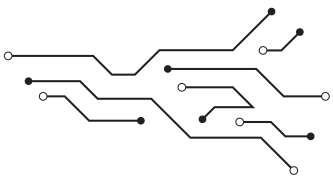
Electronics

Getting Started With Electronics

The Design Center has a variety of electronic materials such as different boards, sensors, add-ons and more. This zine will walk you through the basics of electonics in four sections. By the end, you'll be ready to experiment on your own!

1. Electricity: How does it work?
2. Circuits: Let's build a simple circuit!
3. Arduino Basics: Integrating your circuit with Arduino!

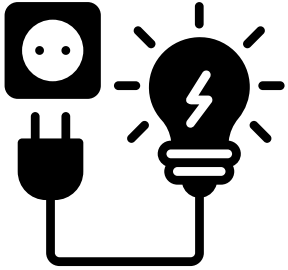



Let's go!

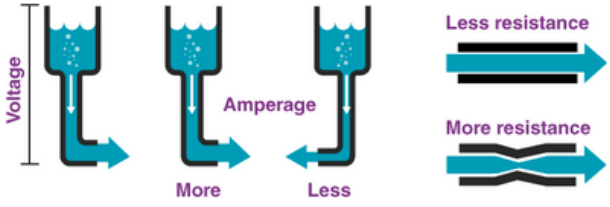
How does electricity work?

Electricity can be broken down into 3 basic components:

1. Current (Amps) - Amount of charge per second
2. Voltage (Volts) - Electric potential, amount of energy per charge
3. Resistance (Ohms) - Force against the flow of charge



Electricity is like water!

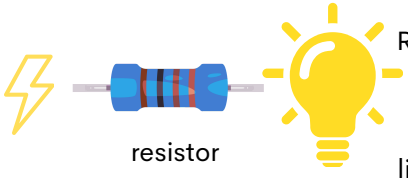


A good analogy to understand the relationship between the three is to imagine a pipe with water. Here, current is the amount of water flowing through the pipe. Voltage is the amount of pressure or force from the water. Resistance is like sand or a blockage limiting the flow of water.

Why is this important?

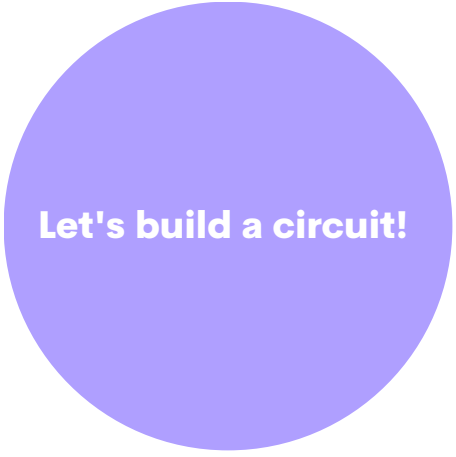
From the buttons on a remote to the lights in a room, electronic circuits are made of many components. Each component has current and voltage specifications. As electricity flows through a circuit, applying resistance before the component can control these to meet the requirements. This will prevent damage, overheating, and burn outs.

No resistance and too much current causes the light to burn out



resistor

Resistance lowers the amount of current, preventing the light from burning out



All materials can be found in the electronics drawer.

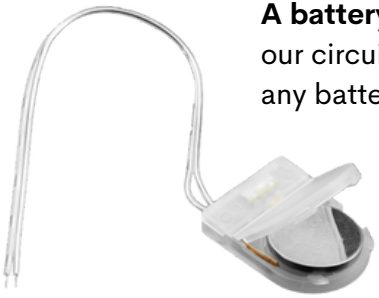
Components you'll need:

Resistors! As current flows through the resistor, the amount of amps output is decreased due to resistance.

LED! (short for light emitting diode) will be the light bulb of our circuit. Because it is a diode, electricity can only flow across the LED in one direction: negative → positive

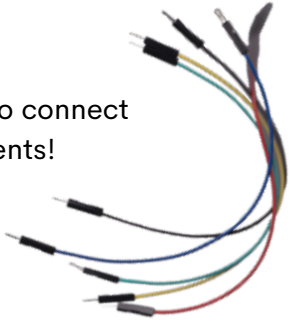
The short leg is negative, and the long leg is positive. Components like this are **polarized**. Note how resistors are not polarized.

Components you'll need:



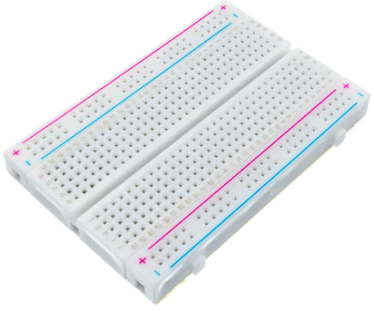
A battery! To power our circuit. For now, any battery will do!

Wires! To connect components!



Components you'll need:

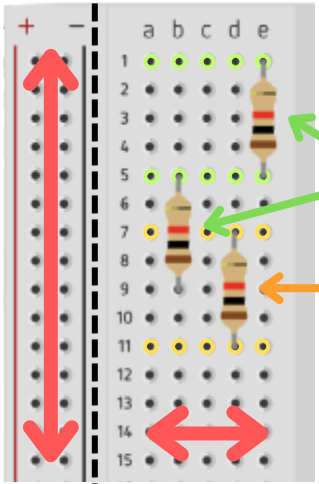
Breadboard! To prototype your circuit!



Note how electricity flows through the breadboard with the diagram on the right: On the sides, current can flow up and down. In the middle, current can flow left and right, but not across the gap.

Think of it like wires connecting the holes! This means components connected to the same row or column will be connected!

Breadboard Anatomy



Electricity can flow between these resistors. They are connected!

This resistor is not connected to another component because it is not in the same row

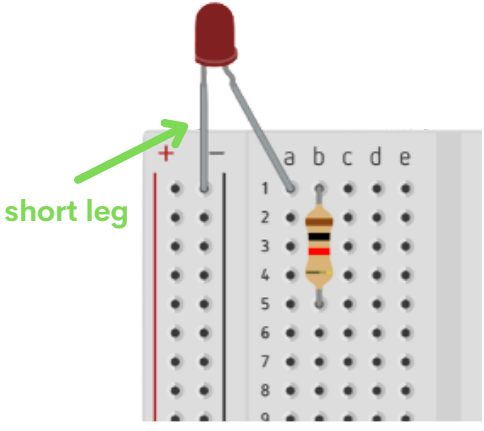
Current doesn't flow across the gap

Electricity flow through breadboard

Assembly

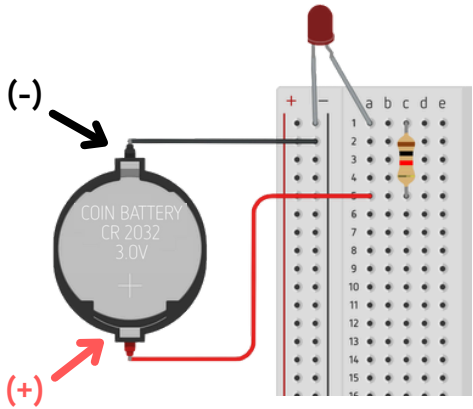
Make the circuit on the right with the following connections:

Connect the LED and resistor, like so:



Connect a wire from the negative (-) side of the battery to the short leg of the LED. Connect a wire from the positive (+) side of the battery to the resistor.

Assembly



Here, current is flowing from the negative side of the battery, through the LED and resistor, and back to through the positive side of the battery. This is called a **closed circuit** because there is a complete path from the negative (-) to positive (+) terminal.

You just built your first circuit!

Arduino Basics!

Arduino Basics

We can control our circuit (for example, to make the light blink) with an Arduino, a type of **microcontroller**. A microcontroller is a programable board that is able to read input (buttons and sensors) and turn it into output (lights motors) using instructions. There are many different types of boards in all shapes and sizes. Picking a board depends on the complexity of your project and how it will be used. For example, some boards can be sewn into clothes!

Instructions are programmed into the board using **Arduino IDE**, a free coding environment. Code is written in C++, but don't worry if you haven't coded before. There are tons of resources online including **TinkerCAD Circuits**, a free website to learn how to build circuits and code!

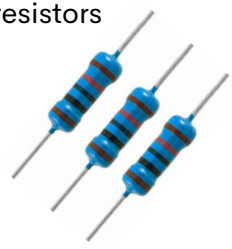
Building an Interactive Circuit

Use the schematics on the next page to build an interactive circuit. When you're done, you'll be able to control the LED color with the joystick! The main challenge is using the breadboard to connect the joystick to the Arduino. Ask a staff member to upload code to the Arduino before testing.

Let's build a bigger circuit

For this, you'll need the following:

3 resistors

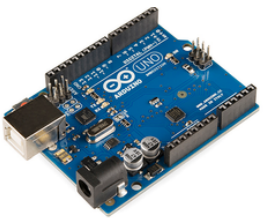


joystick

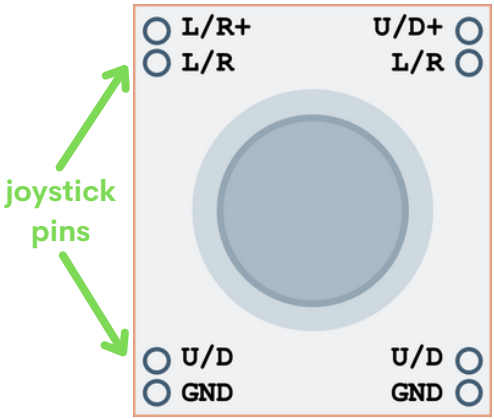
4-pin,
color changing LED
(the longest pin is
negative)

wires

arduino

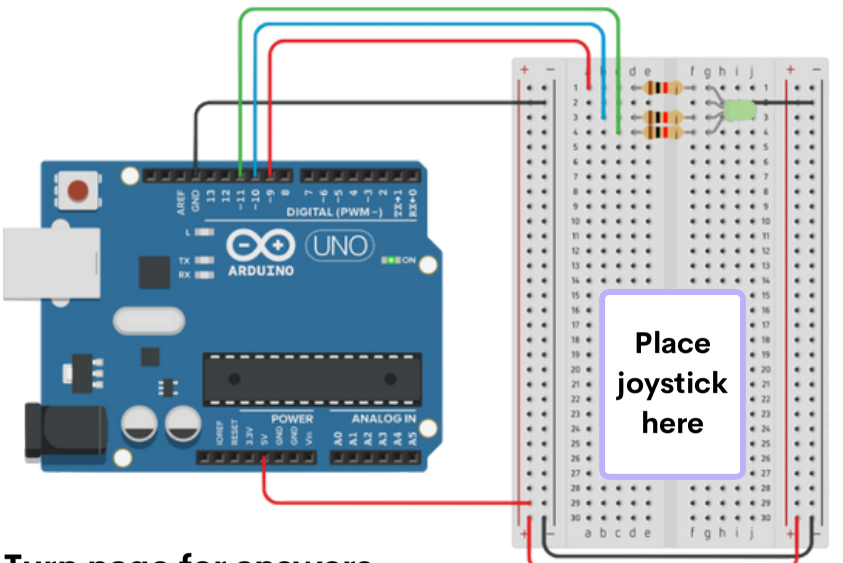


Joystick Schematic

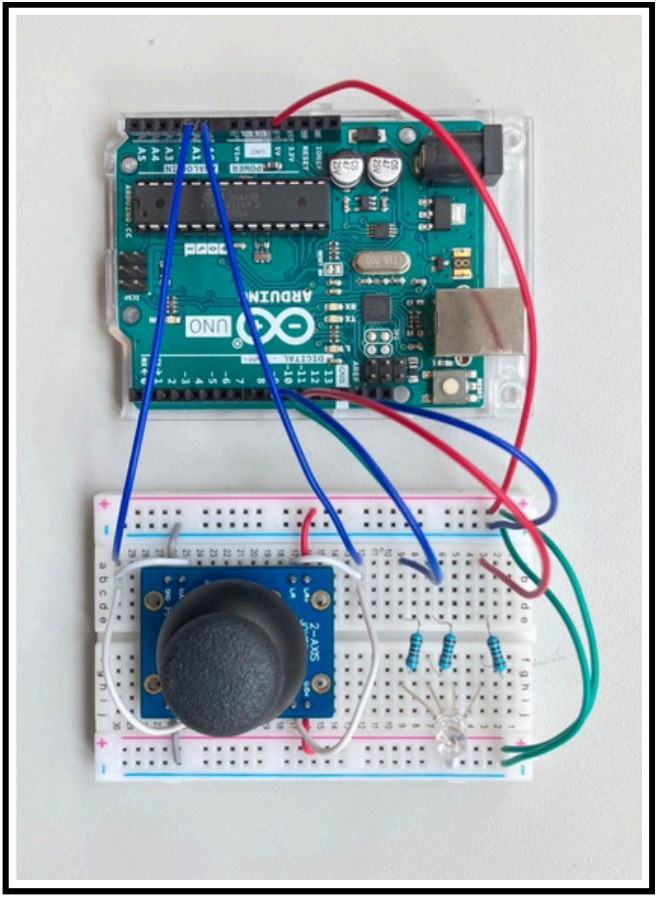


Wire connections between

Joystick Pin		Arduino Board
L/R+		5V
U/D+		5V
GND	GND	GND
L/R	L/R	A0
U/D	U/D	A1



Turn page for answers...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2-AXIS

Circuit Complete!

After uploading the code, move the joystick to watch the LED change colors. Troubleshoot by making sure all of your connections match the circuit on the left. When you're done, you just completed your first electronics project!

Feel free to use this as a jumping off point and experiment further. There are many resources online with varied projects and documentation for inspiration. It can even be fun to combine projects to see what you can build!

The next page has the code used to control this circuit, and resources for further reading!

Feel free to ask staff for help if you need it!

Code

After circuit building, the next step is learning how to program the Arduino. Again, Arduino programming is done in C++, a coding language, in the Arduino IDE. There are many resources online to get started. We recommend TinkerCAD, QR code on the next page. TinkerCAD has lessons on how to build circuits using their online simulator as well as how to code. They even have a drag and drop interface if you are new to coding!

The QR code below links to the code used to control the circuit taught in this zine!

Resources

What is electricity?

Joystick circuit for reference (This source and Instructables are great for exploring!

TinkerCAD circuits for experimenting
Getting Started and Lessons

Design Center

BARNARD COLLEGE