

# The Starry Night T-Shirt

Christalee Bieber  
April 13, 2013



# What Are E-Textiles?

Garments & craft projects that include circuitry and/or electronics

- Originally, embedded wires and modified through-hole components
- Today, conductive thread and components designed to be sewable, including LilyPad Arduino

Photo & design by Tim Bieniosek



# From Basic...

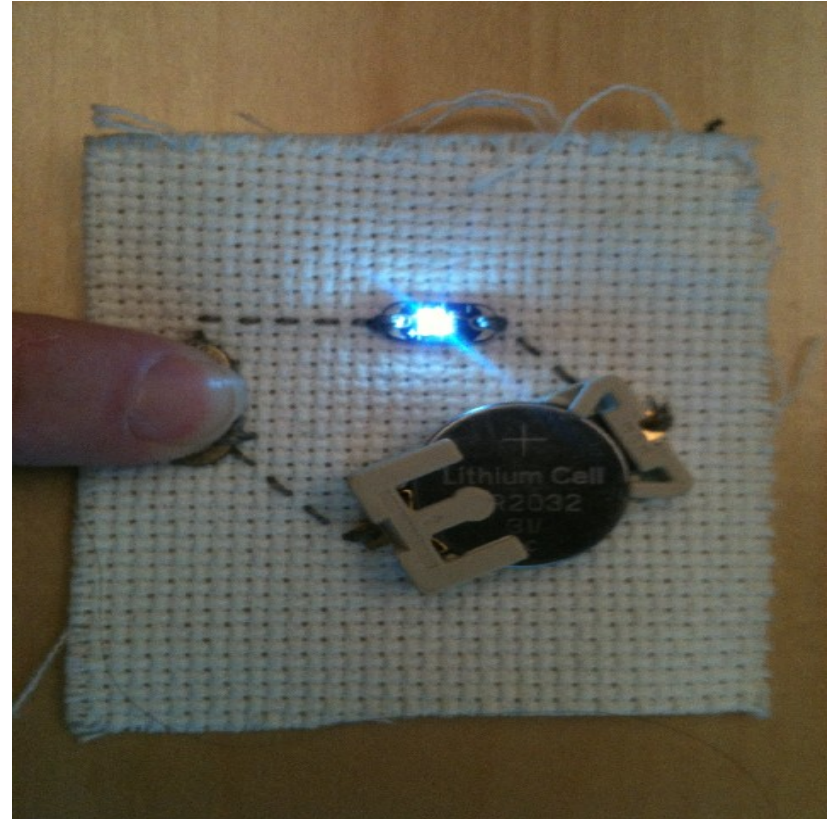


Photo & design by NancyLee Bergey



# ...to Elaborate



Photo & design by Becky Stern

# What Are We Doing Today?



Creating a basic circuit using the LilyTiny, a battery, conductive thread, and some LEDs.





**April 26,  
Friday**

*crafting  
circles*

**Astronomy  
Night 2013**

Franklin Square Park  
600 N. 6th St.  
Open at 6pm,  
lights on at 8pm



April 18-28, 2013

# Instructables Contest

Deb Lui from Penn's Annenberg School is here to help participants enter an Instructables contest:

<http://www.instructables.com/contest/maketolearn/>

This involves taking photos/video of your project while you make it, and answering four questions:

- ▣ What did you make?
- ▣ How did you make it?
- ▣ Where did you make it?
- ▣ What did you learn?

We'll stay til 5pm for this. Deadline: April 15

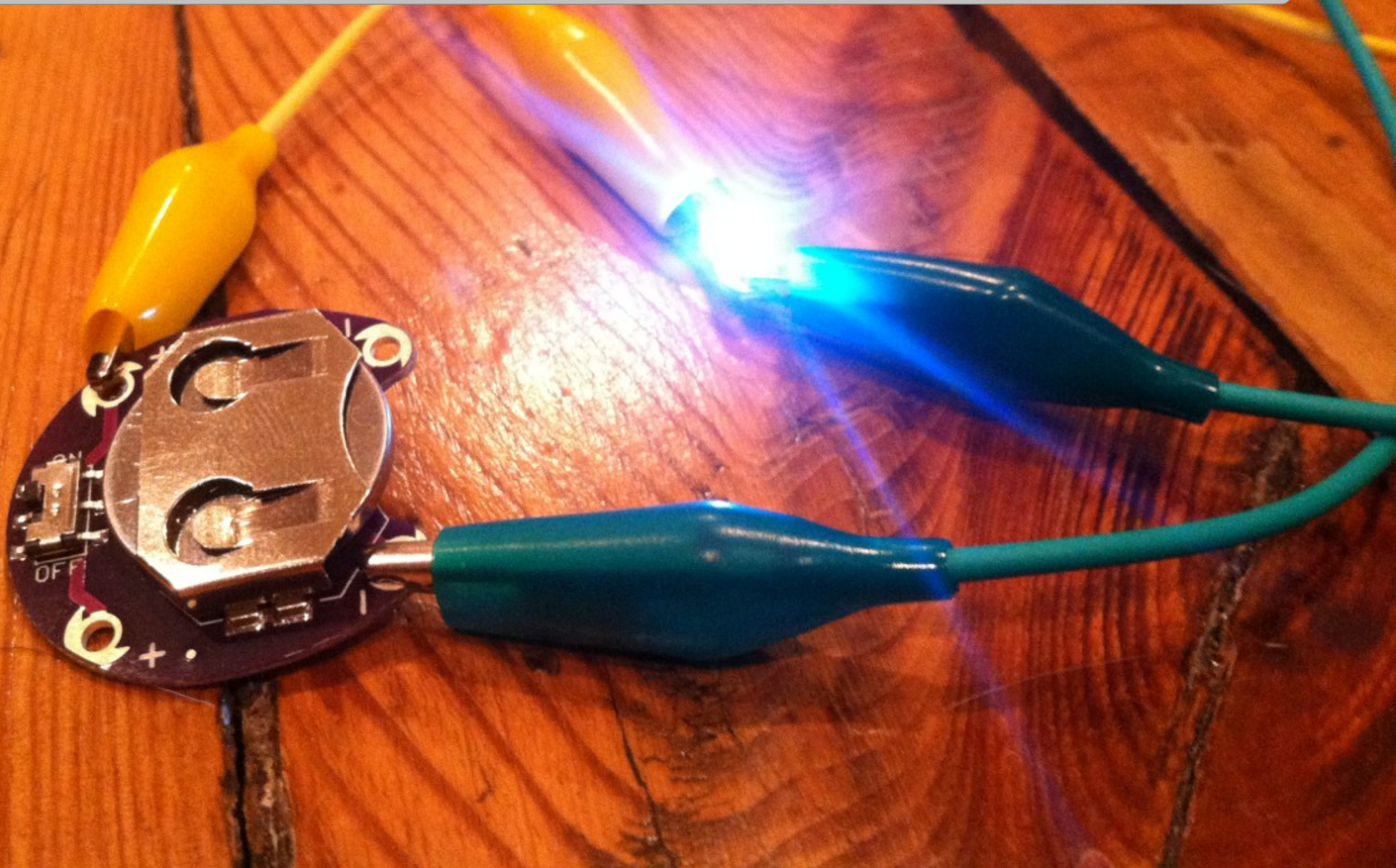


# Electricity and eTextiles



# Light Up an LED

Use one battery, one battery holder, one LED, and two alligator clips to light up an LED





# What did you learn?

Positive on the battery to positive on the LED

Negative on the battery to negative on the LED

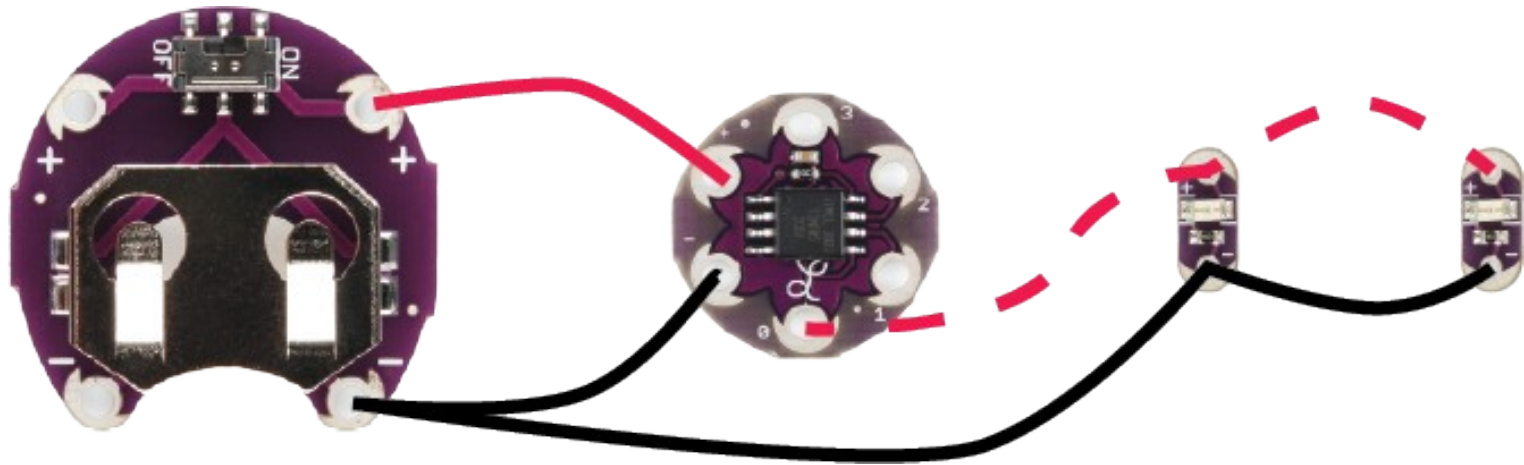
Battery goes into the holder + (smooth) side up

The switch needs to be turned on



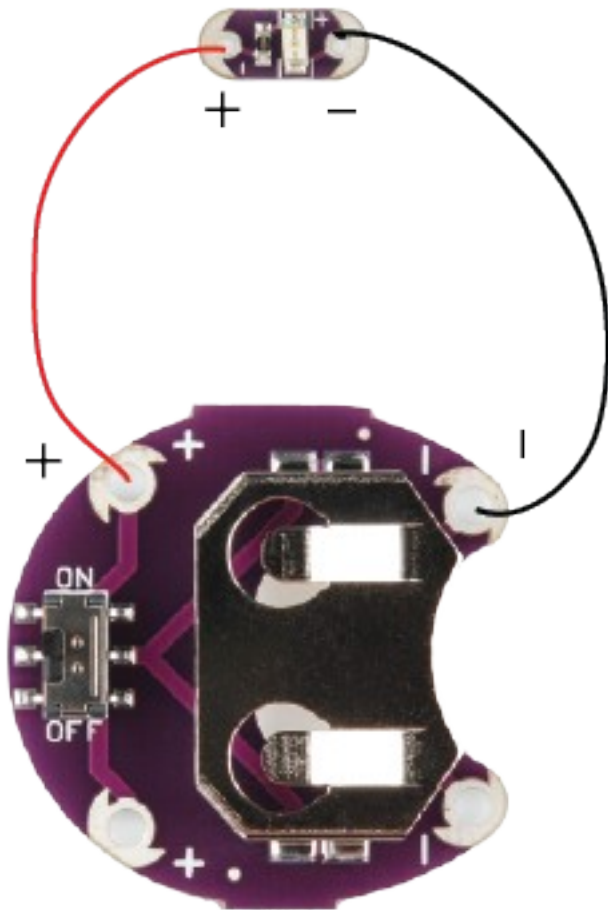
# LED T-Shirt Circuit

- In this project, we're going to use the battery to power the LilyTiny and LEDs, and the LilyTiny to control the LEDs.





# Connecting a Single LED



- Electricity flows from the battery, through the LED, and back into the battery in a complete **circuit**
- The battery helps move the electricity through the circuit by giving each electron a voltage
- ▮ The amount of work (light, heat, motion) the circuit does depends on the voltage per electron and the total current of electrons

# Problem #1: Broken Circuit

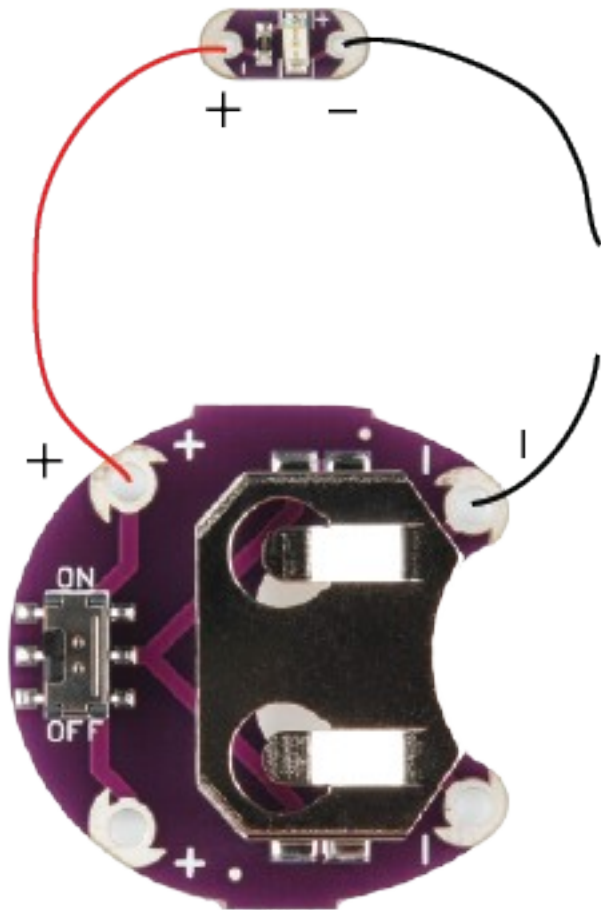
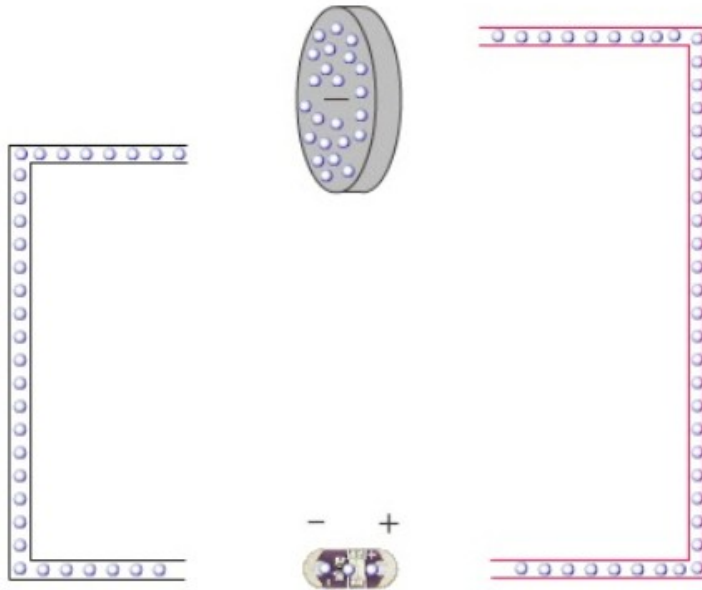


Photo by [U.S. Navy.](#)

# What is Going on Inside the Circuit?



- The battery forces the positive and negative carriers apart.
- If we create a path from the negative side of the battery to the positive side, the charge carriers will follow it.

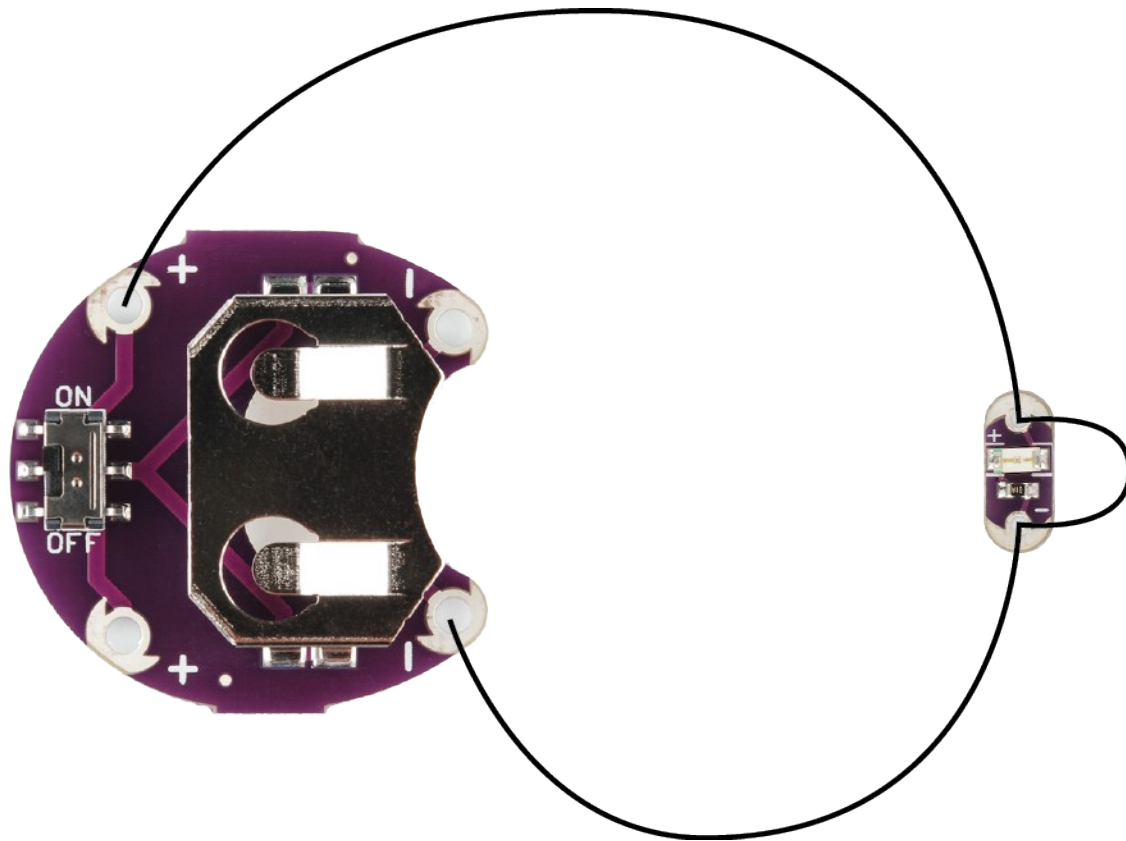


# Problem #2: Short Circuits

- Electrons want to take the easiest path
- Flowing through conductive thread is **easy**, but flowing through an LED is **harder**
- Electrons will go through an LED if the battery has enough voltage to push them through
- If you accidentally give the electrons a shortcut around the LED, they won't go through it!

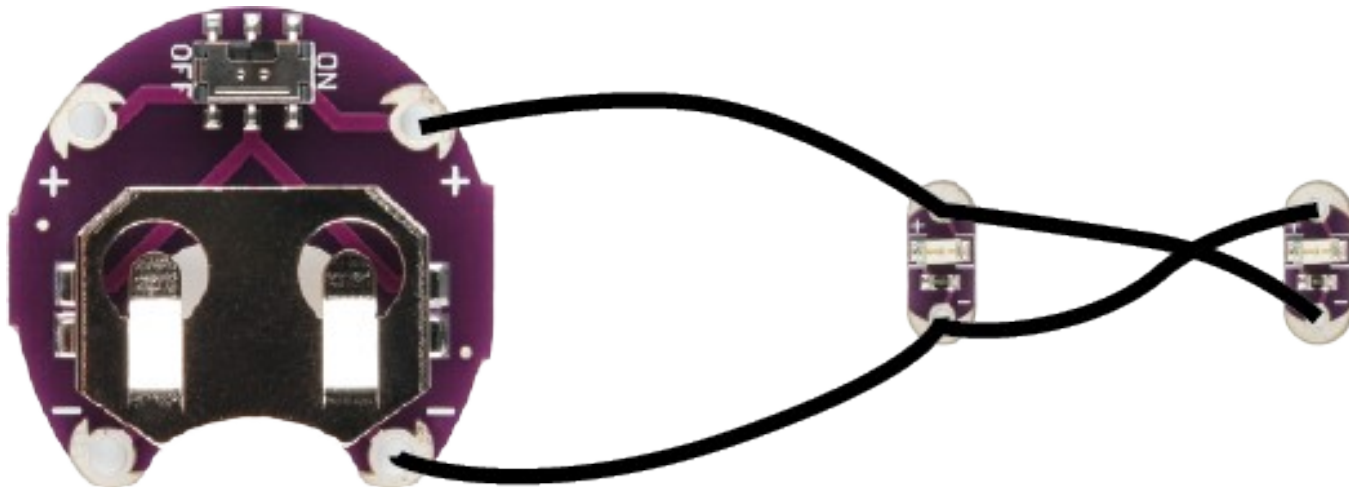
# Short Circuits

- Will the LED light up in the circuit below?



# Short Circuits

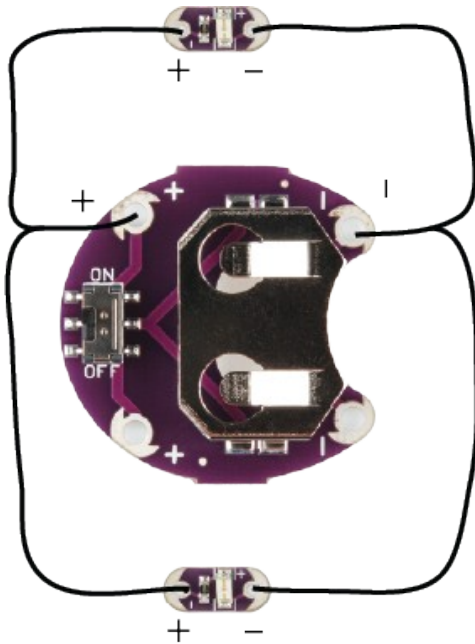
- Will the LED light up in the circuit below?
- No! Remember that electrons are lazy. We have given them a path from one side of the battery to the other without going through the LED. This is a **short circuit**.



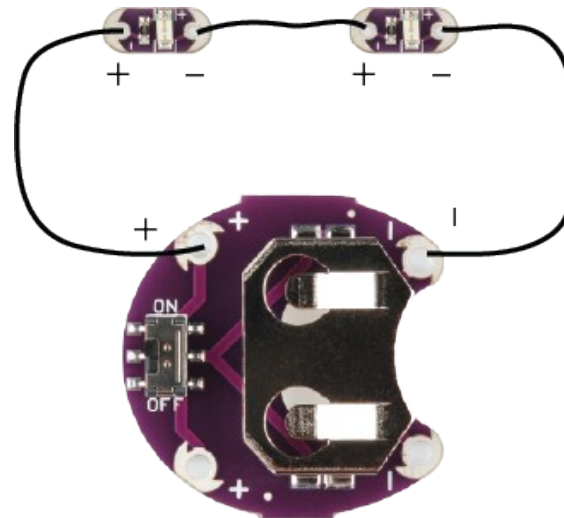


# Multiple LEDs

- Create a circuit out of two LEDs, some wires, and one battery
- There are two different arrangements:

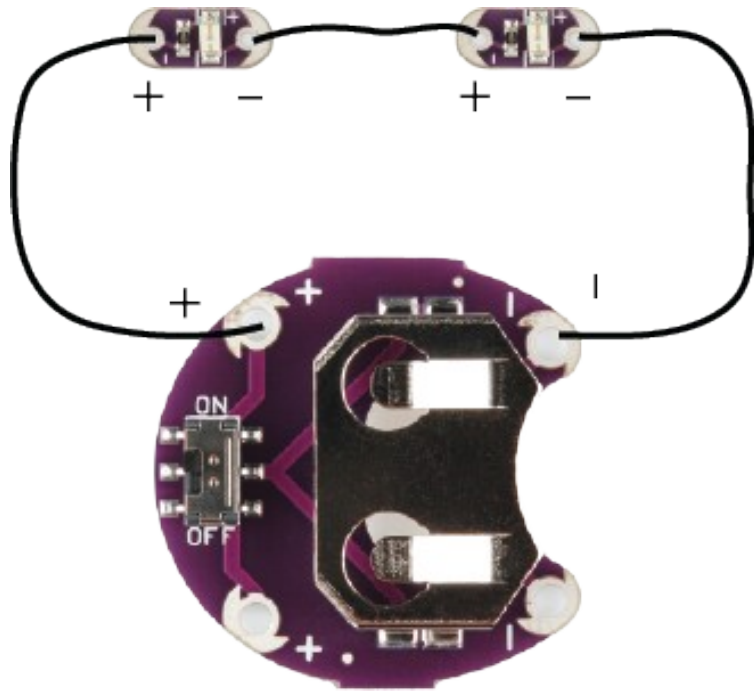


Parallel



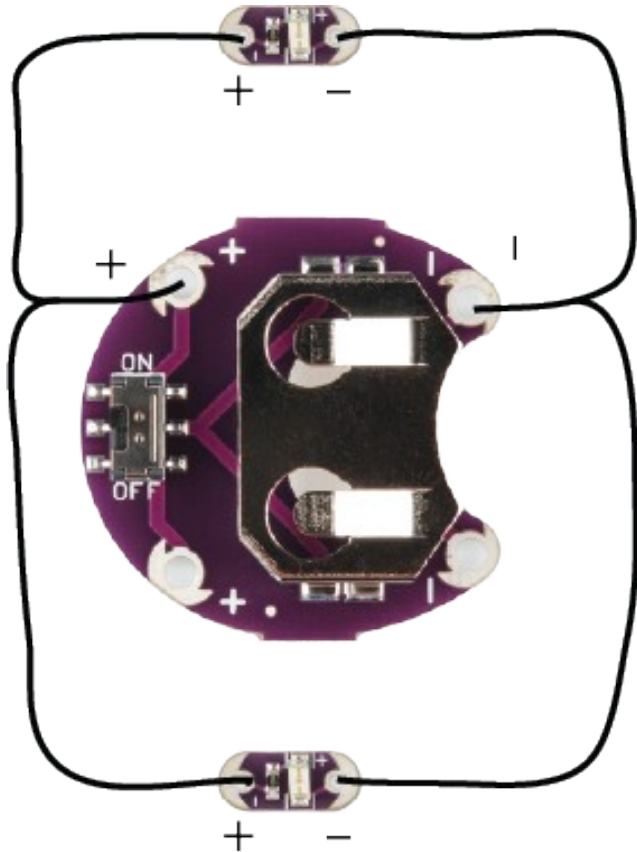
Series

# Series Circuit



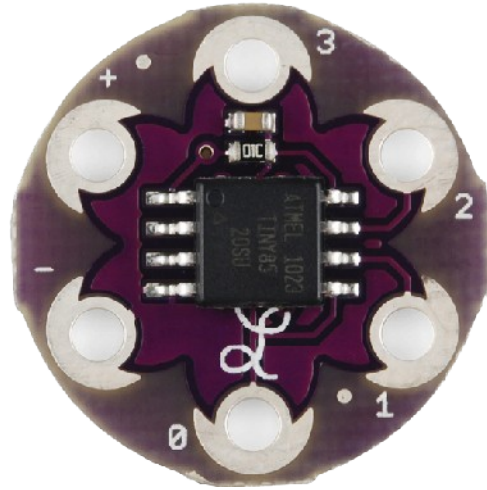
- Each electron passes through both LEDs
- Sometimes, the battery doesn't have enough voltage to push the electrons through both LEDs

# Parallel Circuit



- Each electron passes through **one** LED
- Our battery has enough voltage to push each electron through a single LED
- Because of this, we will usually connect our LEDs in parallel

# The LilyTiny



The LilyTiny gives us more control over the LEDs

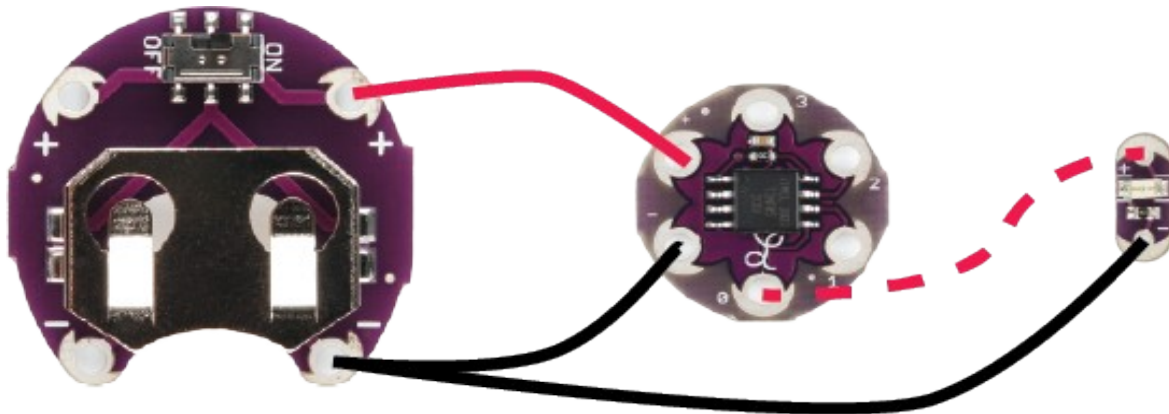
Each numbered pad has a different effect: blink (0), heartbeat (1), breathing (2), and random (3)

You can connect LEDs to one or more effect!



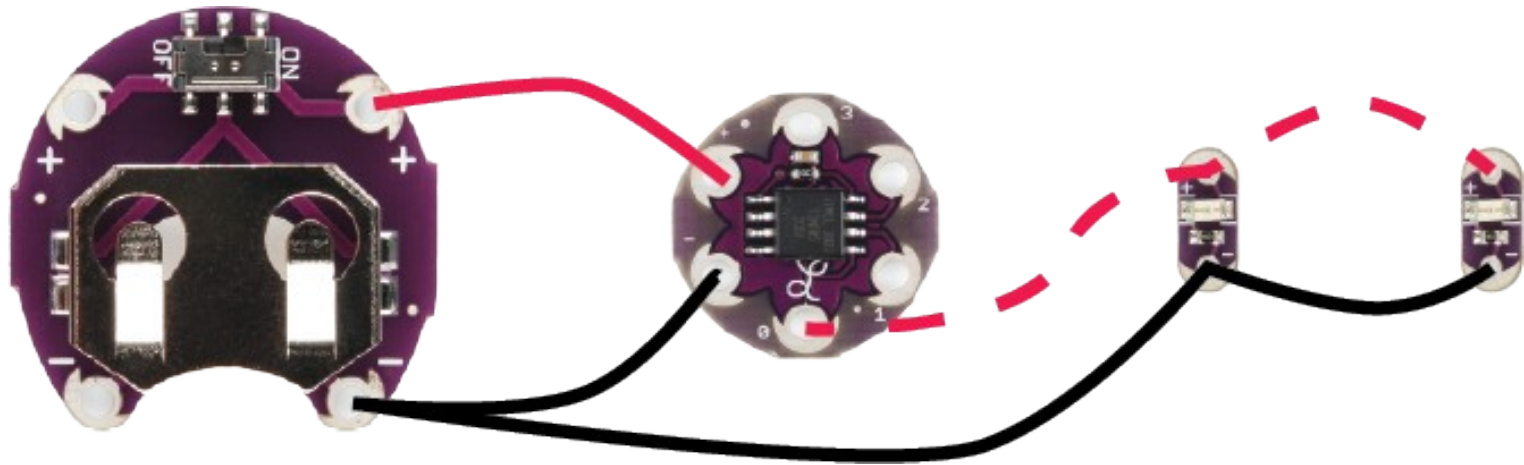
# The Blinking LilyTiny Circuit

1. Connect the positive terminal on the battery to the positive terminal on the LilyTiny.
2. Connect the negative terminal on the battery to the negative terminal on the LilyTiny.
3. Connect the positive terminal of the LED to the numbered terminal of the LilyTiny.
4. Connect all the negative terminals together.



# Connecting More LEDs

- To connect more than one LED to each effect, we use a parallel circuit
- Positive to positive, negative to negative

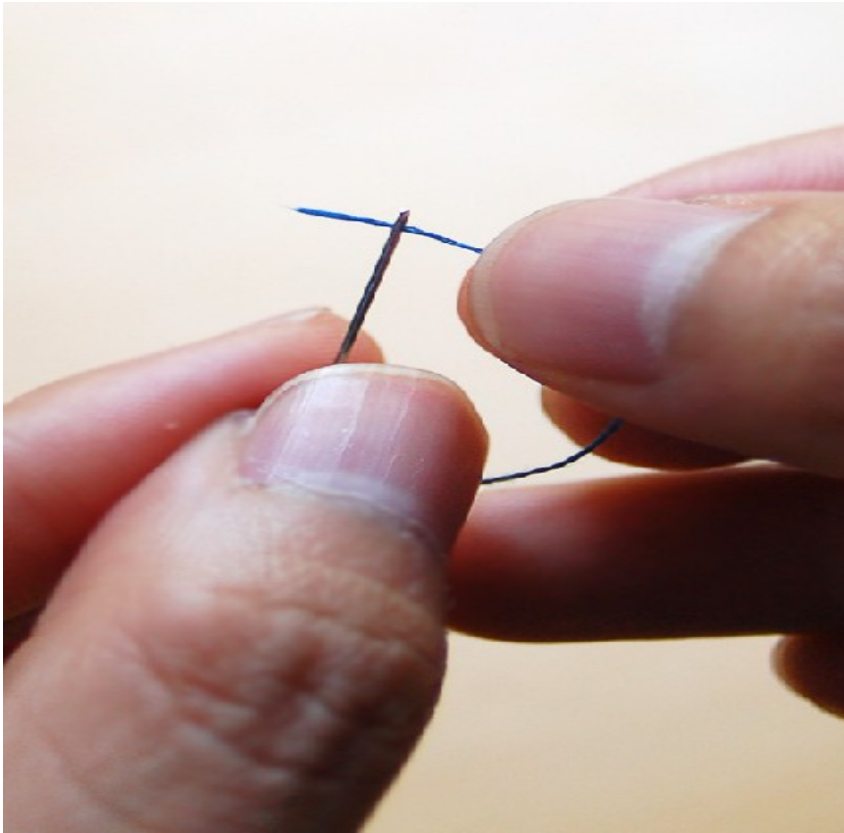


# SEWING TECHNIQUES

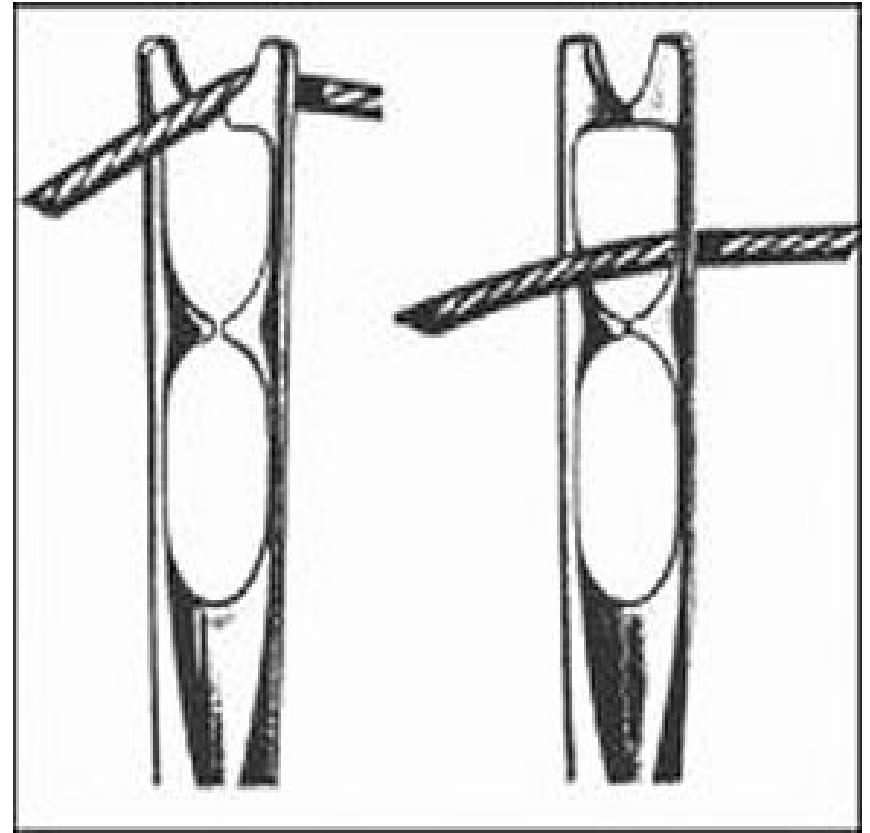


# Threading the Needle

**Normal Needle**



**Self-Threading Needle**





# Starting Knot



1. Make an X near the end.



2. Grip the X with thumb & index.

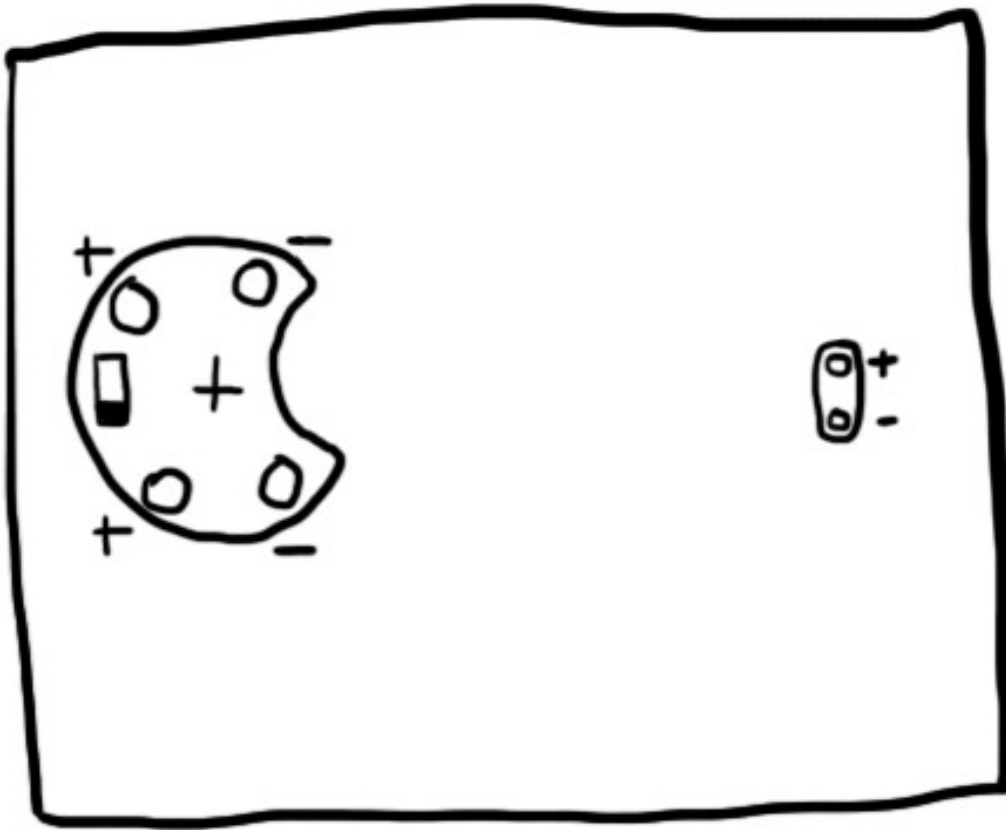


3. Roll thread off finger with thumb.



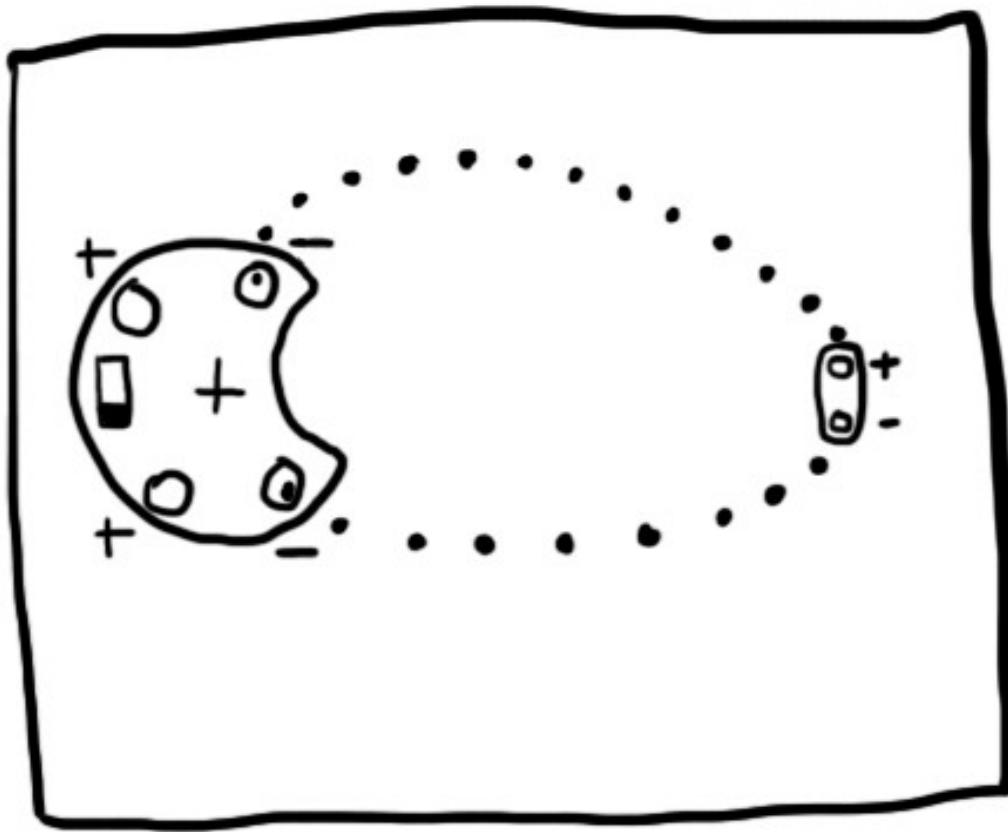
4. Tighten loops into large knot.

# Step 1: Place the Components



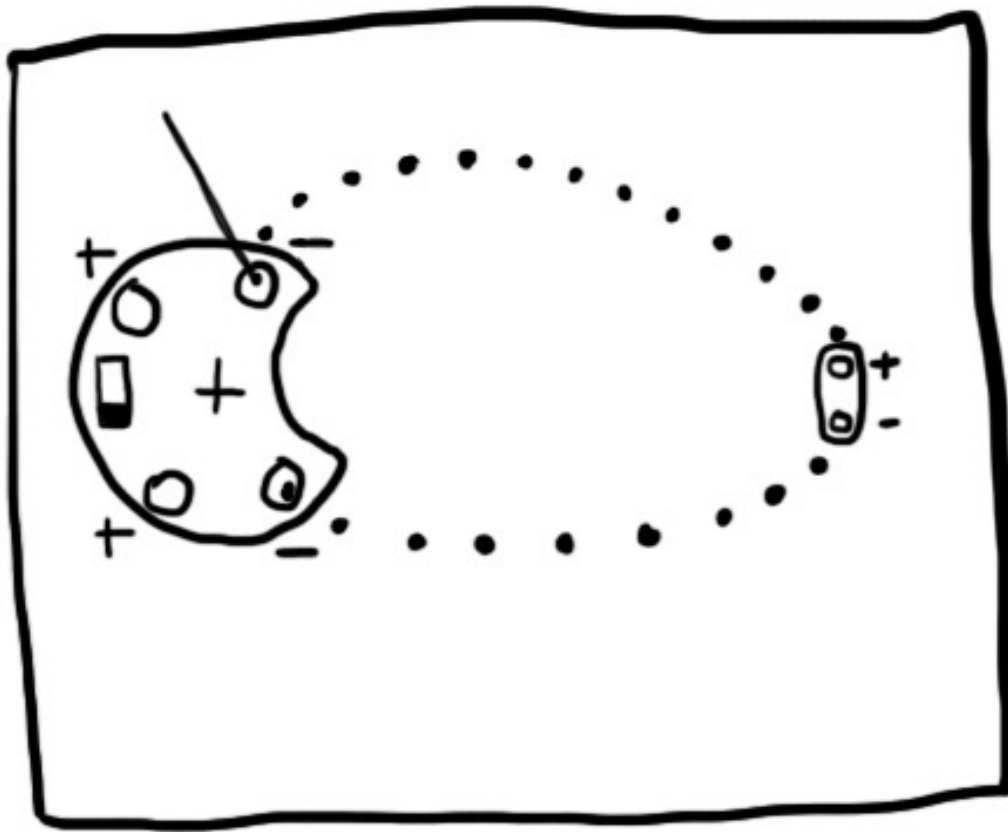
Place the battery holder and an LED onto the fabric. Keep them in place with some double-sided tape.

# Step 2: Draw Dots with a Marker



Use a washable marker to draw two dotted lines. One line should connect the positive terminal on the battery to the positive terminal on the LED. The other line should connect the negative terminals.

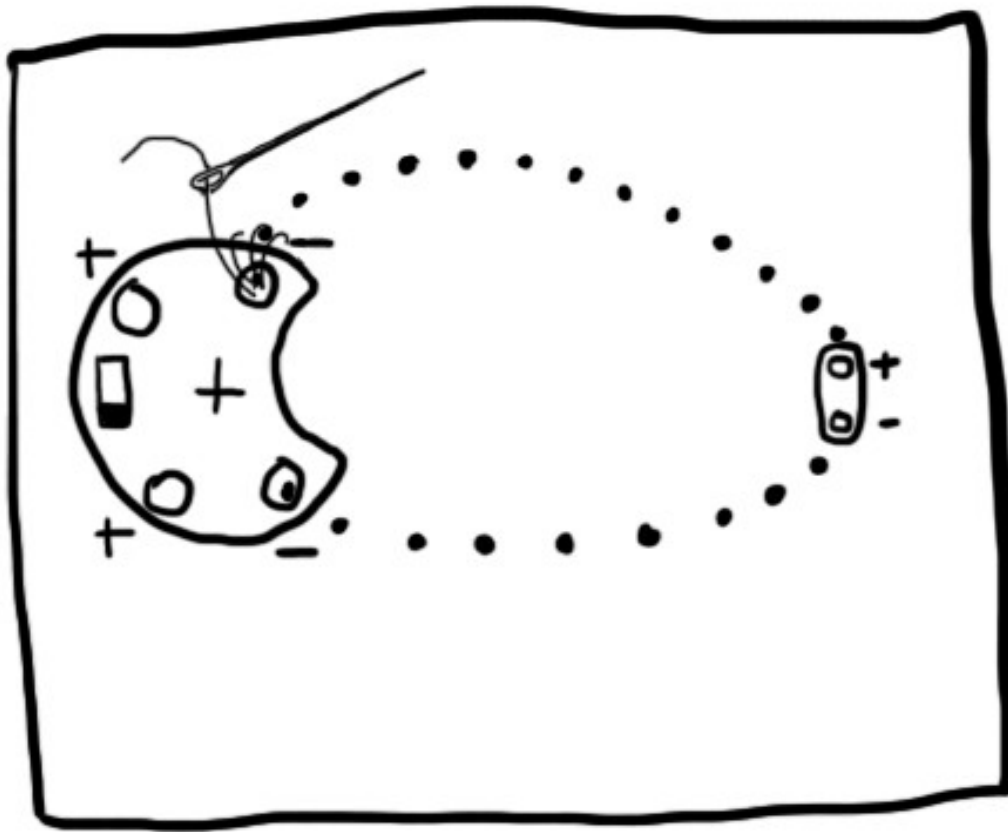
# Step 3: Start the First Stitch



Start the first stitch by poking the needle up through the positive hole on the battery holder. Pull the thread through until the knot is right on the other side.

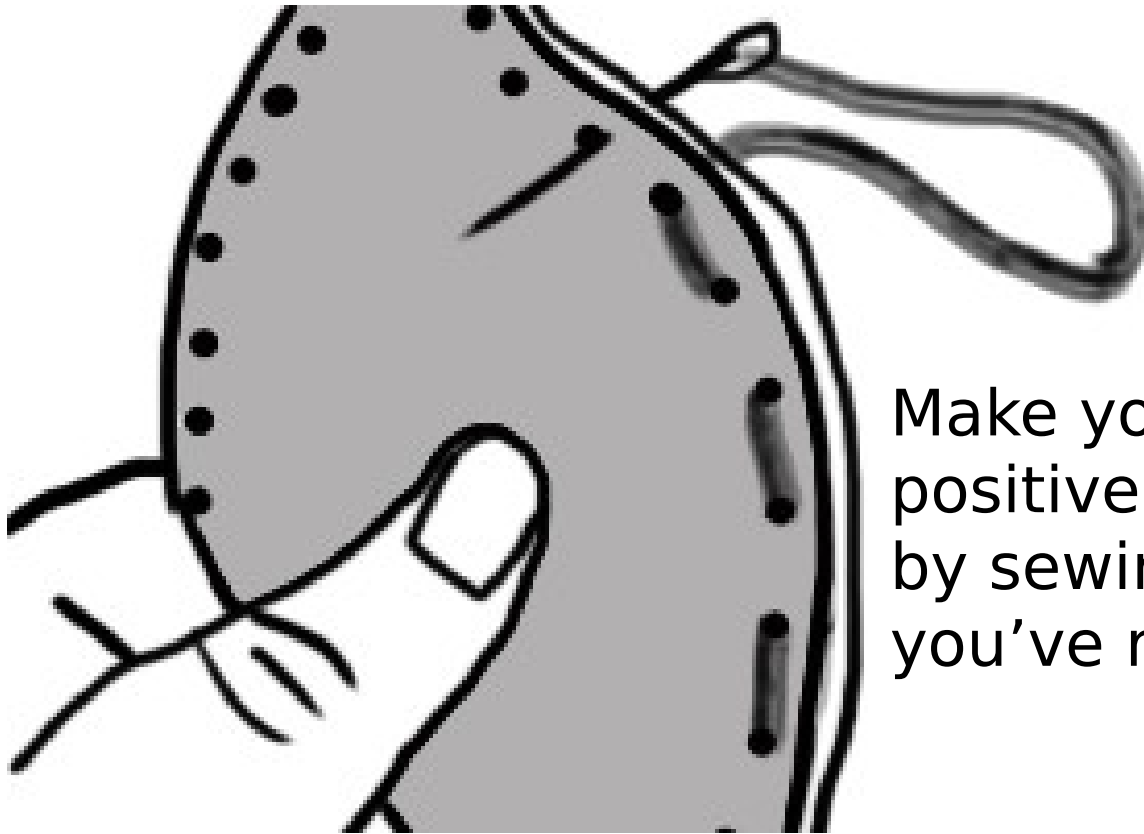


# Step 4: Loop Three Times



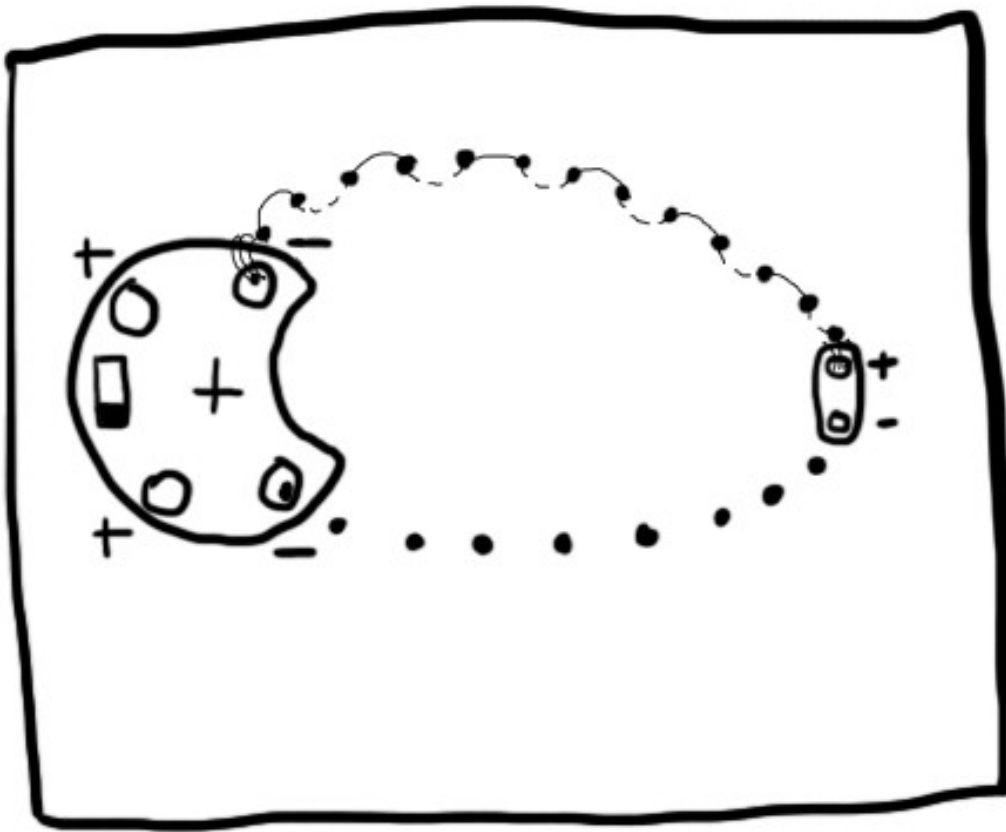
Make three loops through the positive terminal of the battery. This makes a strong connection between the conductive thread and the positive terminal.

# Step 5: Sew Along the Dotted Line



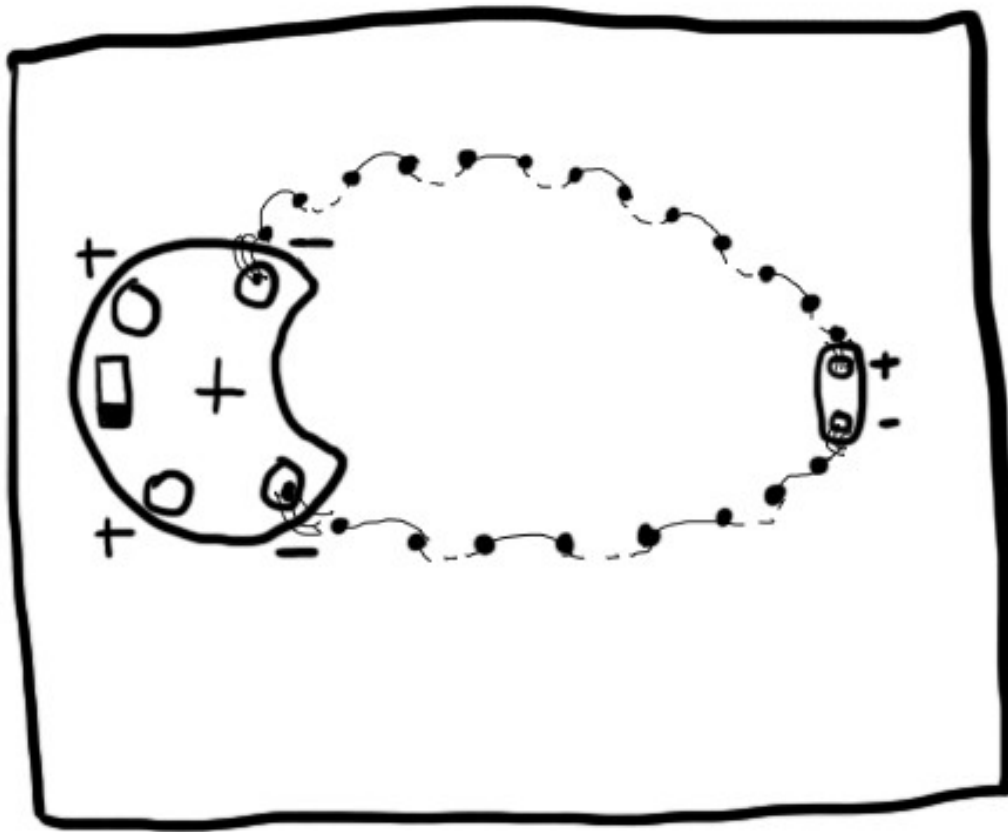
Make your way to the positive terminal on the LED by sewing up and down until you've reached the end.

# Step 6: Loop Three Times



Once you reach the positive terminal on the LED, loop through three times. Then, knot the thread and cut off the extra bit.

## Step 7: Connect the Negative Terminals



Make a new knot and sew a running stitch to connect the negative terminals. Once you're done, put in a battery (+ side up) and flip the switch to ON to light up the LED.



# Suggestions for Success

- Check the back for knots and loose threads; these can cause short circuits
- Needles are sharp, handle with care!
- Leave the battery off until ready to test, to avoid shocks & draining
- Use alligator clips to test the LilyTiny patterns before starting to sew.
- If you have to cross conductive thread lines, use fabric as an insulator.
- Use regular thread for ribbon and sequins.