

# How do circuits work?



## Problem / Testable Question

How do you connect all the different pieces in a circuit on a breadboard and make the bulb light up?

## Background Information

A circuit is basically a circle of elements like a bulb, a battery, and a resistor. When the circuit forms a closed loop, the battery is able to send current to pass through the bulb and make it light up. The resistors are used to make sure not too much current can get in to the bulbs so they don't burn up.

## Hypothesis

I think all the energy from the battery will go to the LED light when we connect the positive and negative wires together on the breadboard.

## Variables

What variable was changed in your experiment?  
(Independent Variable)

The one variable that was changed in the experiment was the value of the resistors.

What variable was measured in your experiment?  
(Dependent Variable)

By changing the resistor values, the brightness of the LED circuit varied which is what was observed.

## Materials

Quantity (detailed list)	Materials (be specific)
2	Breadboard
5	Resistor
6	LED bulbs
3	9V Battery
2	Short wires
1	Magnifying Glass
1	Multimeter
1	Phone for pictures

## Procedure

1. First, I gathered the materials to get ready to build my circuits.
2. Two breadboards were used to build a total of 3 circuits (pictures in the Photos section). The first circuit had 2 red LEDs and 2 yellow LEDs. 1 resistor of 470 ohms was used. The LEDs were wired in a parallel connection which means the + side of the LEDs are all connected together and the - side of the LEDs are all connected together.

The other 2 circuits were on a separate breadboard – the first circuit had 1 LED and a resistor of 220 ohms in series with it, which means connecting the + side of the LED to the + side of the battery and the - side of the LED to one leg of the resistor, and the - side of the battery to the other leg of the resistor. The second circuit had 1 LED but 3 resistors (each of value 470 ohms) and again connected in a series fashion.

3. Next, I used help to put all the pieces in their right spot which meant connecting the plus wire from the battery to the the plus side of the LED, then the resistor, and from the resistor, wiring to the negative side of the battery. This made the LED lights light up.
4. Using help, I carefully took the multimeter's red and black leads and measured the resistance of the resistors to make sure they were of the correct value and working properly.

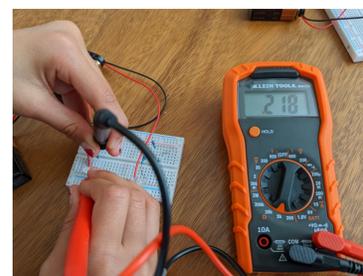
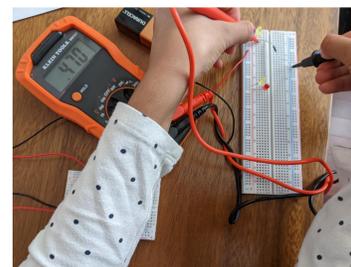
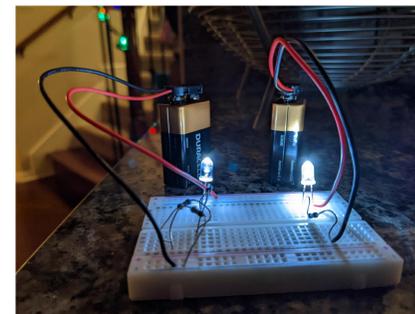
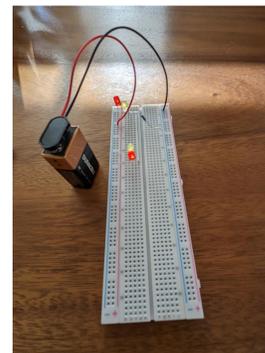
## Results

The first breadboard with the red and yellow LEDs connected in parallel all lit up.

On the second breadboard, I compared which circuit setup was brighter, and I saw that the circuit with only 1 resistor was much brighter than the circuit with 3 resistors. This is because the circuit with 3 resistors has less current compared to the one with 1 resistor, and so the bulb in the second circuit doesn't shine as brightly.

Finally, using the meter, the resistor values were checked which is shown in the below pictures (470 ohms, 465 ohms, and 218 ohms)::

## Photos



## Conclusion

I found out that to make a bulb light up, we must have a complete loop also known as a closed circuit – only when the battery's + and – terminals are correctly connected to an LED with a proper resistor, do we see the LED light up.

I also learned the difference between using 3 resistors versus 1 resistor in a circuit because of how much current there is in the circuit – when resistance is more, the current is less which means the LED doesn't shine as brightly.

## References

Cite at least 3 sources for your background information on your project. These could be websites, articles, people interviewed, books, etc. or specific websites. Include title, author, publisher, and/or date retrieved from the web.

1. Ducksters, "Electricity for Kids"; [https://www.ducksters.com/science/electricity\\_101.php](https://www.ducksters.com/science/electricity_101.php); 1/16/2022; <https://www.ducksters.com/>
2. Science Buddies, "How to use a Breadboard"; <https://www.sciencebuddies.org/science-fair-projects/references/how-to-use-a-breadboard>; 1/16/2022; <https://www.sciencebuddies.org/>
3. Instructables Circuits "Breadboard and LED"; <https://www.instructables.com/Breadboard-and-LED/>; 1/16/2022; <https://www.instructables.com/>

## Photo and Display Credits

Photos were taken by my Dad – Sunil Shukla.

# Reflections on Learning



Please answer the following questions about your project.

1. Where did you do your project and who supervised you?

ANSWER:

I did my project at home, and my Dad supervised me.

2. Please fill out the chart with the safety risks for your project and the safety measures you used.

Possible Safety Risk	Safety Measures Used
Example: Use Power Drill	Parent Supervised
Example: Handled Liquid Chemicals	Wore gloves and washed hands after use
Example: Plants Grew Mold	Threw plants away as soon as they molded

ANSWER:

Possible Safety Risk	Safety Measures Used
LED or resistor can melt	High resistor value used to control total current.
Possible electric shock	Small voltage (9V) battery used.
Sharp leads on meter can poke	Handled under supervision.

Did you follow all of the Austin Energy Regional Science Fest's Elementary Rules and Guidelines?

ANSWER: Yes, I did.

3. What gave you the idea for this project?

ANSWER:

I was talking to my Dad and I asked about what he does at his job, and that gave me my idea.

4. What did you learn from doing your project?

ANSWER: I learned how basic circuits work and that you need a source of energy like a battery and make a closed loop to be able to have a bulb light up. I also learned that you can make a bulb dimmer versus brighter based on how many resistors you put in the circuit. When we put more resistors in the circuit, the bulb is dimmer, and when we only have 1 resistor in the circuit, it is brighter.

5. What would you change about the project and why?

ANSWER: I would make it a little less complicated and less fragile (wires don't move so much and the bulbs don't go out just by slightly moving them). I would make the project a little easier so that I could do it without any supervision.

6. What new questions do you have?

ANSWER: I want to know how does the electricity just immediately turns on and off just by flipping a switch in your house?

7. Is there anything else you want to tell your judge?

ANSWER: This was a lot of fun, and I would like to learn more about electric circuits by doing future projects at home with my family.