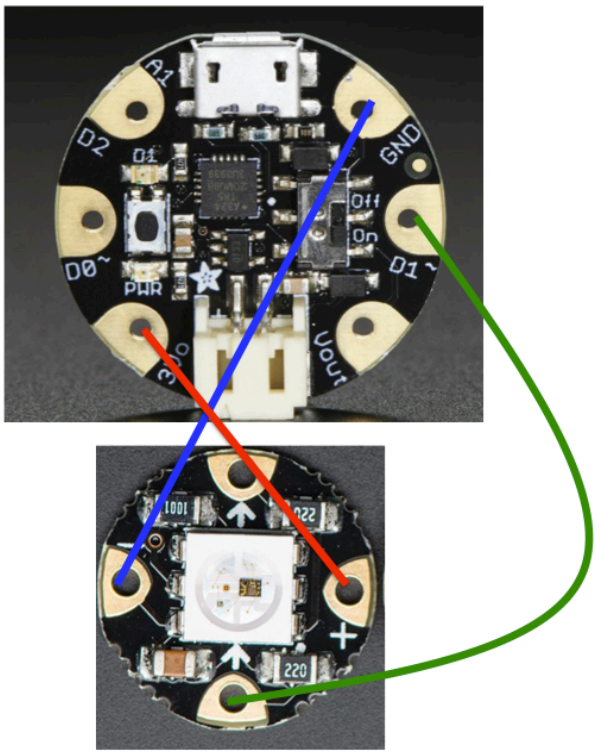
Light Up: We're Creating Wearables
The University of Texas at Austin WECE and WiCS

The objective for today is to sew and program an LED bandana. You'll need the following:

- Gemma v2 (Adafruit)
- Neopixel (RGB LED)
- Conductive thread
- Bandana
- Battery pack
- 2x CR2032 coin batteries
- Laptop setup w/ Arduino IDE for Adafruit Gemma
- Micro USB data cable

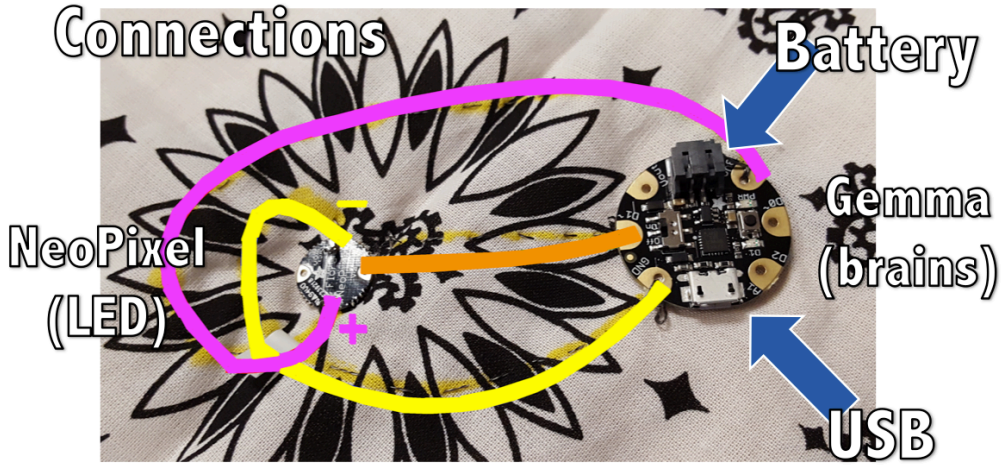
Please visit the Adafruit pages to see the full pinouts and technical specifications of the Gemma and Neopixel. Here's the connections we'll be making.



The Neopixel is sensitive, so connect while off or unpowered.

Gemma	Neopixel
GND	(-)
3Vo (power)	(+)
D1~	ARROW IN →TOWARDS LED

Here's an example of what it may look like on the bandana – feel free to get creative with placement.

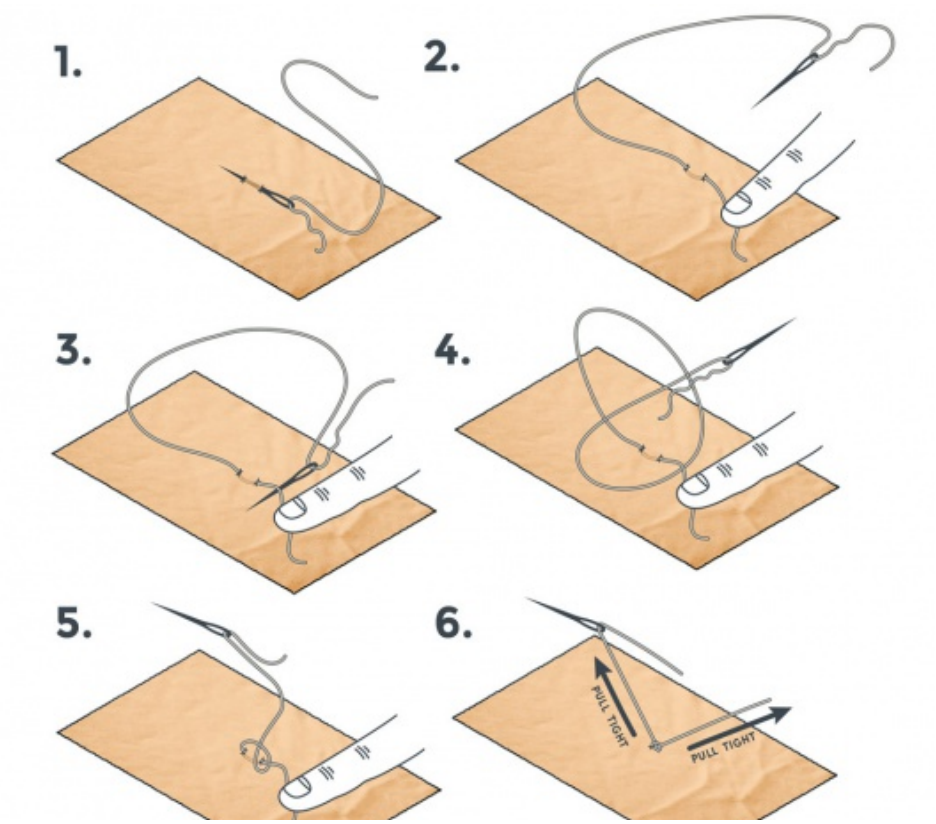


Working with conductive thread

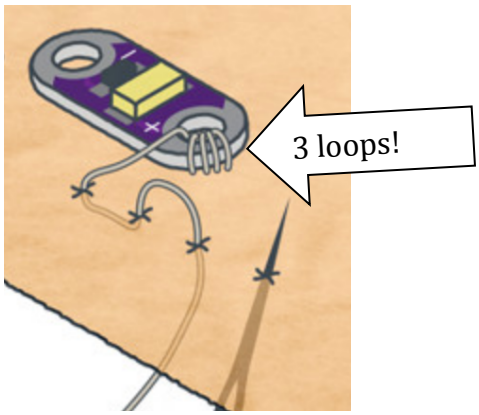
Sparkfun has a great tutorial: https://learn.sparkfun.com/tutorials/sewing-with-conductive-thread
But here are the important points –

1. **It's conductive AND un-insulated!** If your stitches cross, it will short your circuit. So plan your routes carefully and utilize electric tape. We have some beeswax if you'd like to provide a little more protection from accidental shorts and smooth stray fibers.
2. We recommend using a crayon/pen/pencil to highlight the routes you're going to stitch
3. THREE loops around each copper plated hole of Gemma/Neopixel is recommended for good connection.
4. The longer the distance between your circuitry, the higher the resistance. We have a fairly thin thread, so if you find your resistance too high, double up the strands. With the size of this bandana, it's unlikely you'll need to do this, but we haven't tested it.

Here's how to get things started – "Starter knot"



Don't forget 3 loops around each connection:



Software

Please visit github.com/txjenniek → Adafruit_Neopixel_Girlstart → Repository → WECE-WiCS-Docs for customized setup instructions for Windows and Mac computers. If you're getting "read-only" errors, try saving the sketch wherever it recommends.

If you'd like to read more detail about Gemma and Neopixel setup, please visit:
https://learn.adafruit.com/introducing-gemma/introduction
https://learn.adafruit.com/flora-rgb-smart-pixels/overview

`File → Examples → Adafruit NeoPixel → WECE`

About Arduino code

1. We will be programming in "C" but the Arduino IDE/framework/library have several parts of the language abstracted as it's targeted towards hobbyist progammers.
2. Arduino has 2 functions – setup() which is run once before loop() which is run as long as the Gemma is powered.
3. You can use single line (`// Commented Out`) or multi line (`/* Commented Out */`) comments to adjust the code.

About WECE example code

There are actually 3 LEDs on the NeoPixel board – red, green, and blue. The arguments to `strip.Color` function represent how brightly you want to turn each of the 3 LEDs on. The number must be between [0-255]. The higher the number, the brighter the LED. "0" will turn the LED off.

```
colorWipe(strip.Color (#RED, #GREEN, #BLUE), 10);
```

The last number (10 shown above) affects the period with which the color changes. **Experiment!** You can add as many or as few calls to colorWipe (with different colors and durations) as you'd like.

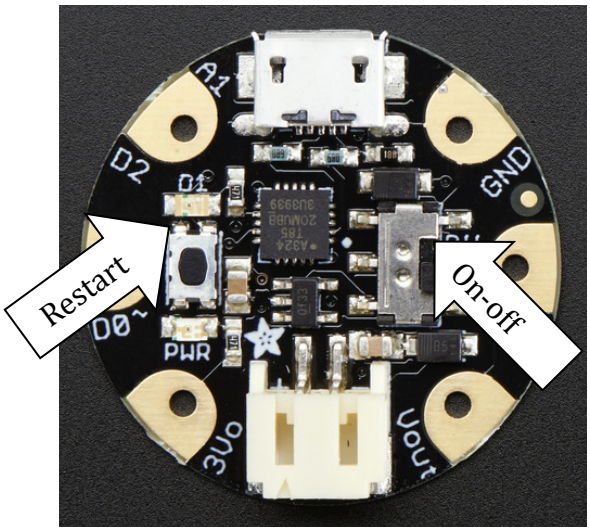
Next, experiment with the pre-written `rainbow` function. I recommend commenting out any `colorWipe` functions while first running rainbow.

```
rainbow(50);
```

Rainbow only takes 1 parameter – a "delay" time in milliseconds. This parameter will control how fast the LED cycles through the "rainbow." The code implementing `rainbow` is available below; change at your own risk!

Programming the Gemma

Select the **Adafruit Gemma 8MHz** board from the **Tools → Board** menu.
Select the **USBtinyISP** from the **Tools → Programmer** sub-menu.



When you plug in the USB cable, it powers the Gemma, so you don't need the battery pack.

Gemma has a custom bootloader it needs to be running for you to program it. Upload to the Gemma within the first 10 seconds of it starting up. Right before you want to upload, either use the **reset** button or the **on-off switch** to get it into bootloader mode.

Final things to note

- Gemma does not have a Serial port connection for debugging so the serial port monitor will not be able to send/receive data
- Some computers' USB v3 ports don't recognize the Gemma's bootloader. Simply use a USB v2 port or a USB hub in between
- Don't forget to plug in the Gemma via a **known-good USB cable** to start the process. You should see the green power LED lit and the red bootloading LED pulse indicating that the Gemma is ready to start programming. If the red bootloading LED pulse is weak, it's likely you have a power-only USB cable, not a data USB cable.
- If the Arduino exe is "damaged" and you're using a Mac – it is likely you didn't allow applications from anywhere (it's in your security settings)

Color mixing cheat sheet – Light doesn't mix the same way as paint.

Yellow	(255, 135, 0)	Teal	(0, 255, 255)
Lavender	(255, 106, 250)	Orange	(255, 55, 255)
Light Blue	(0, 118, 255)	Hot Pink	(255, 0, 55)