurt the pixels if you get it wrong -- just be sure to test before installing in your project!

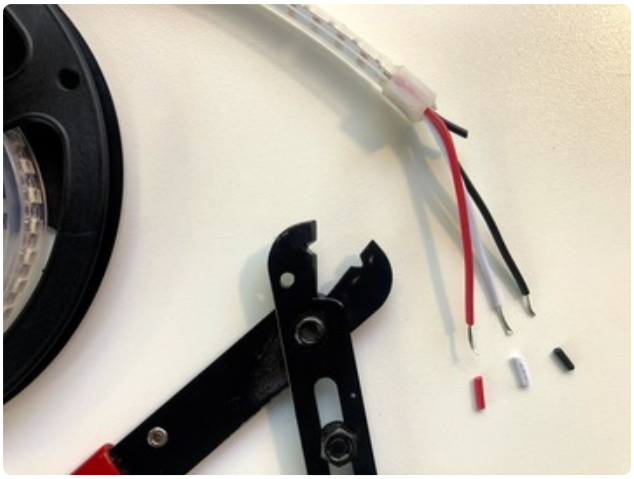
Hooking Up with the Bolt-On Kit



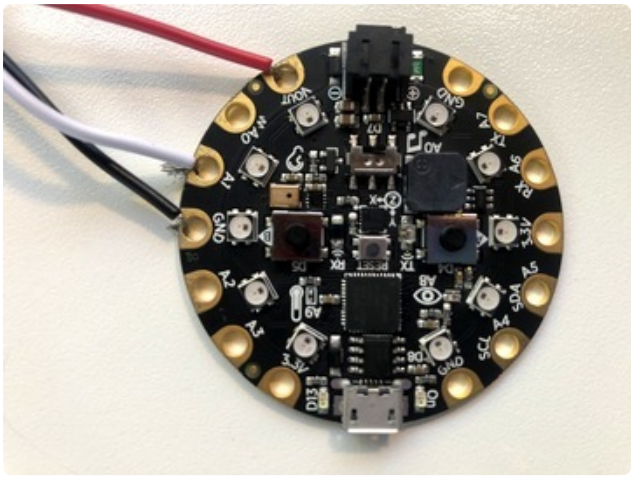
Get out your bolt-on kit. It comes with four screws and four bolts that are just the right size to fit through the Circuit Playground's mounting holes. We'll need just three of them (so if you dropped one on the floor and lost it in the carpet, no worries).



Once you've found the **IN** end of your strip, cut off the connector. If there's an extra black wire, you can trim that one off as well. You want to be left with a red wire, a white wire, and a black wire.

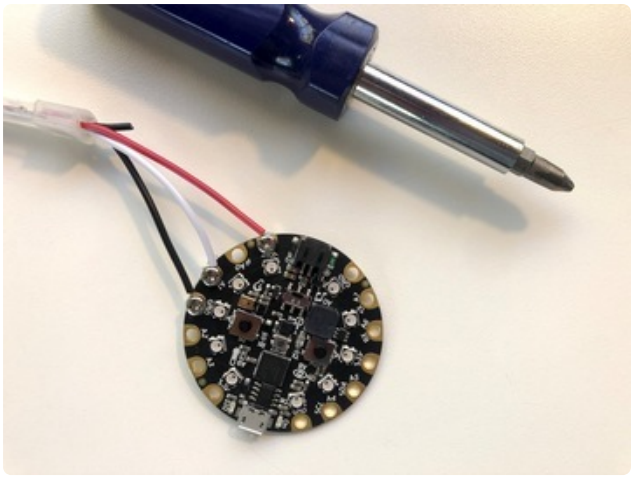


Now use our wire strippers to strip about 1/4" of shielding off each of these three wires.



Twist the stripped wires together and stick the red wires through the **VOUT** hole, the white wires through **A1**, and the black wire through **GND**.

If you're using NeoPixel dots, the red wire goes to **VOUT**, the middle wire to **A1**, and the remaining wire goes to **GND.**



Now, stick the bolts through the holes and secure them with the little nuts on the back. It helps to use a screwdriver to tighten them down. You don't need them to be super tight -- finger-tight is fine. The idea is just to hold the wires firmly in place against the pads.

Power up your Circuit Playground and watch the lights glow! This configuration is much sturdier than the alligator clip method, and will easily hold up to costume usage.

Choose your Pixel Type

NeoPixels come in so many types. You can see all Adafruit's NeoPixel products here (https://adafru.it/dYn). I'll describe a few of the more commonly used types for wearables and cosplay, with pros and cons for each.

Strips

These are the most common type of NeoPixels. They come in a variety of widths and spacing. The most common are 30 lights/meter (http://adafru.it/1376) or 60 lights/meter (http://adafru.it/1138), though you can also get the super-dense 144/m strip (http://adafru.it/1506).

The denser strips are more expensive, both in terms of how much they cost and also how much power they use -- your battery will last longer if you have dozens of LEDs instead of hundreds in your project.

Here's a quick video demonstrating the different densities. (https://adafru.it/Kb-)

Adafruit NeoPixel Digital RGB LED Strip - White 60 LED

You thought it couldn't get better than our world-famous 32-LED-per-meter Digital LED strip but we will prove you wrong! You wanted...

https://www.adafruit.com/product/1138

Projects that Use NeoPixel Strips

- FireWalker Sneakers (https://adafru.it/Kc0)
- FloraBrella (https://adafru.it/dNe)
- Wizard Staff (https://adafru.it/Kc1)
- Raver Bandolier (https://adafru.it/DCR)
- Bunny Ears (https://adafru.it/Kc2)
- Wonder Woman Bracers (https://adafru.it/Kc3)

Dots

These are my favorite lights for cosplay applications. They are really tough! Each light is fully encased in plastic, so these light strands are really hard to break. I've even used them underwater. Adafruit sells them in 2" spacing (http://adafru.it/3630) or 4" spacing (http://adafru.it/3631).

Adafruit NeoPixel LED Dots Strand - 20 LEDs at 2" Pitch

Attaching NeoPixel strips to your costume can be a struggle as the flexible PCBs can crack when bent too much. So how to add little dots of color? Use these stranded NeoPixel dots!...

https://www.adafruit.com/product/3630

Projects that use NeoPixel Dots

- Fairy Crown (https://adafru.it/Kc4)
- Motion Reactive Tutu (https://adafru.it/DCQ)

- Sparkle Skirt (https://adafru.it/Kc5)
- Rainbow Hoodie (https://adafru.it/Kc6)
- Magic Light Bag (https://adafru.it/Kc7)

Rings & Pixels

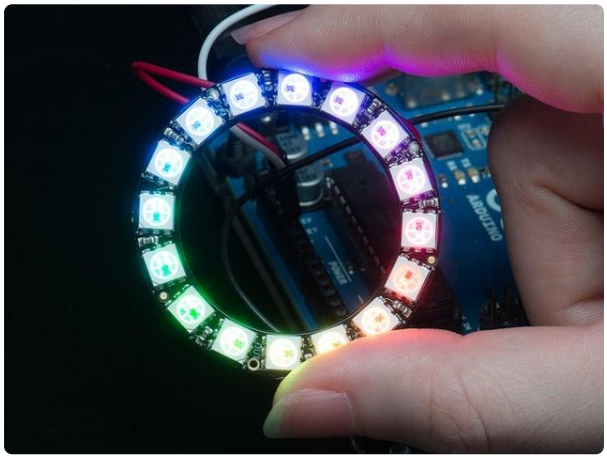
Sometimes you want a small form-factor or just a few small lights. NeoPixel rings or pixels can be perfect for making light-up gadgets. They come in a variety of sizes: 12 pixel/ring (http://adafru.it/1643), 16 pixel/ring (http://adafru.it/1463), 24 pixel/ring (http://adafru.it/1586), or a giant 60 pixel/ring (http://adafru.it/2874) size.

You can also get a 7-pixel NeoPixel Jewel (http://adafru.it/2226) which is perfect for necklaces or very small projects, or individual NeoPixels (http://adafru.it/1559) -- single pixels you can place exactly where you want.

These pixels are a bit more advanced to use and will require some soldering to get them working.

These are also available in both RGB and RGBW versions.

Much more about rings here! (https://adafru.it/Kc8)



NeoPixel Ring - 16 x 5050 RGB LED with Integrated Drivers
Round and round and round they go! 16 ultra bright smart LED NeoPixels are arranged in a circle with 1.75" (44.5mm) outer diameter. The rings are 'chainable' - connect the...
https://www.adafruit.com/product/1463

Projects that Use Rings & Pixels

- Ring Bracelet (https://adafru.it/tfX)
- Superhero Power Gauntlet (https://adafru.it/Kc9)
- Kaleidoscope Eyes Goggles (https://adafru.it/nYc)
- NeoPixel Jewel Necklace (https://adafru.it/Kca)
- Color Touch Necklace (https://adafru.it/Ehj)
- Luminary Lanterns (https://adafru.it/HgC)

Specialty

Here are a few other types of NeoPixel strip that exist!

- UV Blacklight Pixels (http://adafru.it/3851): these do not show color, only UV purple, but they're still programmable in that you can change brightness and run animations on the strip. UV Parasol Project (https://adafru.it/Kcb)
- Side Light Pixels (http://adafru.it/3636): Similar to the LED strips above, but laid out so the lights shine to the side. This is useful for projects that need to bend the strips in another way. LED Corset Project (https://adafru.it/Kcc)
- Neon-Look Strip (http://adafru.it/4310): These strips are encased in a diffuser that make them look like neon, and they're really flexible and bendy. Mickey Ears Project (https://adafru.it/Kcd)

Find out much more in the NeoPixel UberGuide. (https://adafru.it/Bej)

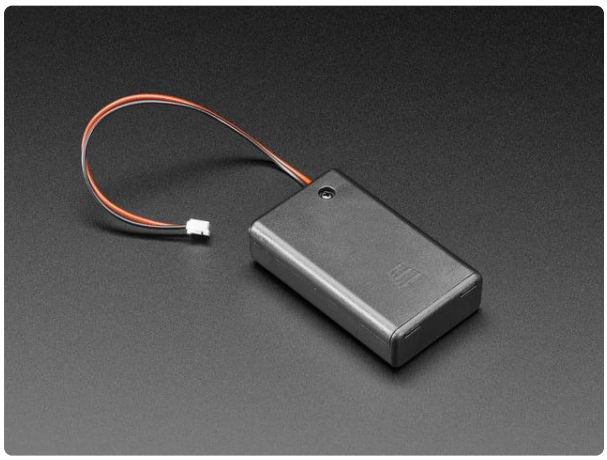
Batteries & Power

Here are a few battery choices that work well for cosplay or wearable applications.

If your project has more than a couple hundred pixels, you'll want to head over to the NeoPixel Überguide Power Page (https://adafru.it/DCq) to delve a little deeper. Powering is easy for small projects, a bit more involved for big ones.

For smaller costume-sized projects, read on!

AAA Battery Pack



3 x AAA Battery Holder with On/Off Switch and 2-Pin JST
This battery holder connects 3 AAA batteries together in series for powering all kinds of projects. We spec'd these out because the box is slim, and 3 AAA's add up to about...
https://www.adafruit.com/product/727

This battery pack is perfect for most costume projects. It has an on/off switch, which is super handy, and it will power hundreds of pixels for a couple hours (depending on brightness, colors, temperature, phase of the moon and luck). The nicest thing is that if your batteries die, it's easy to find new ones.

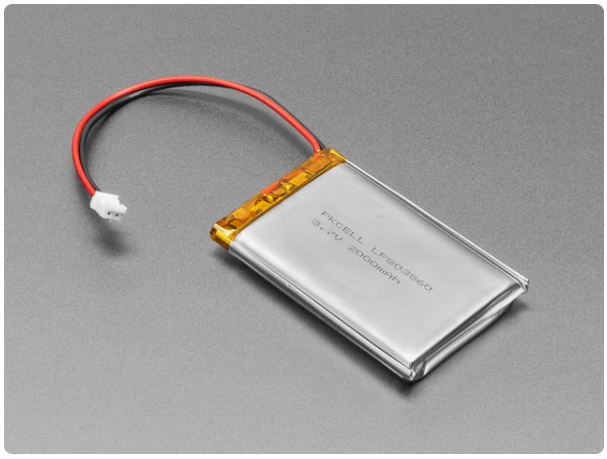
Don't use rechargeables! They don't provide quite enough voltage.

Coin Cell Battery Pack

2 x CR2032 Coin Cell Battery Holder - 6V output - On/Off switch
This tiny coin cell battery holder is ideal for small portable or wearable projects. It holds two 20mm coin cells (2032 or CR2032 are the most popular size) in series to generate 6V...
https://www.adafruit.com/product/783

If your project is really tiny -- say, you just want to power the Circuit Playground itself and the lights on the face, or you have just one or two pixels, this is a perfect solution. It's got an on/off switch! And it's really tiny and easy to hide. It won't last all night with more than one or two pixels on, but.. sometimes that's all you need! And it's fairly easy to find replacement batteries when you need them.

Lithium Polymer Batteries



Lithium Ion Battery - 3.7V 2000mAh
Lithium-ion polymer (also known as 'lipo' or 'lipoly') batteries are thin, light, and powerful. The output ranges from 4.2V when completely charged to 3.7V. This...
https://www.adafruit.com/product/2011

I love these batteries for their tiny tiny size. They last several hours powering most smaller projects, and they're so thin that they can be worn inside a bra or hat band

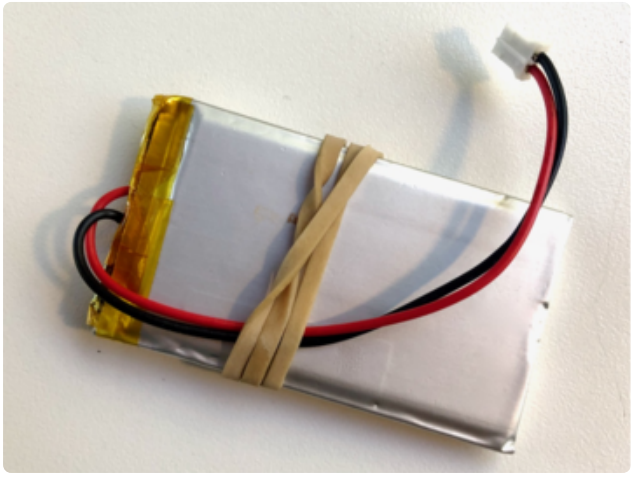
without leaving a big bulky silhouette. These are more or less the same batteries used to power cell phones.

They come in a good variety of shapes and sizes (https://adafru.it/Kce), from tiny necklace-sized ones to big 2500mAh batteries that will power your LED vest all night long.

A warning: lithium polymer batteries can be dangerous! They can catch on fire if they get punctured and/or wet.

Read that again.

Now, make sure you're not going to fall in the pool or the ocean with this battery strapped in your armpit. If you're good to go, I have one more warning:

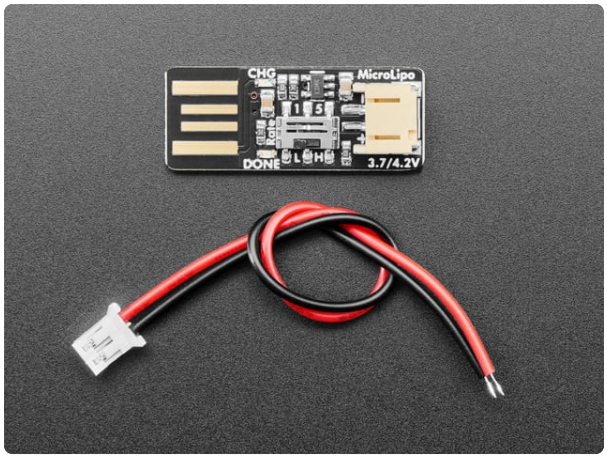


These little wires break off ALL THE TIME. They are not attached very well, and have absolutely no defense against flexing. Luckily there's an easy fix: put a rubber band around the battery, trapping the wires inside, so any pulling will be relieved by the rubber band.

Do this the minute you take the battery out of its shipping box! Don't wait.

Charging Lithium Polymer Batteries

Charge these batteries up with one of these Micro Lipo chargers. It plugs into your USB port. It'll charge any of the LiPoly batteries that Adafruit sells, and there's a little bridge-able solder pad on the back which will make it charge larger-sized batteries more quickly.



Adafruit Micro Lipo - USB LiIon/LiPoly charger

Oh so adorable, this is the tiniest little lipo charger, so handy you can keep it any project box! Its also easy to use. Simply plug in the gold plated contacts into any USB port and a...

https://www.adafruit.com/product/1304

You can find out much more about this type of battery here: LIon and LiPoly Batteries Guide (https://adafru.it/tfN)

Terminology

Here's what All the Words mean. Take a minute to read through so you have a handle on the basics.

NeoPixel

Programmable lights with three wire connections: power, ground, and data. These are really common, and come in lots of different form factors so they're a great place to start.

Microcontroller

The mini-computer that tells the LEDs what to do. The Circuit Playground Express (http://adafru.it/3333) is the microcontroller we're using in this guide.

Power & Ground

The two wire connections that make electricity flow. Power is almost always the red wire, or a +, or labeled **VOUT**, and Ground is almost always the black wire, or a -, or labeled **G**.

You can connect power and ground to either end of of your NeoPixel strip, or to the middle, or basically anywhere you'd like, but it's important to NOT get them mixed up. Hooking these two up backwards is the quickest way to fry your project.

Data IN/OUT

The third wire connection, which tells the LEDs what color to be, how bright, etc. This wire (often white or yellow) hooks up to one of the pads on your microcontroller. Labeled **IN** or **OUT** on the pixel strips.

Data must flow from **IN** (at the microcontroller end) to **OUT**, or the strips won't light up. There's no danger of frying your project if you hook this up wrong, it simply won't work.

RGB vs RGBW

When you're shopping for NeoPixels, you'll find them in both RGB and RGBW varieties. If you're just starting out, I recommend sticking with RGB for now -- not all programming applications support RGBW since they're still pretty new (at the time of writing).

What's the difference? The W stands for white, and the RGBW lights have four LEDs inside each pixel: red, green, blue, and white, instead of just the 3 red, green, and blue LEDs inside RGB pixels. You'd want to use RGBW if you're trying for a specific white-light look (though RGBs will make white light as well).

Code Samples

There are more and more MakeCode examples available every day. I've listed some of my favorites in the sidebar, and there are new ones being added almost every week. Just search "MakeCode" in the Learn System search bar to dive in.

Also, check out John Park's MakeCode Minute YouTube Series (https://adafru.it/KeS) for more tips and tricks than you can shake a stick at.

Have fun making things light up, and post lots of pictures of your costumes!

NeoPixels with MakeCode

NeoPixels with MakeCode (https://adafru.it/D1L)

NeoPixel Strand with Light Sensing

NeoPixel Strand with Light Sensing (https://adafru.it/KcA)

Simple Fascinator Hat

Simple Fascinator Hat (https://adafru.it/EgS)

Bunny Ears with Motion Reaction

Bunny Ears with Motion Reaction (https://adafru.it/Kc2)

LED Spats with Gradient Color

LED Spats with Gradient Color (https://adafru.it/E6a)

Motion Reactive Umbrella

Motion Reactive Umbrella (https://adafru.it/KcB)

Umbrella with Light Modes

Umbrella with Light Modes (https://adafru.it/dNe)

Steven Universe Gem Cosplay

Steven Universe Gem Cosplay (https://adafru.it/KcC)

Steven Universe Gauntlet Cosplay

Steven Universe Gauntlet Cosplay (https://adafru.it/E5y)

UV Umbrella Hotspot

UV Umbrella Hotspot (https://adafru.it/Kcb)

Crystal Staff with Motion Reaction

Crystal Staff with Motion Reaction (https://adafru.it/KcD)

Flame Effect Dragon

Flame Effect Dragon (https://adafru.it/KcE)

LED Corset

LED Corset (https://adafru.it/Kcc)