BYTES & BITES
CIRCUIT SHENANIGANS

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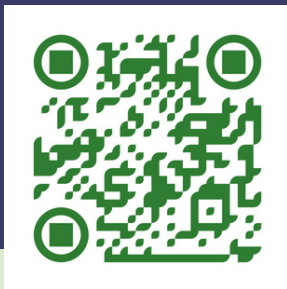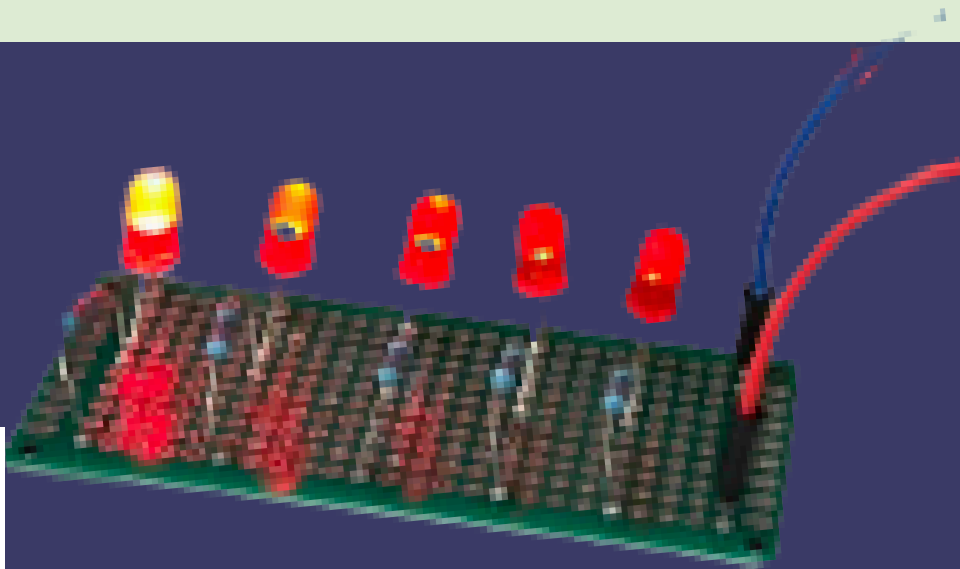
Beginner
Soldering Workshop

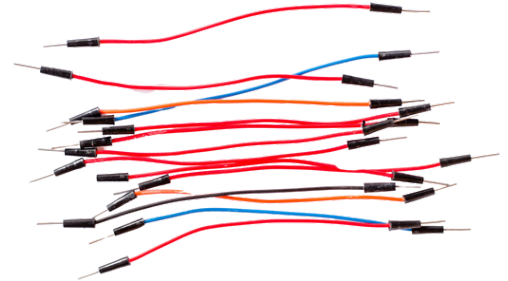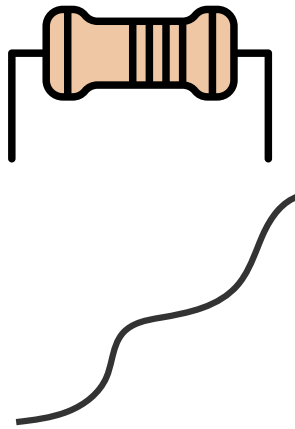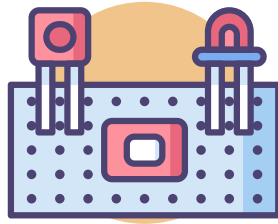**Relationship between current, voltage, and resistance is called "Ohm's Law"**
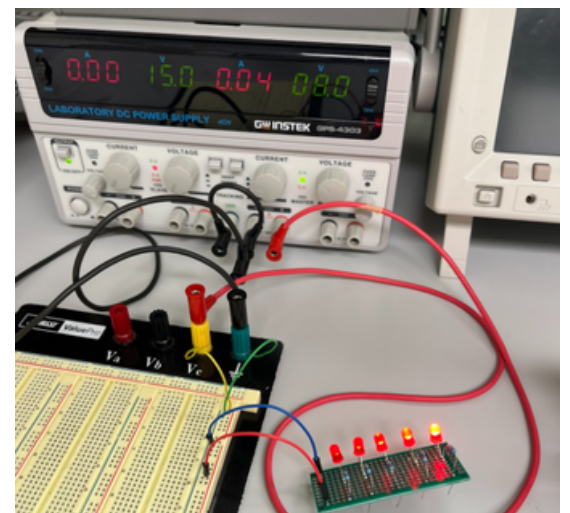Written By: Gordon Ho
Edited By: Eli, Rhea & Gordon Ho
Created By: Gordon Ho

Materials

1 PCB Board

5 LEDs

5 Resistors

    1 220 Ω

    1 1K Ω

    1 2K Ω

    1 5K Ω

    1 10K Ω

2 Bare Wires

2 Breadboard Wires (preferably different colors)

1 Battery Holder

LED Soldering Activity
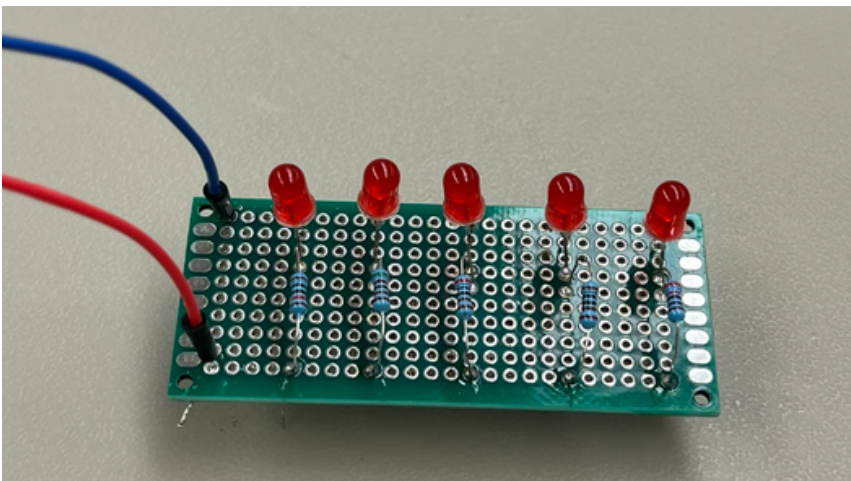
Circuit Schematic
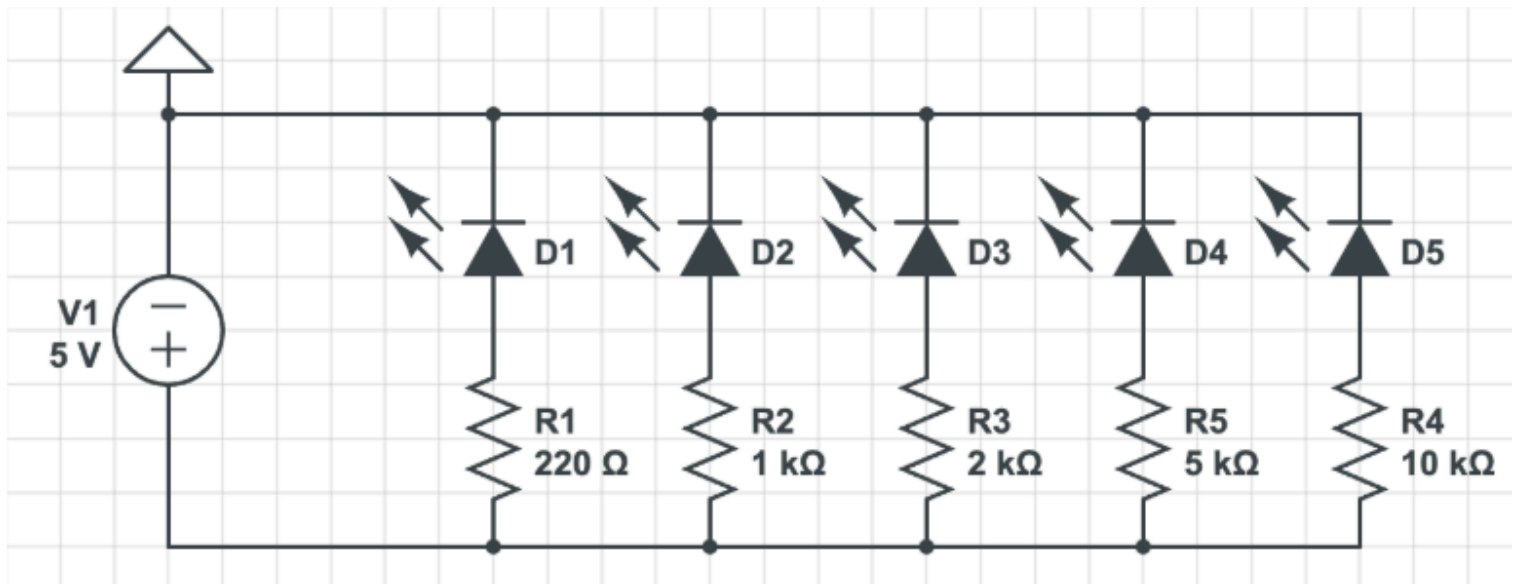
Light Emitting Diode (LED)

The triangle with a horizontal line above it is called a diode, an LED is notated with the arrows pointing away from it. You will notice that the LEDs in your hand has a long leg and a short leg. The long leg is called the anode and the short leg is called the cathode.

Ohm's Law Visualized

Component

Cathode (-)   Anode (+)

Schematic Symbol

Steps

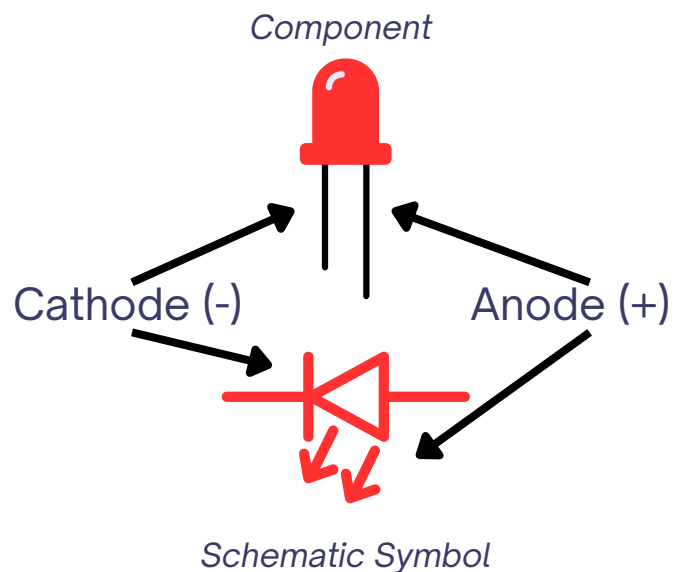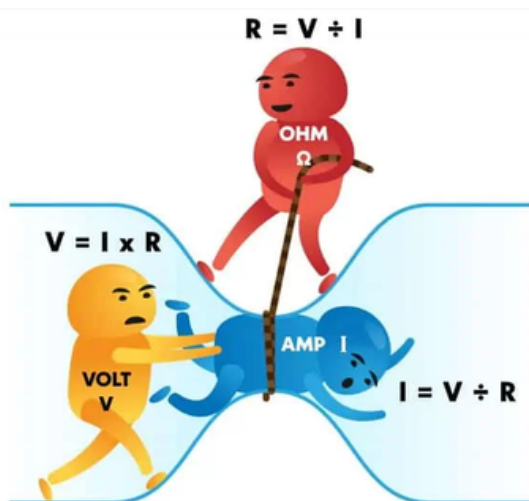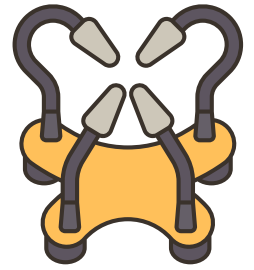**1.** Start your project by setting up the helping hand so that it is holding the empty PCB board flat above the table.

2. Start your board by placing the cathode in the top row of your board, skip two holes as seen in Figure 2a, and insert the anode into the third hole below the cathode.
IMPORTANT: *Make sure that the anode and cathode are placed where you were instructed, direction matters, if it's flipped the circuit will not work.*
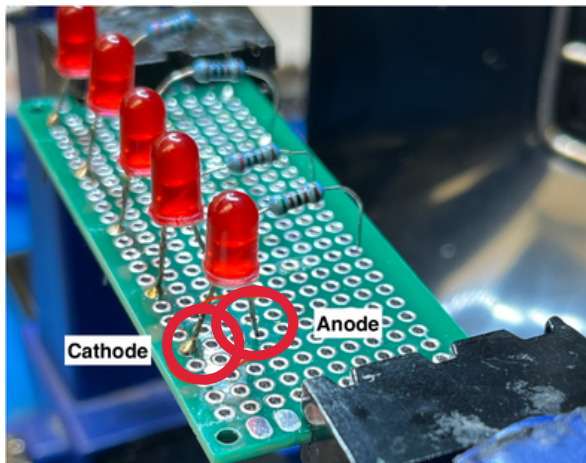

Figure 2a
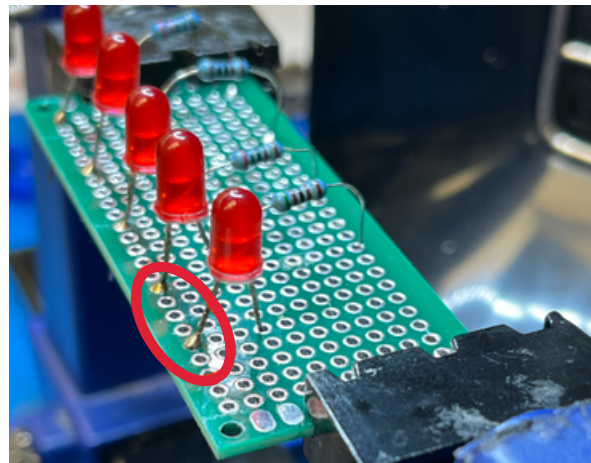
Figure 2b

2a. You will need to bend the legs a bit and use some force to get this placement. The idea is to use friction and tension in the legs to hold the LEDs temporarily. Repeat this for the other 4 LEDs, and space them apart with three or four holes in between each one as seen in Figure 2b.

3. After putting all the LEDs into place, turn the board upside down. If any LEDs fall out, flip the board back up and put the LED back, this time with more tension. If you can't do this, bend the Anode sticking out from the bottom up toward the board and away from the cathode so that it's flat against the board.

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4. Now your mentor will teach you how to solder the LEDs in place. Start by soldering the cathodes on the underside of the board so that the anode can still wiggle around but the LED will not fall out as seen in Figure 4.
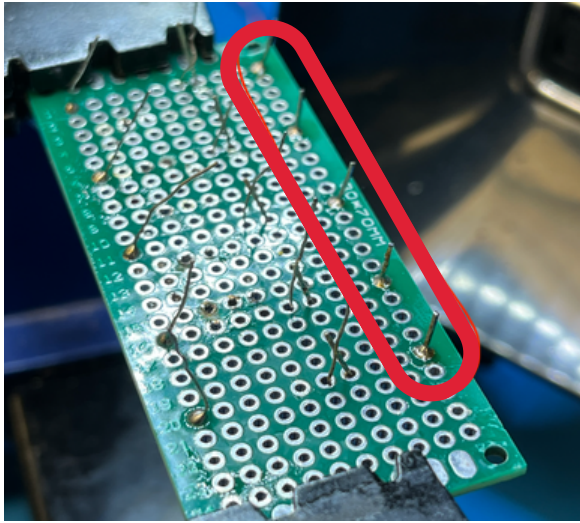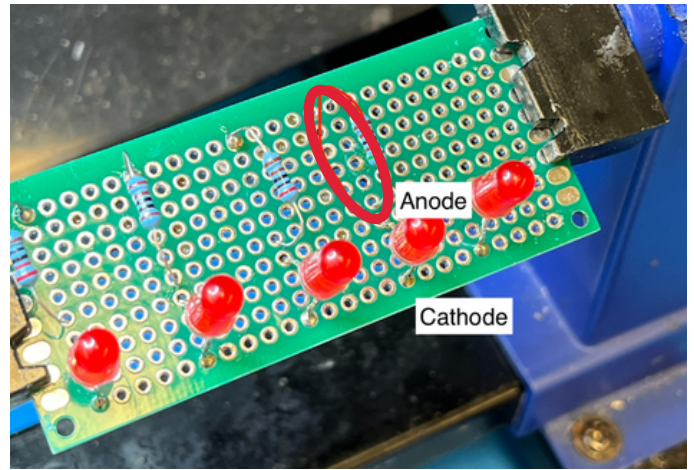

Figure 4

Figure 6

5. After you soldered all the cathodes, get your resistors and prepare them to be placed into the PCB. While the order does not matter, your final product would look better if the light's brightness increased from left to right or vice versa. (See the Circuit Schematic) If you don't know the resistance of your resistors, use the breadboards and multimeter to measure it if you know how. If you don't ask a mentor or someone who knows how.

6. Place one leg of the resistor through a hole below the anode of the LED, skip four holes and insert the other leg into the fifth hole as seen in Figure 6. Again like the LED, use the tension in the legs to hold the resistors in place temporarily. You can do this by bending both legs downward with a width of about three to four holes.

7. After all your resistors are in place, flip the board upside down, once again they should stay in place, if not please make adjustments so they do stay in place or ask for help.

8. Now go ahead and solder the leg of the resistors that are farthest away from the LED to the board. This will hold the resistors in place as we prepare to solder the LED and resistor together. The red circle indicates the legs that should've been soldered after this step and the blue circle indicates the areas that should NOT be soldered yet as seen in Figure 8.

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9. Once your board looks like Figure 8, where everything on the edge is soldered and the middle is empty, you can move on to the next step. Right now the resistors and LEDs are not connected so we need to do this by soldering the legs into the board and bridging the gap between the legs with solder.
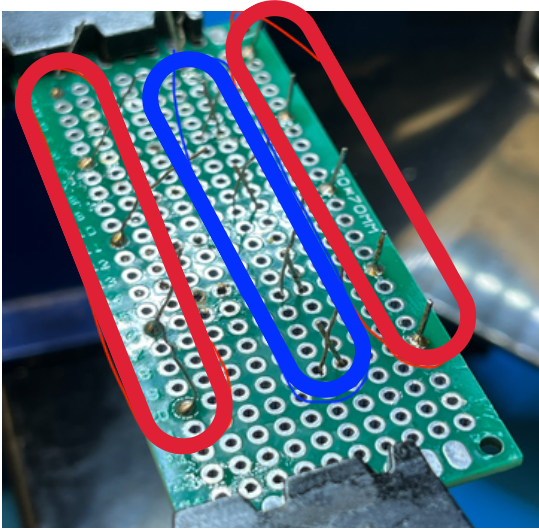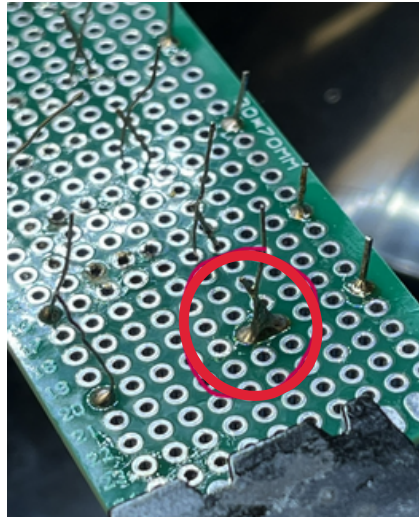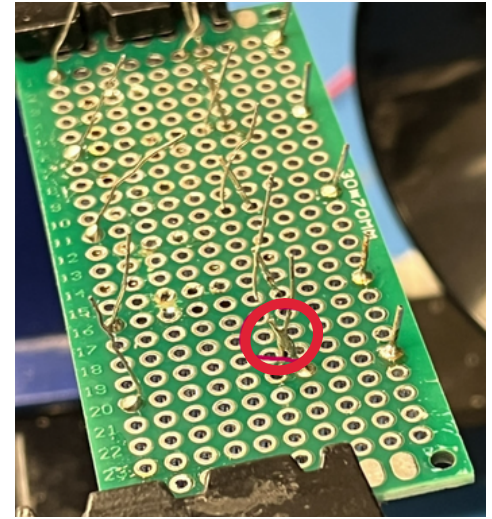

Figure 8

Figure 10a

Figure 10b

10. First, fill the holes occupied by the legs with solder. Then begin to place excess solder between the two holes, try your best to use your iron as a brush of sorts to guide the solder between the wires and not down the holes. If you place your iron too close to the board, the solder will just flow through the hole and out the other end. Your solder bridge should look like Figure 10a. If you are unable to do this. You can just cross the legs of the resistor and LED to form an X shape and just place the solder at the point of intersection, like Figure 10b.

Repeat this with the other four resistors and LED legs.

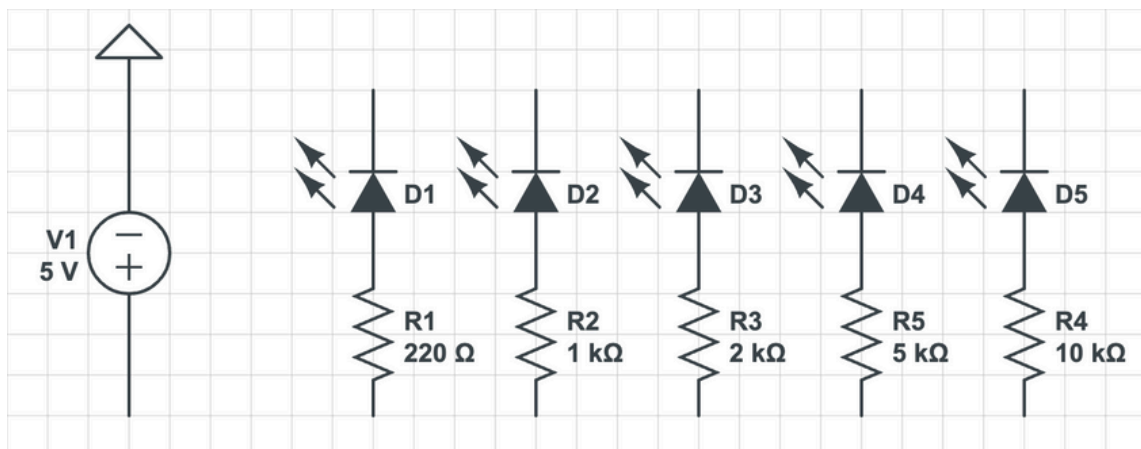**10a.** At this step, if you were to draw a schematic for your board it would look like this.

Figure 10c

11. We need to connect all the diodes, resistors, and power sources now. To do this, flip your board upside down and tilt it at about a 45 degree angle such that the board is facing you directly. Take a bare wire and place it on top of the LED legs as seen in Figure 11. Use pliers if you need to straighten out some of the wires. Make sure there are no big gaps between the wire and the legs of the LED. If there are please attempt to straighten or bend the wire accordingly, we want it to be as close to the LED legs as possible. Also, try to keep the wire centered on the board.
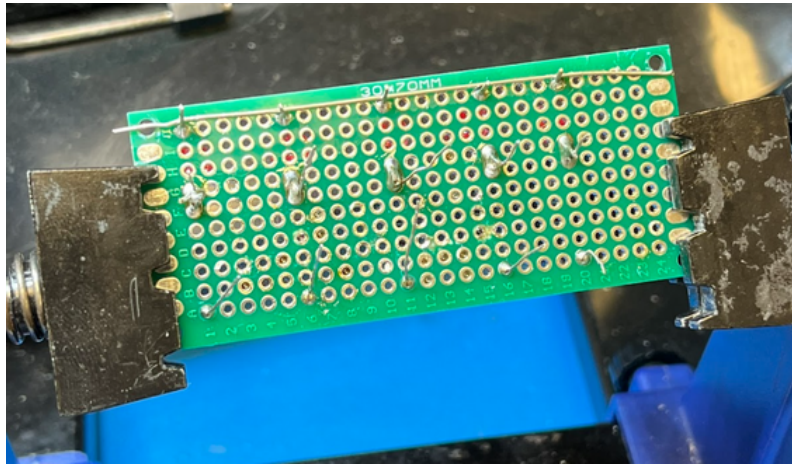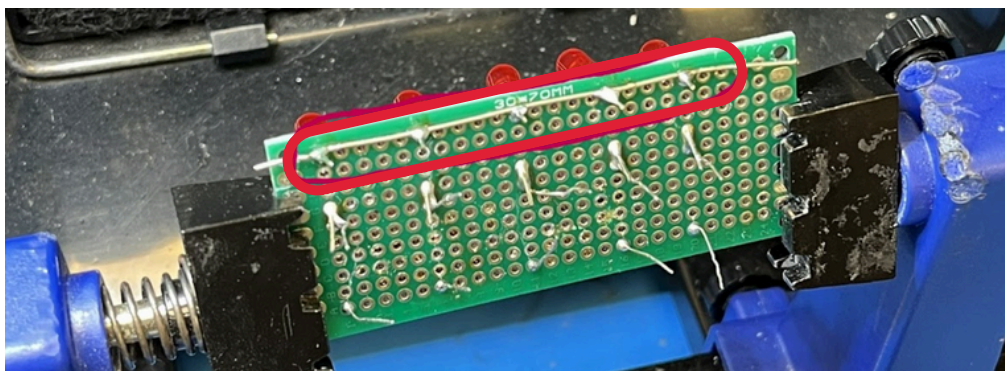

Figure 11

12. Now solder the wire to the legs by placing some solder at each intersection. It may be tricky at first but once you get one, the rest should follow as the initial solder will hold it in place. As you can see in Figure 12, the solder fully wraps the wire and LED legs ensure good physical and electrical contact.
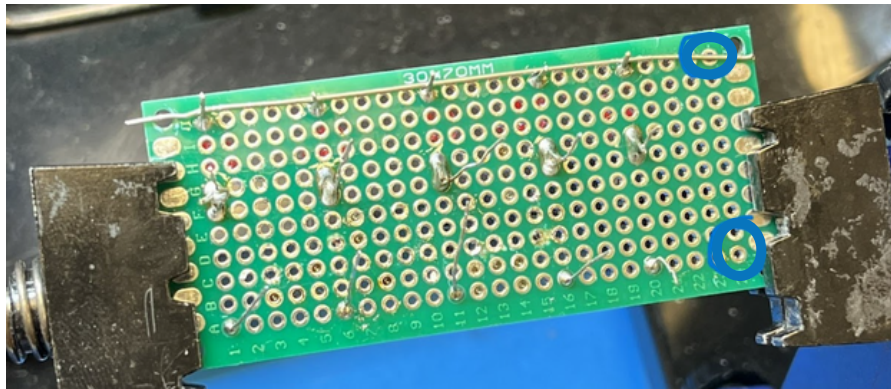
Rotate the board in a clockwise fashion and repeat for the resistor legs.

Figure 12

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13. The next step will be difficult to describe since it doesn't have any pictures but these holes that circled in blue in Figure 13, fill it up with solder, just enough so you can't see through it.
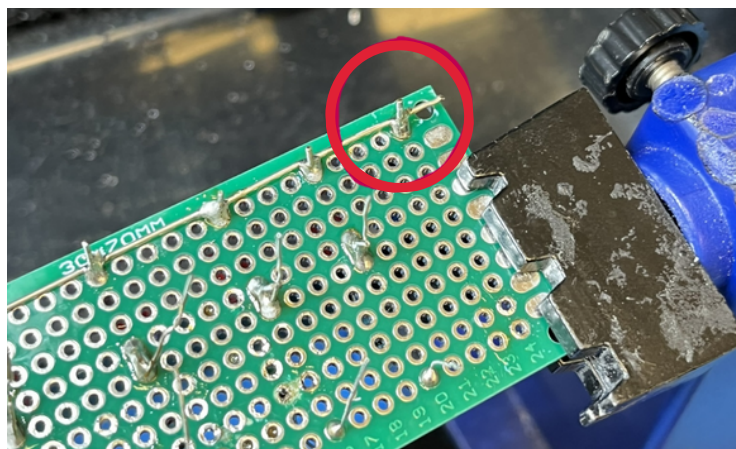

Figure 13

14. Then take one of your breadboard wires, the one with colorful insulation, and place it in your off hand. Use the iron to heat up the solder you just filled into the hole. While the solder is a liquid shove the wire into the hole from the side with the LEDs till the wire has passed through the other side. Remove your iron, and continue to hold the wire in place while the solder cools down and solidifies the wire into place. After that, solder a joint to the insulated wire you, just soldered, to the bare wire that is connecting the LEDs together. It should look like Figure 14.
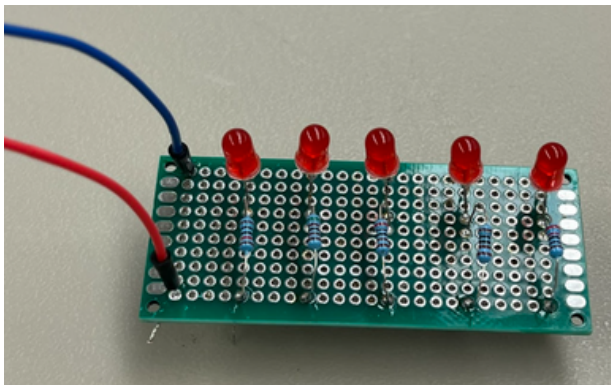
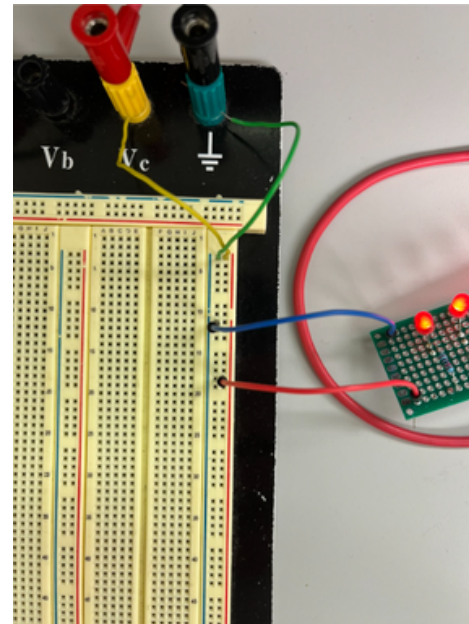Repeat for the other side with the resistor leg.

Figure 14

15. The next step is to power the board, to do this we will be using batteries. Solder the red wire from the battery pack to the leg of the resistor that is not connected to the diode. Solder the black wire from the battery pack to the leg of the diode that is not connected to the resistor as seen See Figures 15a & 15b. Your mentor can help you at this step as well.
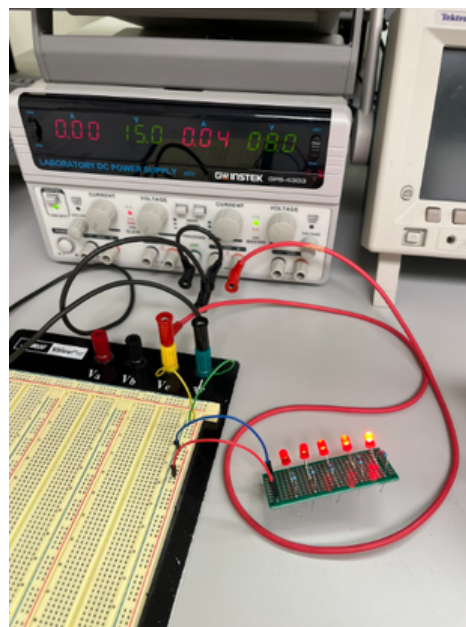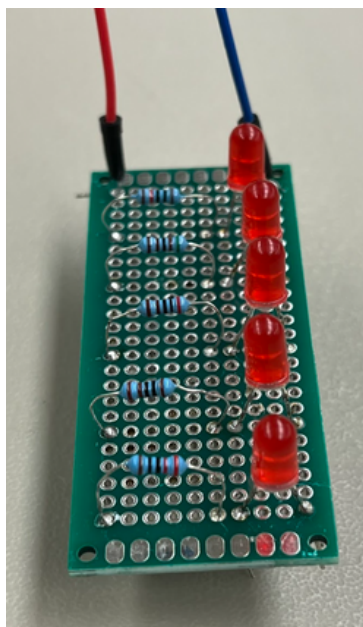**DO NOT ADD BATTERIES UNTIL YOU GET APPROVAL BY A MENTOR.**

Figure 15a

Figure 15b

Good job you're finished!

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