Kaleidoscope Eyes (Trinket-Powered NeoPixel LED Ring Goggles)

Created by Phillip Burgess

https://learn.adafruit.com/kaleidoscope-eyes-neopixel-led-goggles-trinket-gemma

Last updated on 2022-12-01 02:01:49 PM EST

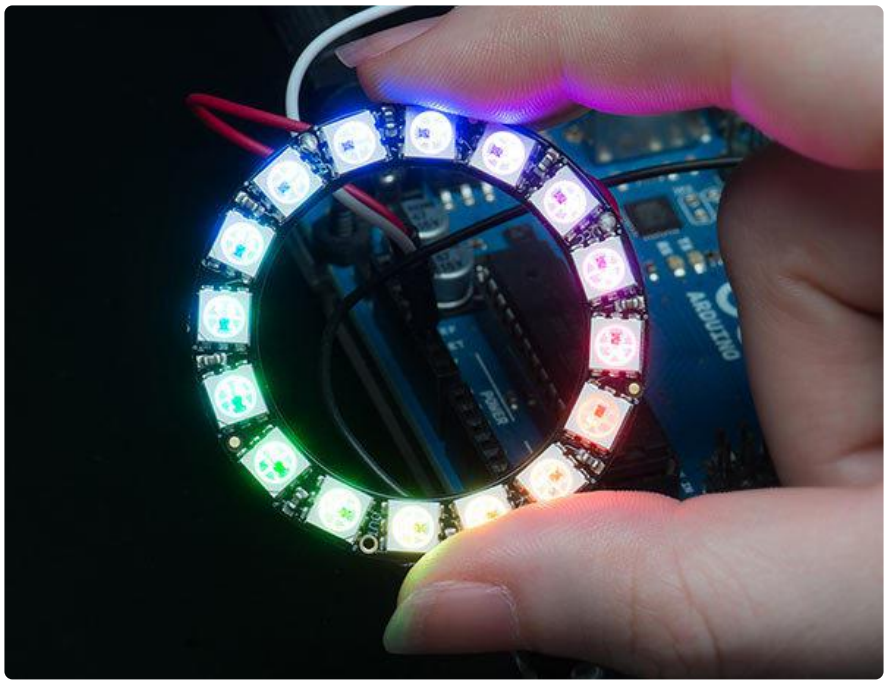
Table of Contents

Overview

Here's a project to dazzle onlookers at Halloween parties, cosplay conventions, raves or at Burning Man. These full-color animated LED goggles attract a LOT of attention!

Adafruit NeoPixel LED rings fit perfectly inside the eyecups of most 50mm round goggles — a very common size. It's almost as if these rings were made with this project in mind!

This guide was originally written for the Trinket Mini boards, but also works with Trinket M0. We recommend the Trinket M0 as it is easier to use and is more compatible with modern computers!



Tools Needed

This is a soldering project, albeit a small one. You will need the common soldering paraphernalia of a soldering iron, solder and tools for cutting and stripping wire.

You'll need some method of securing the electronics inside the goggles. Hot-melt glue (requiring a glue gun) works well for this. Watch your fingers! Or craft glue (such as E6000) is an Adafruit favorite. Tape could be used for a quick and temporary setup.

Parts Needed

We have a DIY kit with all the necessary pieces (including goggles), or you can "bring your own goggles" for a custom-made design.

The kit version includes our costume goggles (), two NeoPixel rings (), a Trinket M0 () or Trinket Mini Microcontroller (), JST connector (http://adafru.it/1769), rechargeable 150 mAh LiPoly battery (), enough wire for all the connections, plus a USB battery charger ().

...or Bring-Your-Own-Goggles

If you already have a favorite pair of goggles that you'd rather build this around, then you just need to add the electronic parts linked above. You also then have the option of stepping up to a larger 500 mAh LiPoly battery () or a less costly 3x AAA battery case (). You'll need to provide your own wire and perhaps some heat-shrink tubing.

An assortment of goggles...the ones in front are safety and welding goggles, while the two in back are costume shop and toy store finds. Yet they all use 50mm round lenses!

If you go the custom route, the design must be adapted to fit your reality.

Great thing about our costume goggles () is that you can assemble all the electronics first, outside the goggles, then install them. That's not always the case with these alternates...you may need to snake wires in and out of the eye cups and solder parts with them already in the goggles...this can be tricky! Soldering novices may prefer the kit version for this reason.

If you choose a 3x AAA battery case (instead of a rechargeable LiPoly battery), it won't fit inside the goggles. This could be attached to the strap, or run longer wires and keep the battery pack in a pocket.

Can I use a Gemma instead of a Trinket?

Absolutely! You won't need the extra JST connector for the LiPo battery — Gemma M0 () and the earlier Gemma v2 () have has one built-in. The board is a bit wider and might be more challenging to fit, but one option is to show it off rather than conceal it, mounting the board on the outside of the goggles near one temple. Geek pride!

Wiring & Soldering

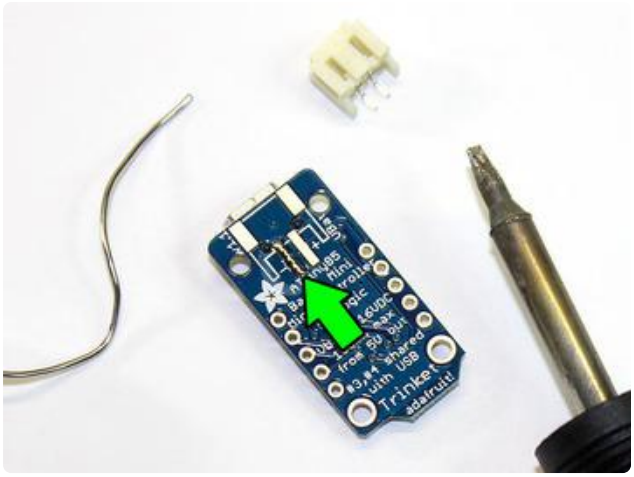
Before starting, take inventory of all your parts:

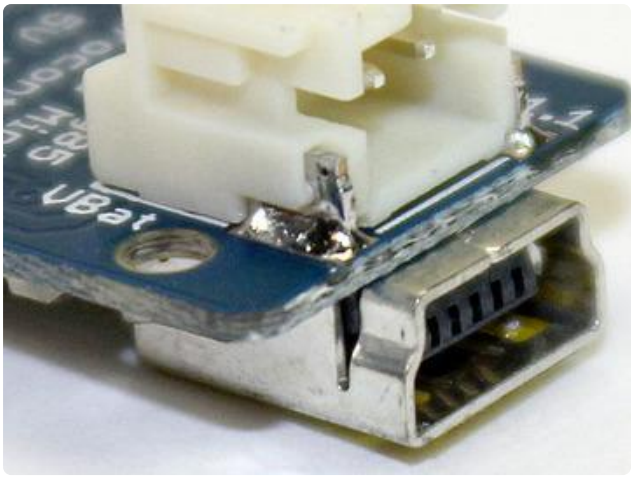
Goggles
NeoPixel rings (2)
Trinket M0 or Trinket Mini Microcontroller
JST connector
Micro LiPo USB charger
LiPoly battery
Wire
Your kit might have a couple of extra bits; a small power cable and some pin headers. If present, they can be tossed in your spare parts drawer; they're not used here.

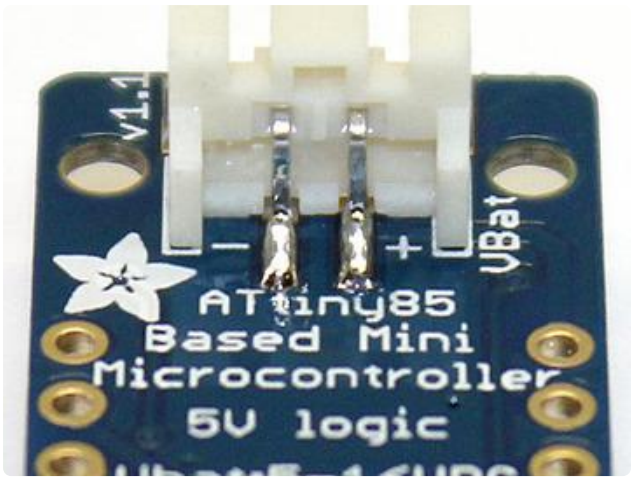
If this is your first time using the Adafruit Trinket microcontroller, work through the Adafruit Trinket M0 () or Introducing Trinket () guide first. This explains how to set up the Arduino IDE software or CircuitPython and load code onto the board. Don't continue here until you have something like the "blink" example working.

If you encounter problems, post on the Adafruit Forums () for help...it's much easier to troubleshoot and replace parts before they're soldered together and glued into some goggles!

Let's get the trickiest soldering out of the way first, installing the JST battery connector on the underside side of the Trinket board...







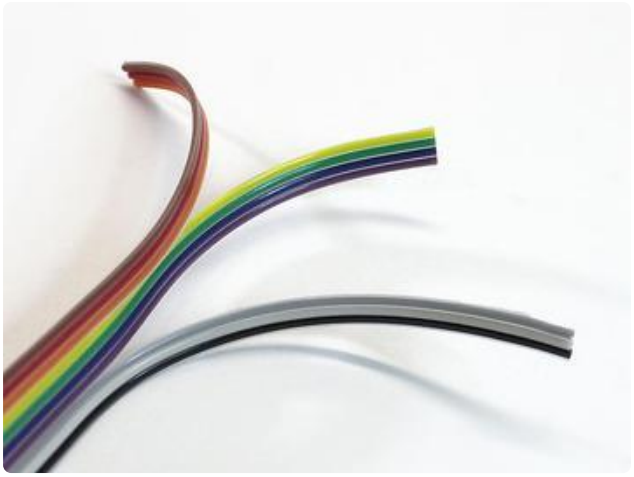
Start by “tinning” one of the JST pads on the back of the Trinket...heat the pad and apply solder so the whole surface is coated.

Hold the JST socket in place (tweezers recommended) and re-melt the solder, allowing the part to sink into position.

Once this first pin is tacked down, the rest are easy. Remember to heat the parts, then apply solder...do not melt solder on the iron and “wipe” it on the parts...that makes a weak cold solder joint. Properly done, the connections should be smooth.

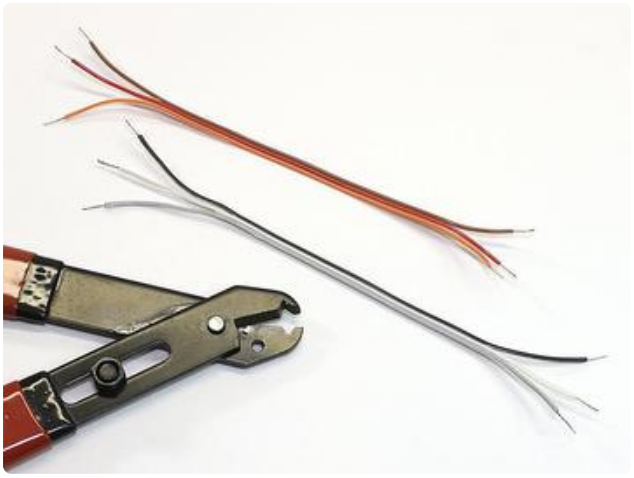
Congrats, you’ve done surface-mount soldering!

The USB battery charger in the kit is a separate part — it does not get incorporated into the goggles. You must disconnect the battery from the goggles and use the charger to top it off.



Next, peel away two sets of three wires each from the included bit of ribbon cable. (If you're building your own custom goggles, you can just use separate pieces of wire for this, it's all good.)

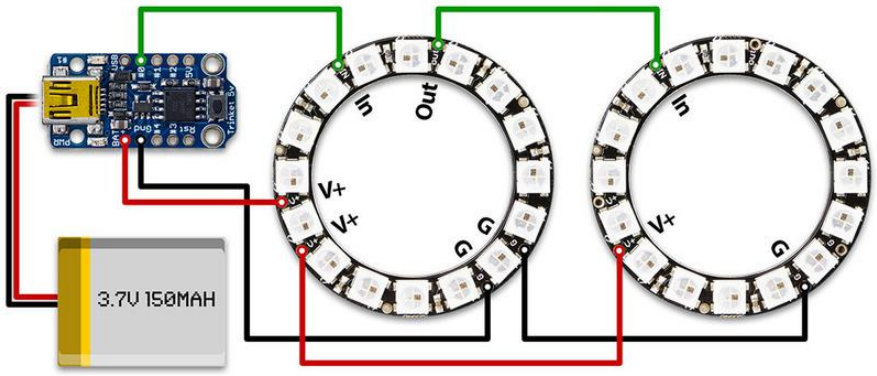
If using our costume goggles, one of these 3-wire cables will be visible on the outside, so pick a color combination that you like.



Separate the wires by about 1 inch at both ends, strip away a little insulation and give the wires a twist to prevent fraying. Optionally tinning the wire ends makes them a little more manageable...heat each one with a soldering iron and melt just a tiny bit of solder into the strands.

If you mess this part up, that's okay. Trim the wires back a little further and try again. Or use the left-over wire from the original ribbon cable.

Here's a circuit diagram of what we're aiming for. Of course the real thing won't be all rectilinear like this...we'll walk you through each step.

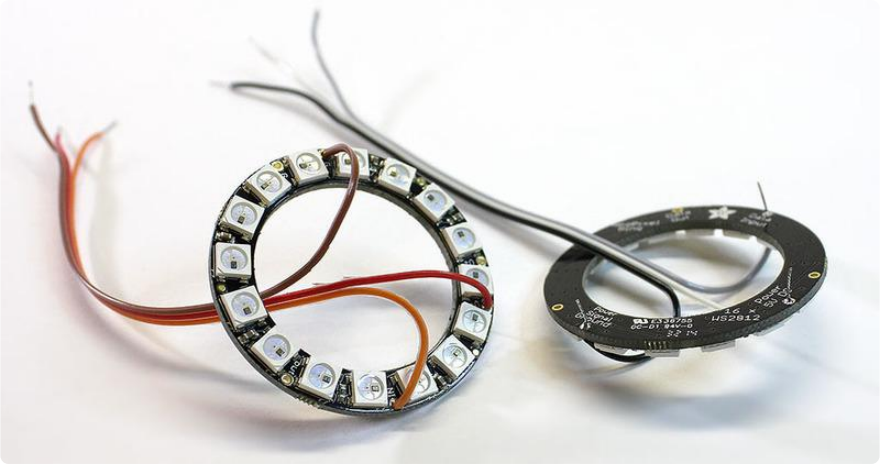


This diagram uses the original Trinket but you can also use the Trinket M0 with the exact same wiring!

Solder one end of the 3-wire cables to the IN, V+ and G points on the two NeoPixel rings. There are two V+ and two G holes on each ring...either one is fine, they're connected.

Keep track of the colors you use for IN, V+ and G...it's vitally important to make the right connections at the other end.

(These are the labels on the front of the rings. The back-side labels are a little more verbose.)



Notice how the wires are inserted from the front, then soldered on the back of the ring. Do it this way if you're new to soldering...it's much easier. It can work the other way too...insert from back, solder on front...but the component tolerances are extreme ly tight and beginners often get a blob of solder in the wrong place and the LEDs don't work.

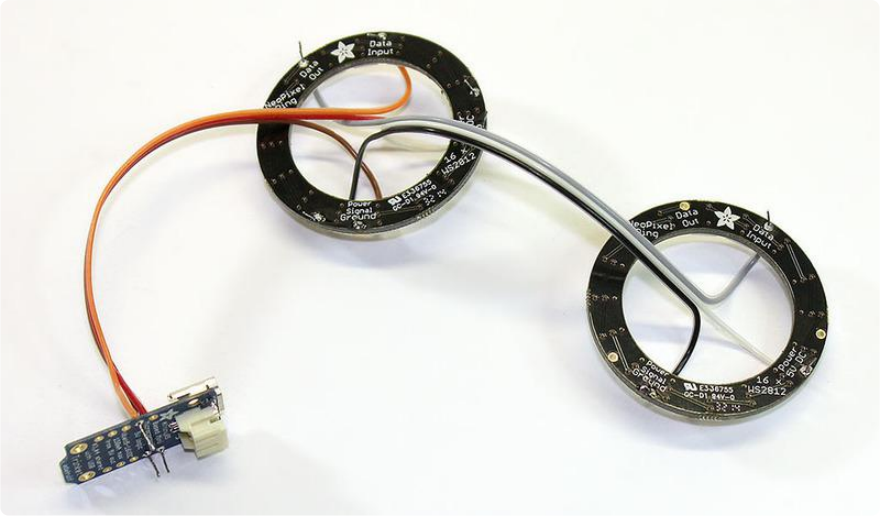
Next we connect the other ends of the 3-wire cables...first one to the Trinket, second one joins the two rings...

Trinket	First Ring
BAT+	V+ (either one)
Gnd	G (either one)
#0	IN

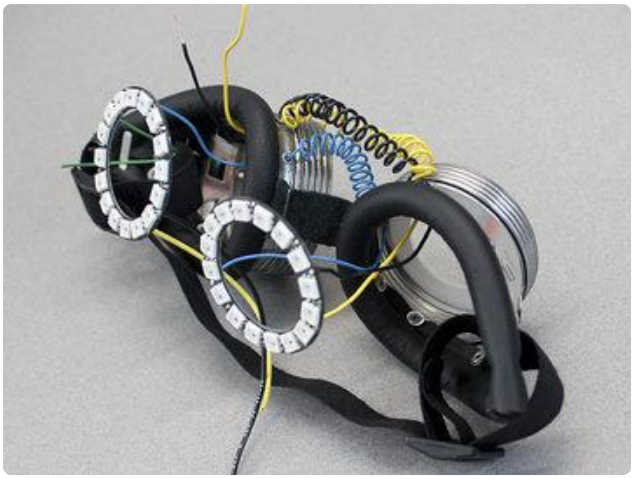
First Ring	Second Ring
V+ (either one)	V+ (either one)
G (either one)	G (either one)
out	IN

The second cable is the “visible from the outside” one, if that matters to your color scheme.

Notice here how the second cable enters the first ring from behind, then the wires are inserted from the front and soldered on the back...the cables should not overlap any LEDs on the front.



If possible, try to align the rings so they’re pointed nearly the same direction (use a landmark like the Adafruit logo for reference). This is not required, but it’s a little easier to program animation effects when both rings have the same orientation.



If using the “bring your own goggles” method, things may be a lot more complex...for example, these goggles have wires passing in and out through side perforations, so it’s not possible to build and test the whole circuit separately first... it must be built around the goggles and is later folded into place. This is tricky!

We’ll clip the wire ends flush in a moment, but let’s test that everything works first...

Arduino Code

The Arduino code presented below works equally well on all versions of Trinket Mini and Trinket M0. But if you have an M0 board, consider using the CircuitPython code on the next page of this guide, no Arduino IDE required!

If you haven’t already worked through the Adafruit Trinket M0 () or Introducing Trinket () guide, do that first. Once you have the Arduino IDE up and running, then download and install the NeoPixel library:

Click to download the NeoPixel library

Installing Arduino libraries is a frequent stumbling block. If this is your first time, or simply needing a refresher, please read the All About Arduino Libraries () tutorial.

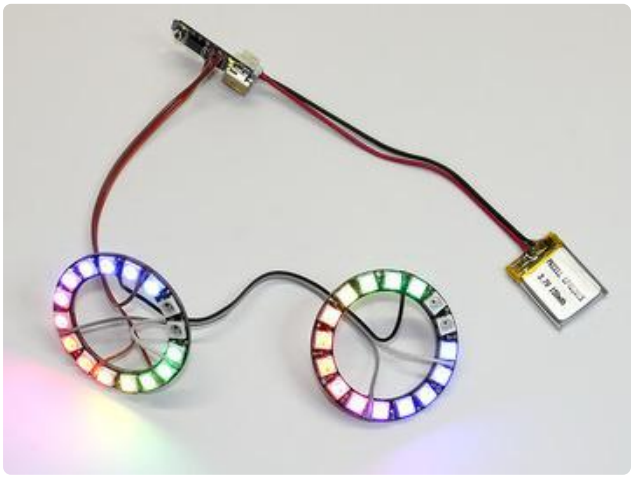
Create a new Arduino sketch (File→New), then copy and paste the following code:

```
// SPDX-FileCopyrightText: 2017 Mikey Sklar for Adafruit Industries
//
// SPDX-License-Identifier: MIT

// Low power NeoPixel goggles example.  Makes a nice blinky display
// with just a few LEDs on at any time.

#include <Adafruit_NeoPixel.h>
#ifdef __AVR_ATtiny85__ // Trinket, Gemma, etc.
 #include <avr/power.h>
#endif

#define PIN 0

Adafruit_NeoPixel pixels = Adafruit_NeoPixel(32, PIN);
```

```
uint8_t  mode   = 0, // Current animation effect
         offset = 0; // Position of spinny eyes
uint32_t color  = 0xFF0000; // Start red
uint32_t prevTime;

void setup() {
#ifdef __AVR_ATtiny85__ // Trinket, Gemma, etc.
  if(F_CPU == 16000000) clock_prescale_set(clock_div_1);
#endif
  pixels.begin();
  pixels.setBrightness(85); // 1/3 brightness
  prevTime = millis();
}

void loop() {
  uint8_t  i;
  uint32_t t;

  switch(mode) {

   case 0: // Random sparks - just one LED on at a time!
    i = random(32);
    pixels.setPixelColor(i, color);
    pixels.show();
    delay(10);
    pixels.setPixelColor(i, 0);
    break;

   case 1: // Spinny wheels (8 LEDs on at a time)
    for(i=0; i<16; i++) {
      uint32_t c = 0;
      if(((offset + i) & 7) < 2) c = color; // 4 pixels on...
      pixels.setPixelColor(   i, c); // First eye
      pixels.setPixelColor(31-i, c); // Second eye (flipped)
    }
    pixels.show();
    offset++;
    delay(50);
    break;
  }

  t = millis();
  if((t - prevTime) > 8000) {      // Every 8 seconds...
    mode++;                        // Next mode
    if(mode > 1) {                 // End of modes?
      mode = 0;                    // Start modes over
      color >>= 8;                 // Next color R->G->B
      if(!color) color = 0xFF0000; // Reset to red
    }
    for(i=0; i<32; i++) pixels.setPixelColor(i, 0);
    prevTime = t;
  }
}
```

From the Tools→Board menu, select either Adafruit Trinket 8 MHz or Adafruit Trinket 16 MHz (either one will work). Also make sure to select USBTinyISP from the Tools:Programmer menu. Connect the USB cable between the computer and Trinket, press the reset button on the board, then click the upload button (right arrow icon) in the Arduino IDE.

Nothing will happen at first, this is normal. The LEDs only work on battery power! Unplug the USB cable, then connect the battery to the JST plug on the back of the Trinket. If all goes well, you should get a sparkly light show from the LEDs.



Success! Unplug the battery and we'll move on to the final assembly...

These rings are running different code... you can always substitute your own! Our example above was designed to only light a few LEDs to improve battery run time. Consider it a simple starting point.

If the code refuses to compile it's usually one of the following:

- The Trinket extensions to the Arduino IDE are not correctly installed (use the ready-made IDE, it's easier).
- The NeoPixel library is not correctly installed.
- The wrong board type is selected (should be Adafruit Trinket M0, Adafruit Trinket 8 MHz or 16 MHz, not any version of the Pro Trinket).

If the code compiles and uploads but nothing happens with the battery connected:

- Compare your connections against the wiring diagram...for example, maybe you've accidentally connected Trinket pin #0 to the first ring's OUT instead of IN?
- An electrical short...a blob of solder or bit of wire making inadvertent contact with something nearby.
- A cold solder joint...solder isn't properly melted between the wire and board.

If you can't identify the source of the problem, you can post in the Adafruit Forums () f or assistance. It's very helpful if you can get a well-lit, in-focus photo (or several) of the project, showing all the wires and solder connections. We'll look it over for any gremlins and recommend fixes.

CircuitPython Code

If using a Trinket M0 board (not the earlier “AVR” type), you have the option of using C ircuitPython instead of Arduino. Once installed, it’s usually easier to program this way.

Trinket M0 Setup for CircuitPython

If you haven't already, follow this guide () to preparing the Trinket M0, including updating it with the latest version of CircuitPython.

CircuitPython Goggles Code

With CircuitPython properly installed (the Trinket should show up as a small flash drive called “CIRCUITPY” when connected to USB), you can then load up the goggles code.

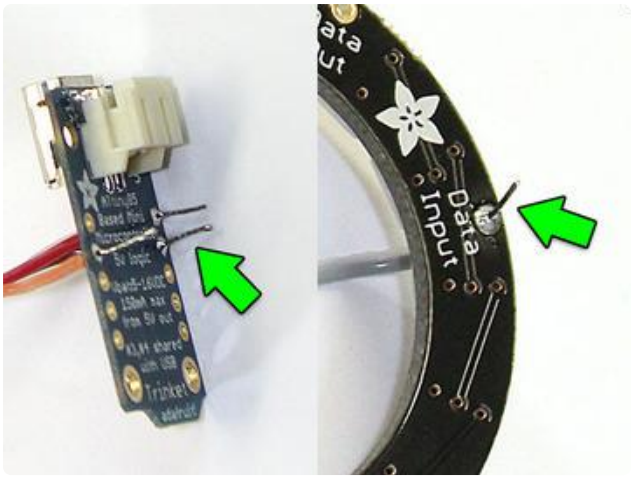
Click the “Download Project Bundle” below. This will download a ZIP file containing the project code and required libraries. Uncompress the ZIP file, look in the folder corresponding to the version of CircuitPython you installed, then drag the “code.py” file and the “lib” directory to the CIRCUITPY drive. It should then start running automatically.

```
# SPDX-FileCopyrightText: 2017 Mikey Sklar for Adafruit Industries
#
# SPDX-License-Identifier: MIT

#
# Kaleidoscope_Eyes_NeoPixel_LED_Goggles.py
#
import time

import board
import neopixel

try:
    import urandom as random  # for v1.0 API support
except ImportError:
    import random

numpix = 32  # Number of NeoPixels
pixpin = board.D0  # Pin where NeoPixels are connected

mode = 0  # Current animation effect
offset = 0  # Position of spinny eyes

rgb_colors = ([255, 0, 0],  # red
              [0, 255, 0],  # green
              [0, 0, 255])  # blue

rgb_idx = 0  # index counter - primary color we are on
color = rgb_colors[rgb_idx]
prevtime = 0
```

```
pixels = neopixel.NeoPixel(pixpin, numpix, brightness=.3, auto_write=False)

prevtime = time.monotonic()

while True:
    i = 0
    t = 0

    # Random sparks - just one LED on at a time!
    if mode == 0:
        i = random.randint(0, (numpix - 1))
        pixels[i] = color
        pixels.write()
        time.sleep(0.01)
        pixels[i] = (0, 0, 0)

    # Spinny wheels (8 LEDs on at a time)
    elif mode == 1:
        for i in range(0, numpix):
            c = 0

            # 4 pixels on...
            if ((offset + i) & 7) < 2:
                c = color

            pixels[i] = c  # First eye
            pixels[(numpix - 1) - i] = c  # Second eye (flipped)

        pixels.write()
        offset += 1
        time.sleep(0.05)

    t = time.monotonic()

    if (t - prevtime) > 8:  # Every 8 seconds...
        mode += 1  # Next mode
        if mode > 1:  # End of modes?
            mode = 0  # Start modes over

        if rgb_idx > 2:  # reset R-->G-->B rotation
            rgb_idx = 0

        color = rgb_colors[rgb_idx]  # next color assignment
        rgb_idx += 1

        for i in range(0, numpix):
            pixels[i] = (0, 0, 0)

        prevtime = t
```

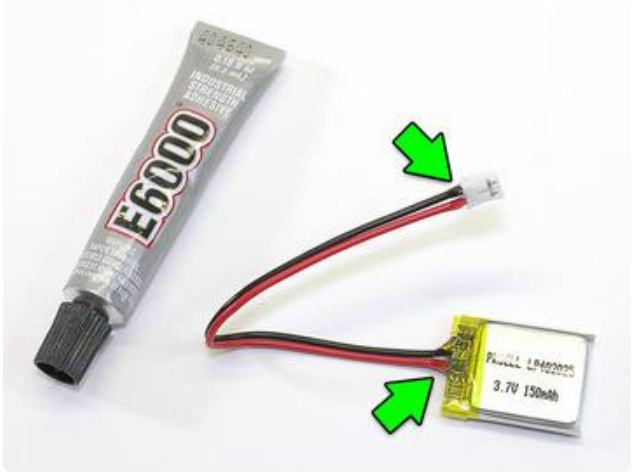
Final Assembly and Use

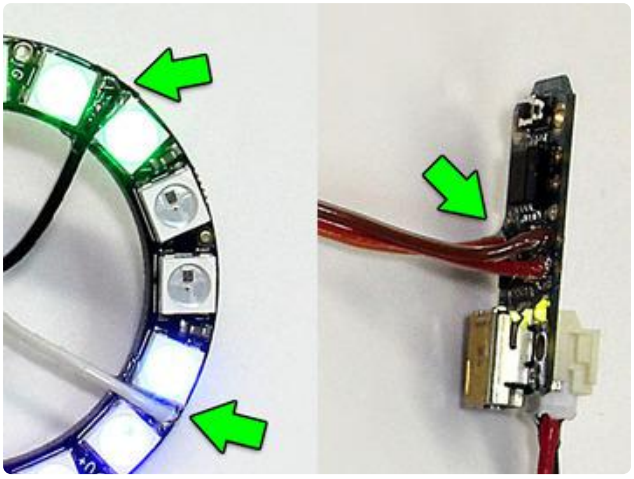
With the electronics squared away, let’s move on to the arts & crafts part of the project!



First, if you haven't already, clip off the tips of the soldered wires.

Gather these up and throw them away... make sure the clipped bits don't end up inside the goggles where they'd cause electrical shorts or put your eye out.





This step is optional but recommended: if you have some 5-minute epoxy or craft adhesive such as E6000, add a small bead at the base of each wire where it meets the board...and especially on the LiPoly battery and JST connector. This creates a strain relief, so wires aren't likely to break off when flexed. On the NeoPixel rings, it helps the wires sit flat.

Wait until the glue or epoxy is fully cured before final assembly or charging the battery.

Unscrew the rings holding the lenses in place. Most goggles (whether our costume variety or the bring-your-own type) will have a couple different layers inside, some clear, some darkened. Set the dark lenses aside, we'll just be using the clear ones.

The costume goggles have slots near the nose piece, bridged by a tiny bit of plastic. If these are clipped away, then all the electronics can be slid in place from the front. You might also cut the slots just a little wider so they don't gouge the wires.

Bring-your-own goggles usually aren't built this way, which is why assembly is more involved.

The NeoPixel LEDs are very bright and focused. Let's make some diffusers to soften the light. (This is optional)

Trace one of the lenses on a piece of paper, then cut it out with scissors. Ordinary printer/copier paper works just fine, or I had this fancy-pants vellum on-hand (it required two layers).

If you have access to a laser cutter (through a local hackerspace, your school, whatever), measure the diameter of the lenses for cutting new ones. 1/16" white acrylic works well for this.

Some of our early photos show ring-shaped diffusers, but we found the goggles were best used as a decorative hatband and not worn (more on this later). So go ahead and make solid diffusers. It's much easier and looks cool.

Insert the electronics into the goggles from the front, with the ring-to-ring ribbon cable across the bridge of the nose.

Prepare the lenses — clear layer first, then the diffuser, then optionally the spacer ring from the original lenses.

Screw the lenses in place, being super extra careful not to gouge the wires!

Connect the battery briefly to make sure all the electronics are happy prior to final assembly. It's easier to troubleshoot while everything's out in the open.

If using metal goggles, make sure there's no contact between the goggles and any exposed conductors.

The rings are then secured in place with a few dabs of hot glue or fast-setting epoxy. Glue just a couple spots at a time, so you can hold the rings centered while it sets.

Finally, the Trinket is then glued to the outer edge of the eye cup, with the USB port and battery connector both accessible. (If using metal goggles, use tape or something

to provide an insulating layer.) The wires can be folded and held in place with additional dabs of glue.

PRO TIP: if you used hot glue and need to remove the rings later, dip a Q-Tip in rubbing alcohol, touch it to the edge of each blob of glue and allow it to soak in for a few seconds. This doesn't dissolve the glue; it seeps between the two parts and cleanly breaks the bond. The glue should peel away with little effort. Science!

Power on the goggles by connecting the battery.

The battery is small enough to tuck away inside the eye cup. Add a bit of masking tape to hold it in place if needed.

SAFETY AND COMMON SENSE

Your LED goggles are a fashion accessory — they should be worn on your forehead or on a hat, not over your eyes. Even if you block most of the light inside, even a small scattered bit is still very bright and will cause headaches, maybe even vomiting (). If you leave out the diffusers and try to see through the rings, peripheral vision is