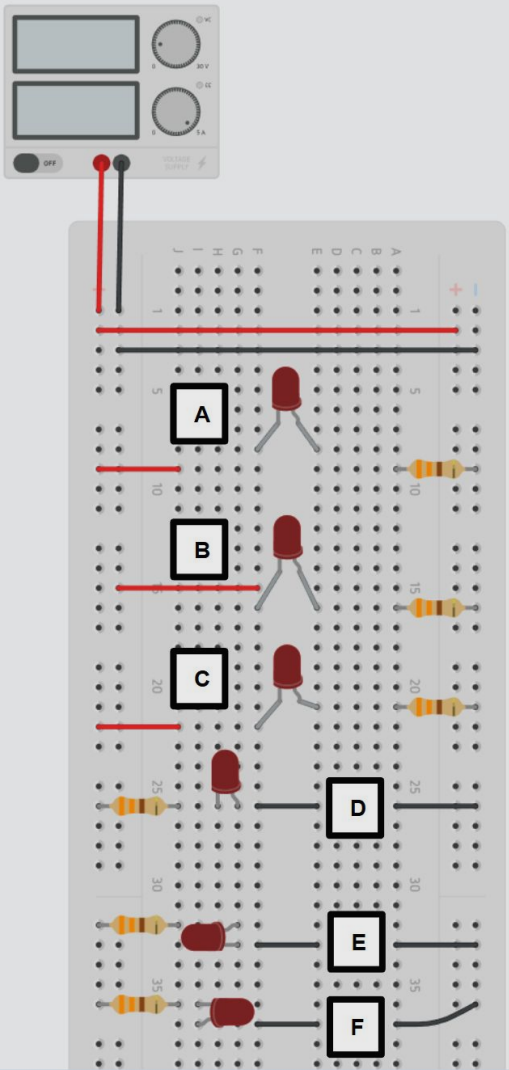
First Circuit Foundations

Student example

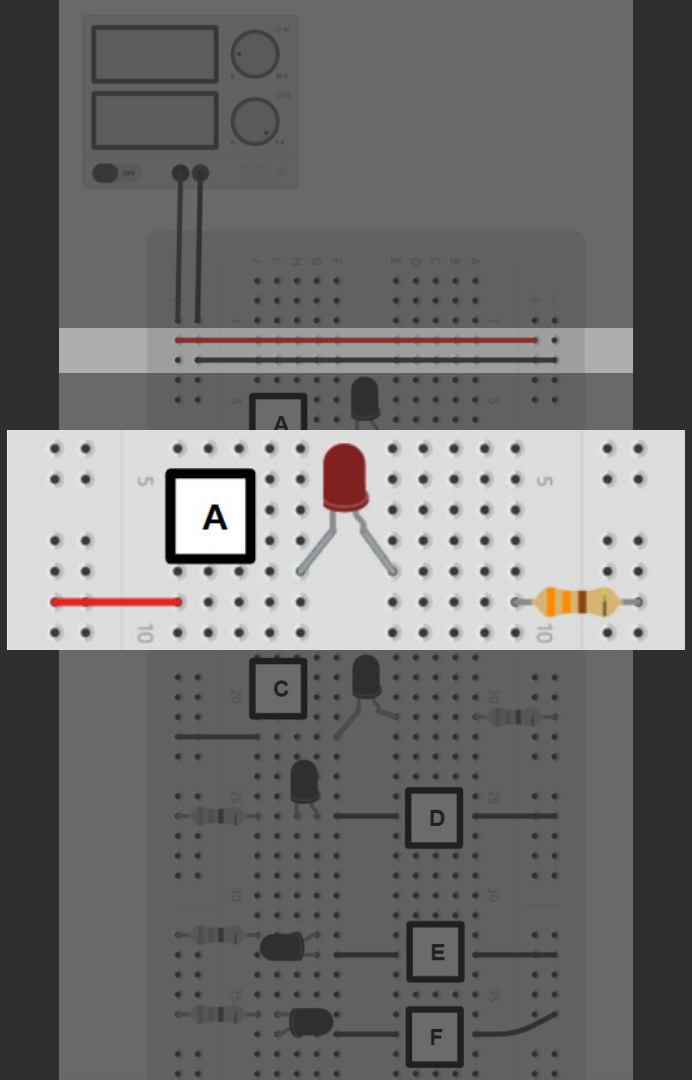
Resistor Identification

Resistor 1	Resistor 2	Resistor 3
		
Resistance: 10 kΩ ±5%	Resistance: 1 kΩ ±5%	Resistance: 220 Ω ±5%
Resistor 4	**Resistor 5**	**Resistor 6**
		
Resistance: 100 kΩ ±5%	Resistance: 47 kΩ ±5%	Resistance: 68 kΩ ±5%
Resistor 7	**Resistor 8**	**Resistor 9**
		
Resistance: 560 Ω ±5%	Resistance: 12 kΩ ±5%	Resistance 680 kΩ ±1% 50PM



Circuit Analysis A-F

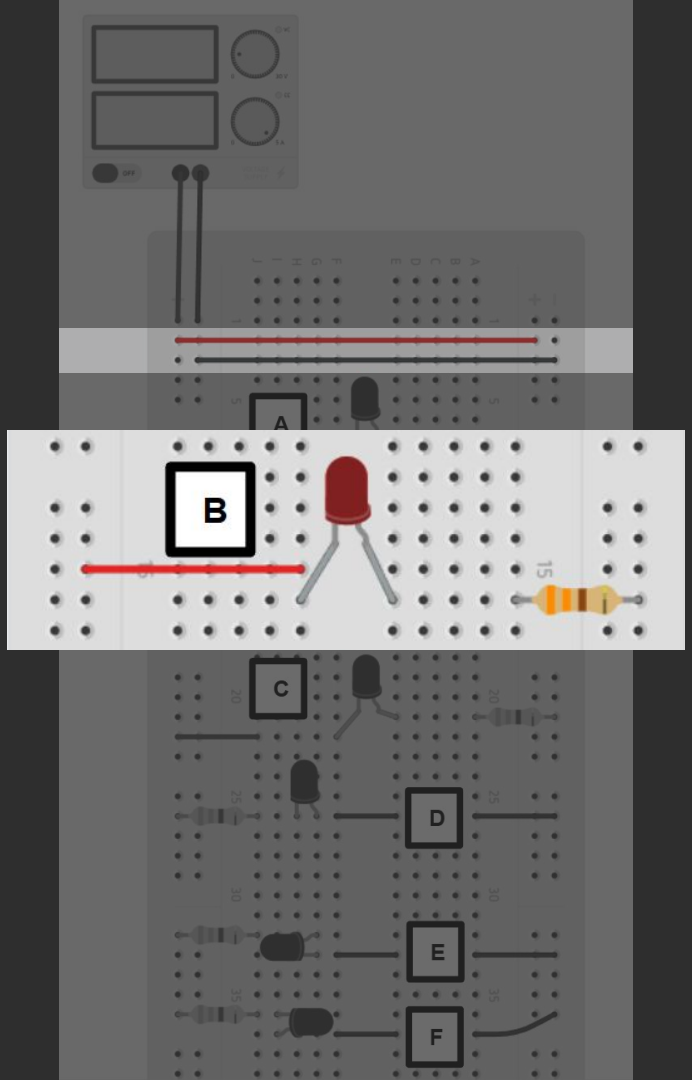
- Correct/Incorrect?
  - Why?
    - Node Connection
    - LED Orientation
    - Current Path; Resistor Location
    - Complete/Incomplete?
  - If incorrect, explain solution



Circuit Analysis: Circuit A

CORRECT / INCORRECT

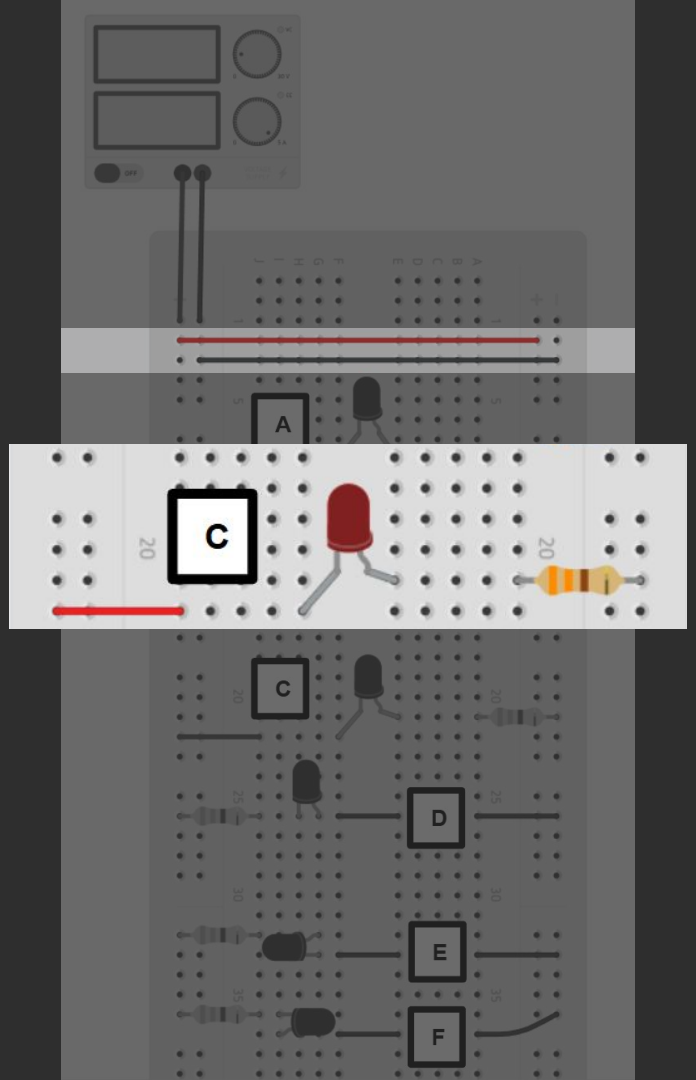
The LED isn't receiving any power because neither of the LED's leads are connected to a powered or grounded **node**, making this an **incomplete circuit**. To fix this circuit, the LED should be moved down and flipped such that the **anode** is in the powered node and the **cathode** is in the grounded node.



Circuit Analysis: Circuit B

CORRECT / INCORRECT

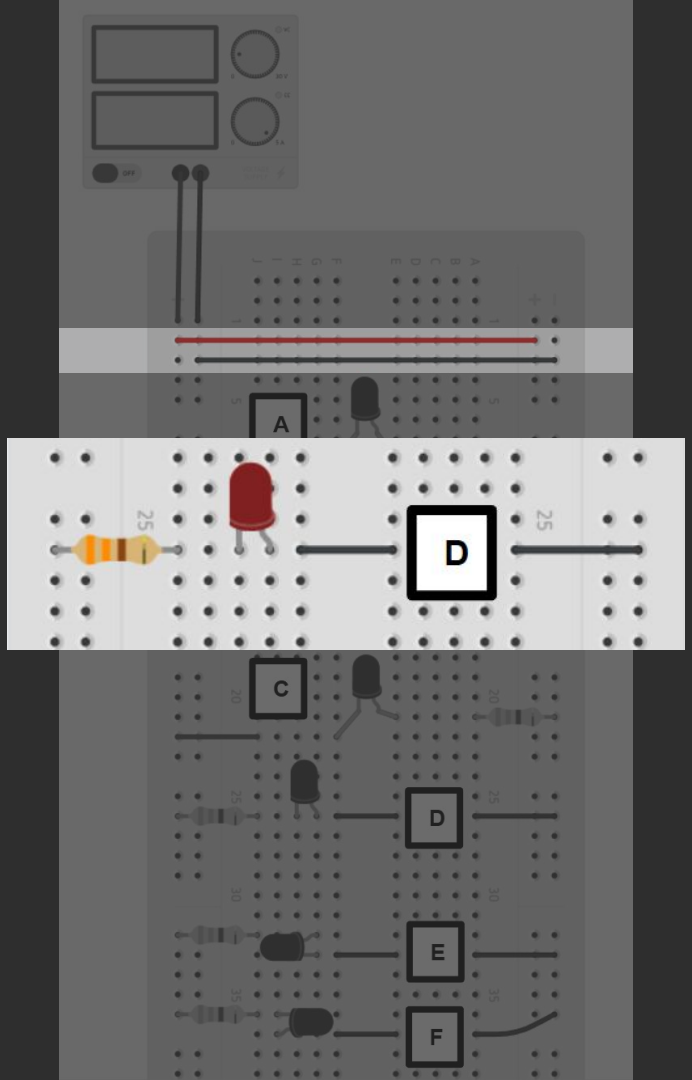
The LED's **polarity** is incorrect and it isn't receiving any power–meaning the circuit is incomplete. To fix this, the LED's **orientation** should first be flipped so the cathode attaches to the node with the **resistor**. Then, the non-power rail end of the jumper wire should be moved to a tie point in the same node as the LED's anode.



Circuit Analysis: Circuit C

CORRECT / INCORRECT

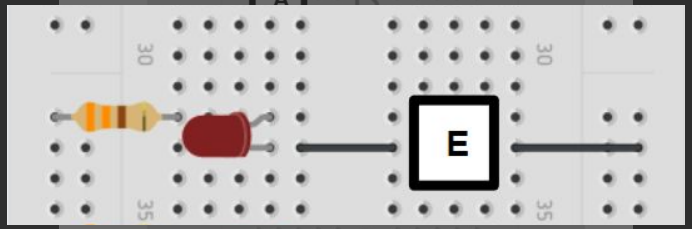
The LED's polarity is incorrect, as the LED's cathode is connected to the powered node and its anode is connected to a grounded node. To fix this circuit, the LED's orientation should be flipped, such that the anode/ cathode are connected to the powered/ grounded nodes, respectively.



Circuit Analysis: Circuit D

CORRECT / INCORRECT

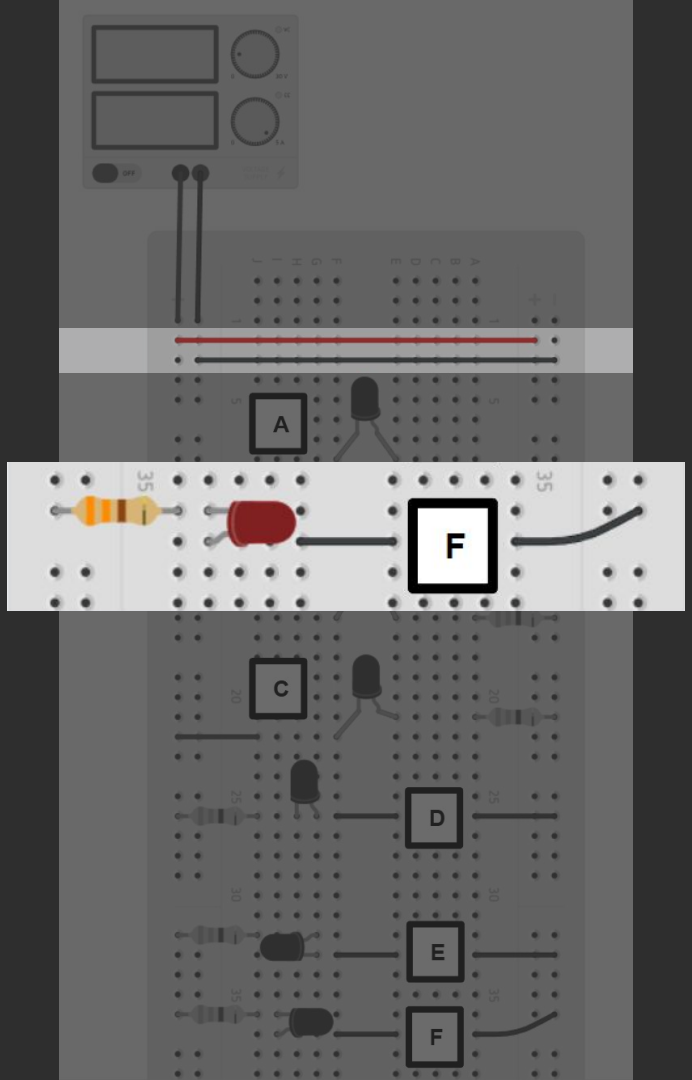
The LED's polarity is incorrect because the power goes into its cathode. Additionally, the LED's leads are both in the same node–bypassing the LED's semiconductor and shorting the circuit. To fix this, the LED flipped so that the anode is in the node with the resistor. Then, rotating the LED 90° will put the cathode in a different node that the jumper wire should also be adjusted to.



Circuit Analysis: Circuit E

CORRECT / INCORRECT

This is a **complete circuit** because the **current** flows through the resistor, into the anode of the LED, out the cathode, and into ground connection with no breaks. The orientation of each component is correct and the current flows in, through, and out of each component as it should.



Circuit Analysis: Circuit F

CORRECT / INCORRECT

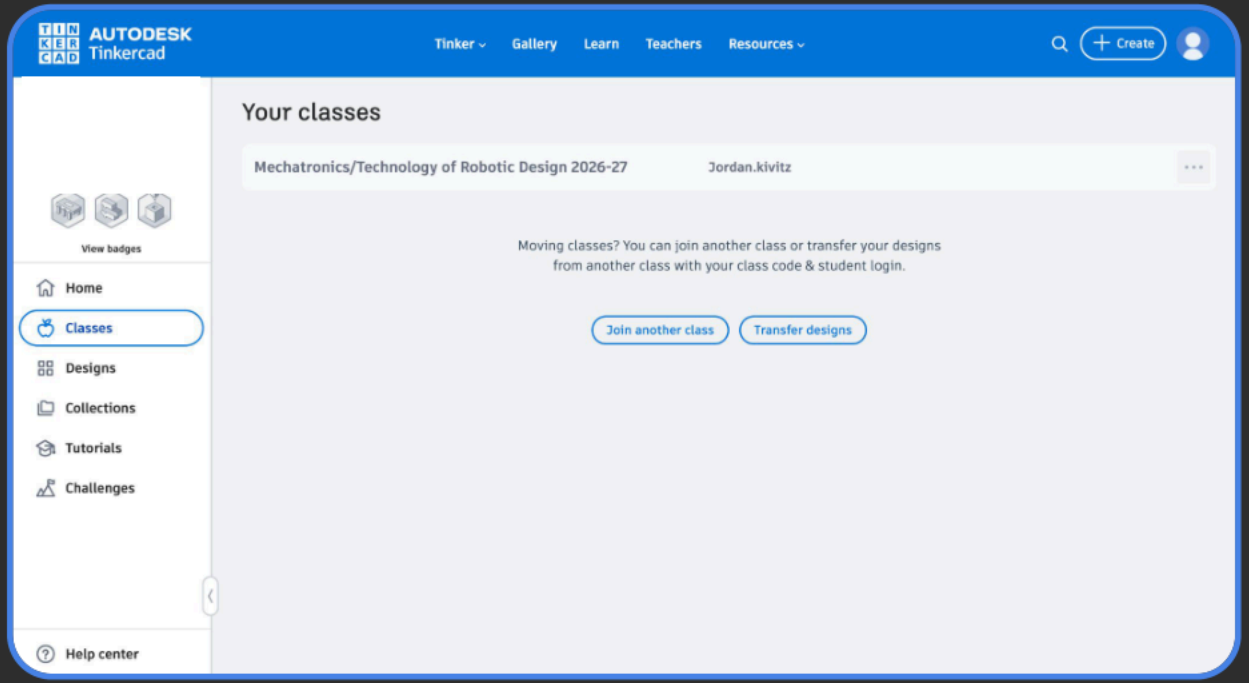
This is an incomplete circuit because the polarity of the LED is incorrect. To fix this circuit, all that has be done is to flip the orientation of the LED such that the current can flow through the resistor, into the LED's anode, out of its cathode, and into the grounded jumper wires in the next node.

Tinkercad

- Tinkercad Setup
  - Joined Class
  - Hello World
- Tinkercad Circuit + Troubleshooting
  - Broken Circuit + Explanation
  - Fixed/Working Circuit + Explanation

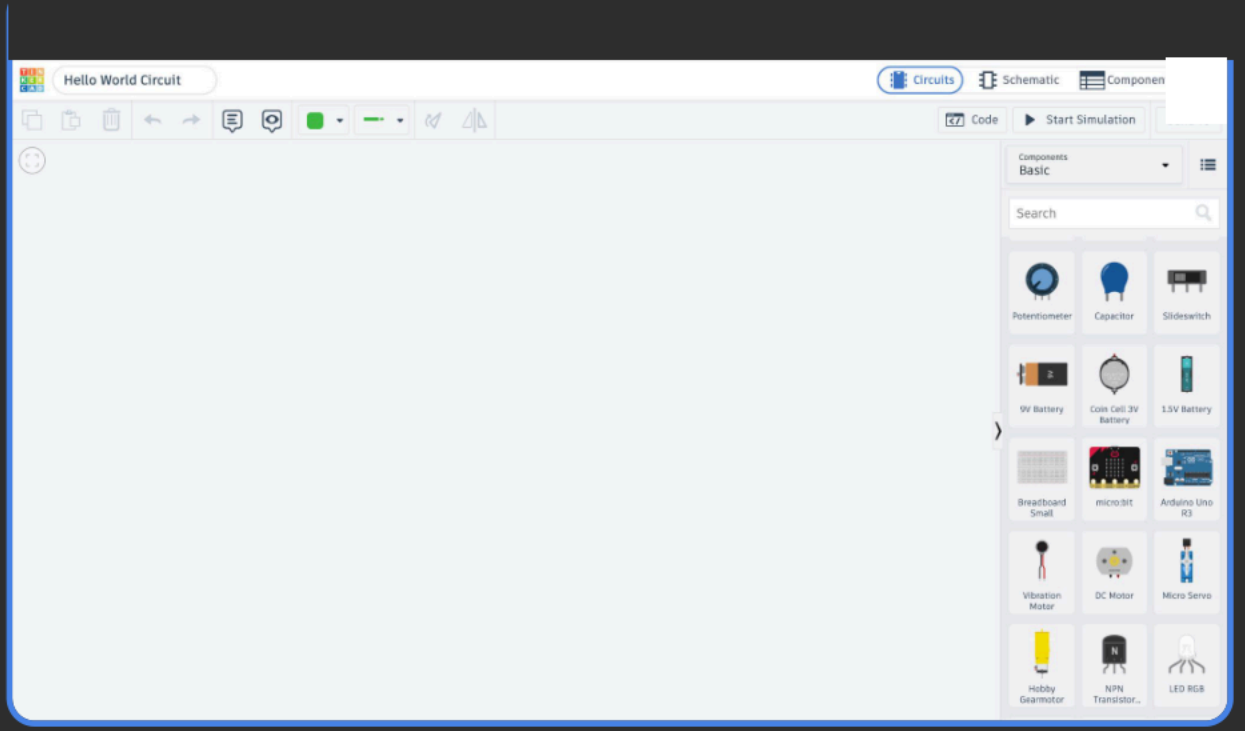
Tinkercad Setup - Joined Class

I joined the Tinkercad class for Mechatronics & Technology of Robotic Design 2026-27.

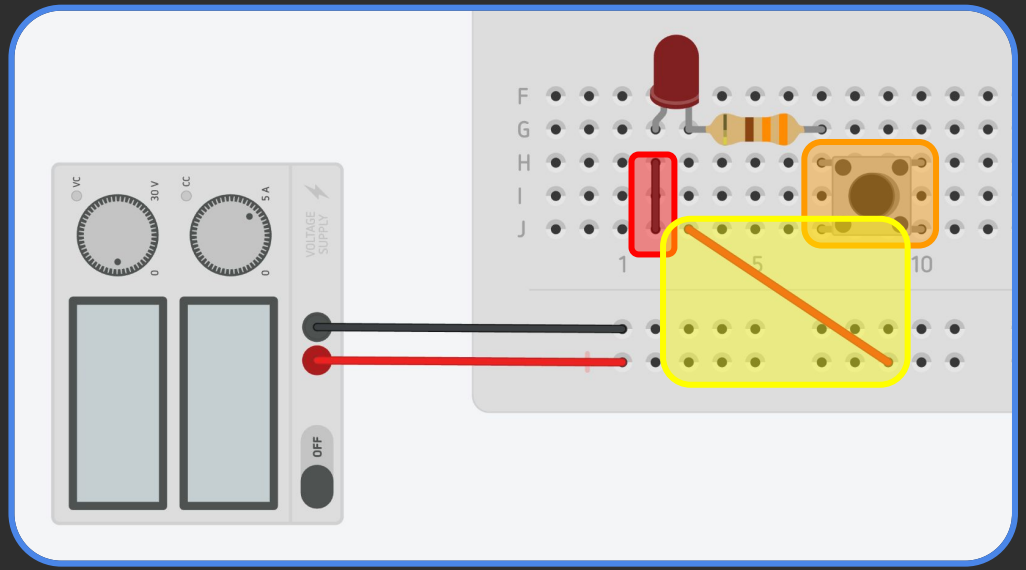


Tinkercad Setup - Hello World

I created my blank Hello World Circuit in Tinkercad.



Tinkercad Circuit(TCC) (Broken)

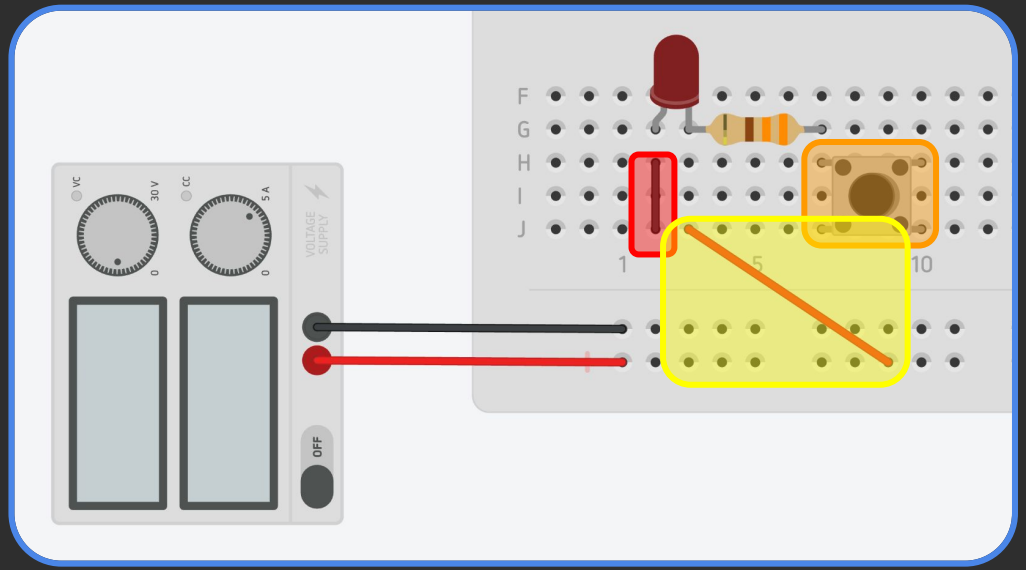


Change #1: Removed the grounded and of the black jumper wire from the grounded power rail.

Change #2: Rotated the push button 90° and connected terminals to new tie points.

Change #3: Moved the non powered end of the red jumper wire into one of the LED's nodes.

Tinkercad Circuit(TCC) (Broken)

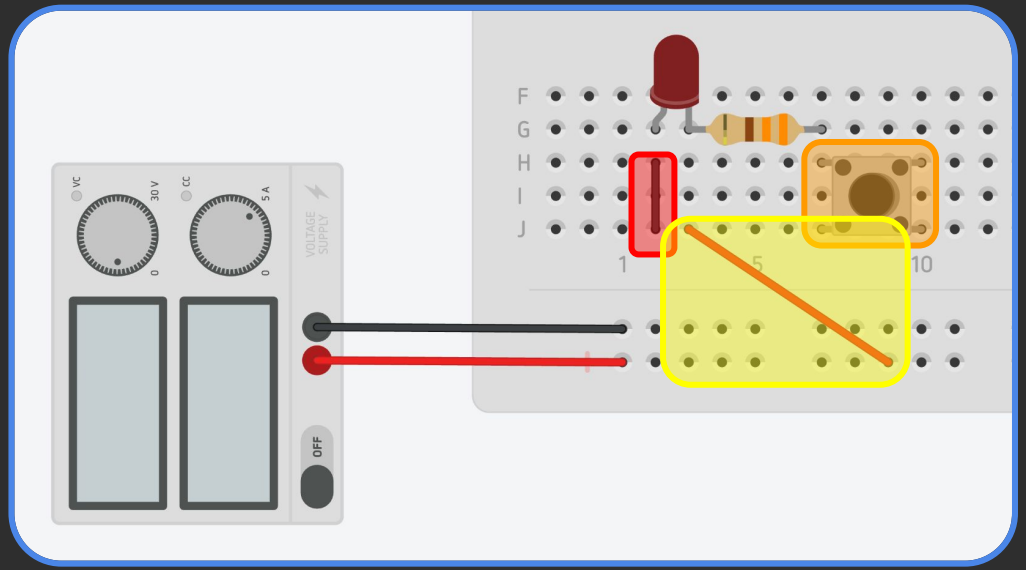


Change #1: Removed the grounded and of the black jumper wire from the grounded power rail.

To figure out what this change did, I reverted every other change and ran the **simulation**. When that didn't reveal anything obvious, I traced the current's flow.

By doing so, I found that the change broke the circuit because it stopped the current from flowing into the **ground**.

Tinkercad Circuit(TCC) (Broken)

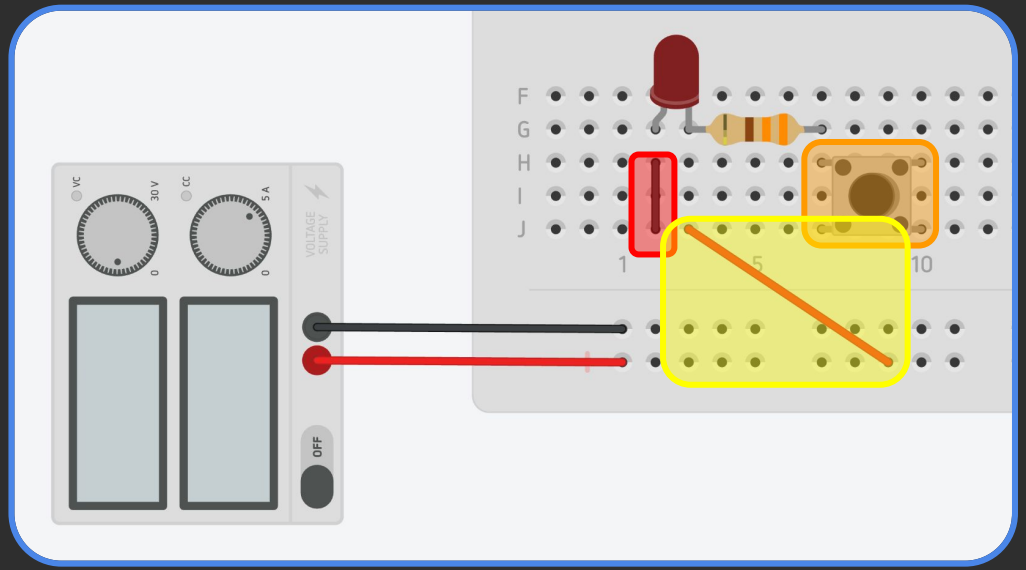


Change #2: Rotated the push button 90° and connected terminals(pins) to new tie points.

I **troubleshooted** this change just like the last, and found no obvious visual clues–so I again went to tracing the current's path.

From this, I found that the push button's orientation connected all of its pins to one another–stopping the flow of current and putting the circuit out of **series**.

Tinkercad Circuit(TCC) (Broken)



Change #3: Moved the non powered end of the red jumper wire into one of the LED's nodes.

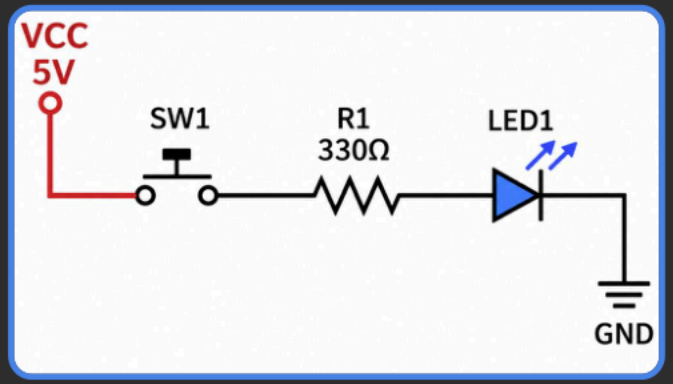
Just as with the other two, I ran the simulation without the other changes–resulting in a blown LED.

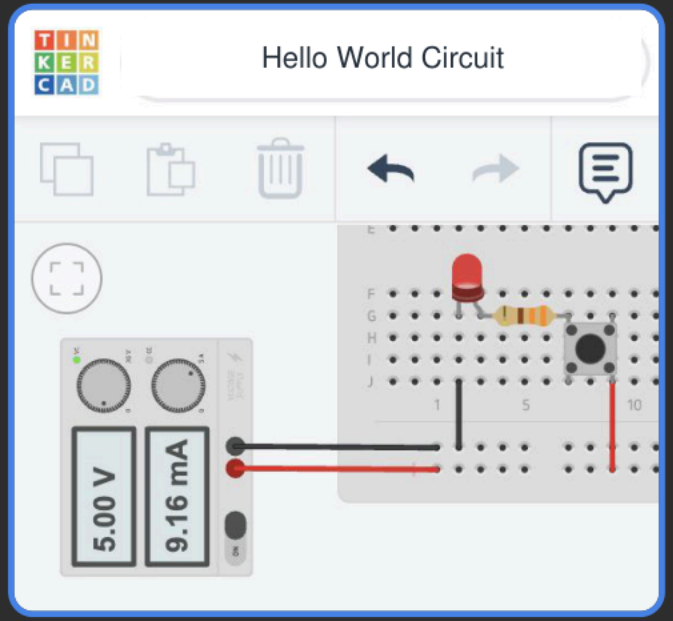
By connecting the power rail directly to the LED, the current was never lowered by the proper **resistance**. This meant that the **voltage** going into the LED was more than it could take, breaking it.

TCC Troubleshooting (Fixed)

In the **schematic** of the circuit, the current takes the following path: 5V from the **VCC** goes into one end of the push button. When the button is pressed the current continues through a 330Ω resistor, then into the anode of the LED, and out the cathode into the ground.

The restored version of the circuit works because it allows the current to flow just like in the schematic–from power, through all the components, with no breaks in the circuit, back into the ground.





Physical Circuitry Components

- Jumper Wires & Breadboard connections
  - Jumper wires + explain
  - Bready connections + explain
- Physical prototype
  - Explanation
  - Perspective images

Jumper Wires + Explain

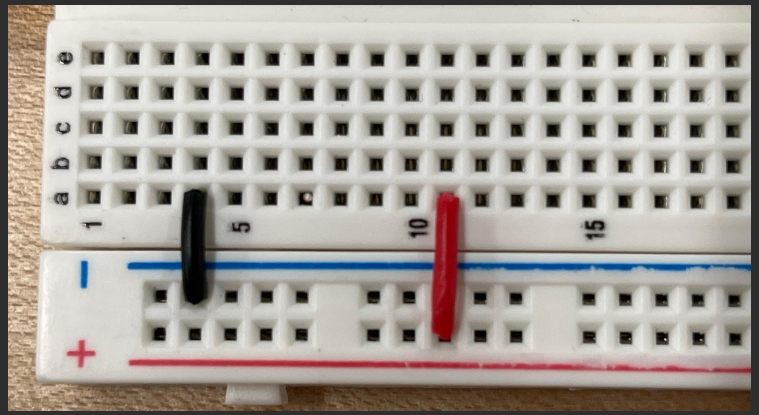


To figure out the proper lengths of each **jumper wire**, I laid the uncut wire over my breadboard to match the diagram. For each wire, I held the end at the **connection point** of the corresponding **rail**, and then over the correct tie point in the **terminal strip**. To mark the length of the wire between those points, I pinched the uncut side of the wire. Then, to account for the extra length needed for the jumper wires to make electrical connection, I added on roughly 4 tie points of wire length and made my cut there.

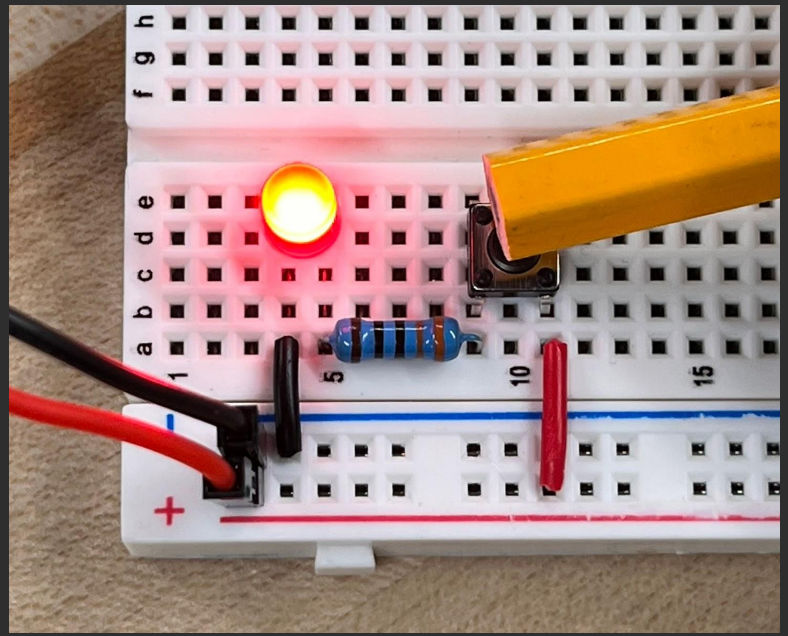
Breadboard Connections + Explain

For my breadboard, I have connected the red jumper wire to the power rail and the to node 11 of the terminal strip.

black jumper wire to the ground rail and



Physical Breadboard Prototype





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Physical Breadboard Prototype

