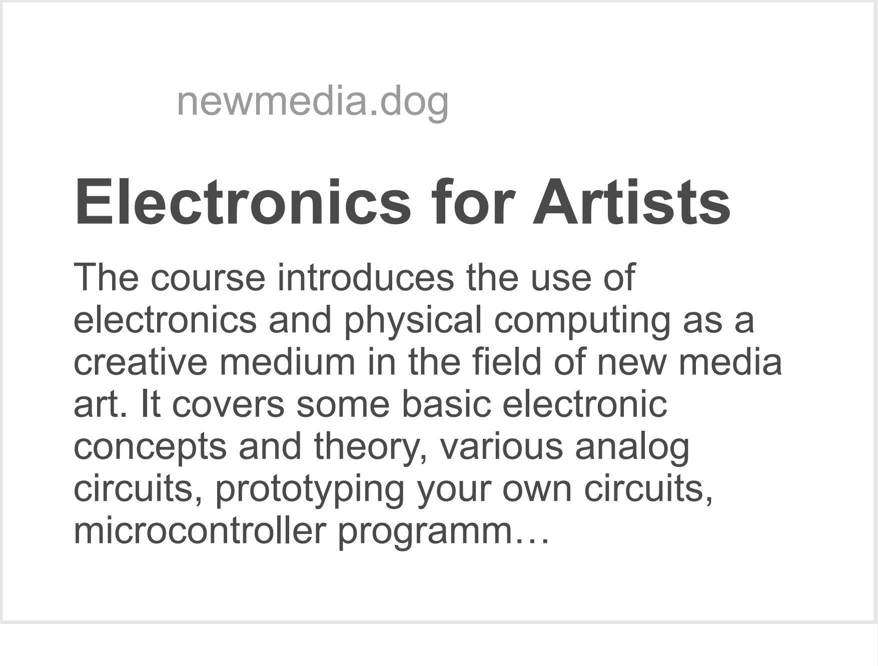
Electronics for Artists
2021

Week #1

001 | Introduction

Course Website | Schedule, Course Structure etc.

- All information and materials can be found from our course website: newmedia.dog/c/efa
- File submissions and announcements from [MyCourses]()
- Lecture slides: this Miro board



newmedia.dog

Electronics for Artists

The course introduces the use of electronics and physical computing as a creative medium in the field of new media art. It covers some basic electronic concepts and theory, various analog circuits, prototyping your own circuits, microcontroller programm…

mycourses.aalto.fi

MyCourses: Course: DOM-E5154 - Electronics for Artists, Lecture, 3.11.2021-17.12.2021

School of Arts, Design, and Architecture (ARTS) School of Business (BIZ) School of Chemical Engineering (CHEM) - sGuides for students (CHEM) - Instructions for report writing (CHEM) School of Electrical Engineering (ELEC) School of Engineering (ENG) Scho…

Schedule

Week 1 | Intro

- Introduction
- Electricity
- Basic Tools
- Microcontrollers

Wed 3/11 Thu 4/11

Week 2 | Sensors

- Sensors
- Smoothing Data
- Mapping
- I2C

Wed 10/11 Thu 11/11

Week 3 | Output

- Motors & Actuators
- Digital LEDs
- EFA Robot Project

Wed 17/11 Thu 18/11

Week 4 |

- Serial
- Native USB
- WiFi (OSC)

Wed 24/11 Thu 25/11

Week 5 | Project

- Levels of Prototyping
- PCB Design
- Project Work

Wed 1/12 Thu 2/12

Week 6 | Project

- Project Work

Wed 8/12 Thu 9/12

Week 7 | Project

- Project Work
- Exhibition Setup

13–17/12
Mon–Fri 9–17

Exhibition

13–17/12
Mon–Fri 9–17

Requirements

- Minimum 80% attendance
- I recommend attending 100%. **If you miss any classes, it is not my responsibility to catch you up.**
- **It is of course perfectly OK to not attend if you are sick or have some other urgent reason not to be present. Just let me know. Don't come to school sick.**
- Homework assignments (these are not for me, these are for you to learn and figure things out on your own)
- Project plan. A planning document that you update constantly during the course.
- Final project. Can be individual or group work (1-3 students).
- Documentation: Process and Final Project
- Exhibition (not compulsory but recommended)

Grading

- Grading 0–5
    - 0 Fail
    - 1 Poor
    - 2 Satisfactory
    - 3 Good
    - 4 Very Good
    - 5 Excellent

Grading

You will be graded based on the following criteria

- Active attendance to classes and discussions (25% of the grade).
    - Minimum 80% attendance
    - Your attitude and activeness in class
- The final project (50% of the grade). You will be evaluated based on:
    - Aesthetic quality of the work
    - Novelty and creativity of the concept
    - Critical approach to the topic
    - Command of the technology
    - Attention to detail
- Documentation of the final project (25% of the grade). You will be evaluated based on:
    - Critical reflection
    - Quality of the audiovisual documentation
    - The amount of detail and depth in the documentation

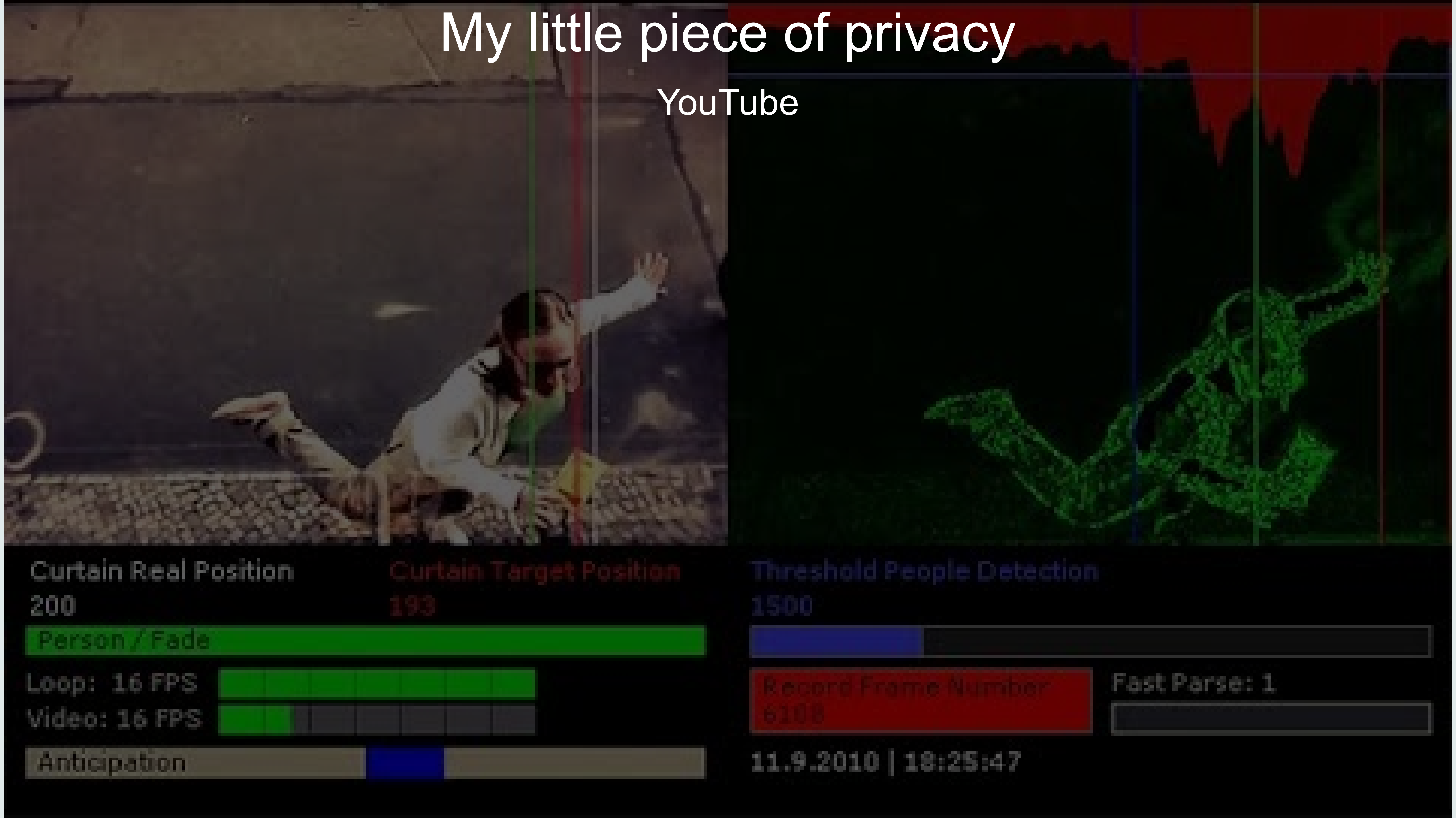
newmedia.dog

EFA | Projects From Previous Years

Here are some example projects from previous years. See all projects from 2020 Aurora Frestadius, Huggable LEDigrade Dinan Yan, Loop the Chop Documentation page Juan Qin, The Pillow Project Eero Pitkänen, Music for 3 small solenoids and 2 servo motors A…

My little piece of privacy

YouTube



Curtain Real Position
200

Curtain Target Position
193

Threshold People Detection
1500

Person / Fade

Loop: 16 FPS

Video: 16 FPS

Anticipation

Record Frame Number
6108

Fast Parse: 1

11.9.2010 | 18:25:47

Galactic Dimension

Niklas Roy - Talk at KIKK Festival 2015

Vimeo

Sirius Crown / Residency at SERDE

Vimeo

Call the Forest / Haloo, kuuleeko metsä?

YouTube

www.niklasroy.com

Niklas Roy - Fine Art with Technology

Niklas Roy explores art, science and technology by building interactive installations which are exhibited worldwide.

katihyyppa.com

Kati Hyyppä -

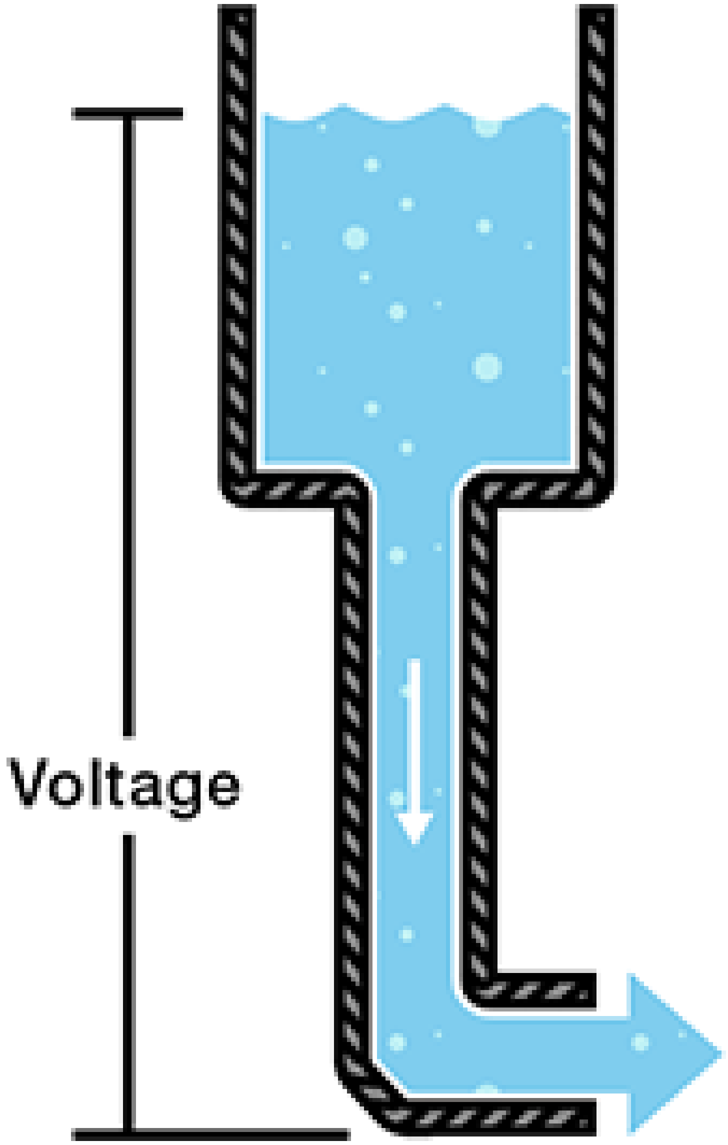
What is Electricity?

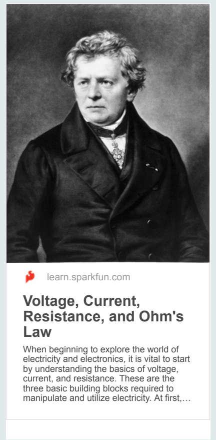
Voltage

- Symbol: V (U in some parts of Europe, E is sometimes used in the USA)
- Unit: Volt (V)

Voltage is the difference in electric potential energy between two points.

You can consider voltage to be similar to the pressure of water in the image on this slide.




learn.sparkfun.com

Voltage, Current, Resistance, and Ohm's Law

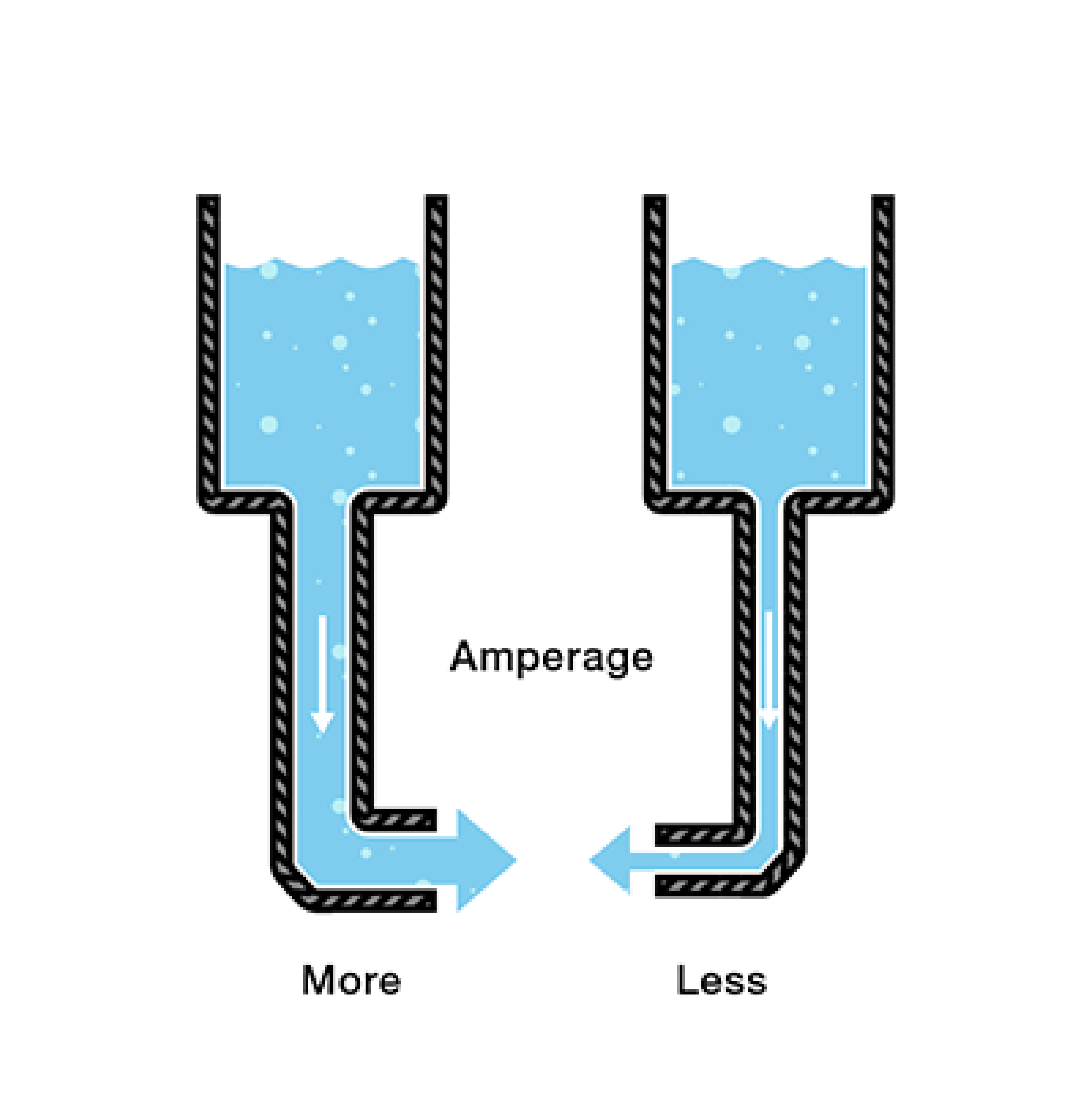
When beginning to explore the world of electricity and electronics, it is vital to start by understanding the basics of voltage, current, and resistance. These are the three basic building blocks required to manipulate and utilize electricity. At first,…

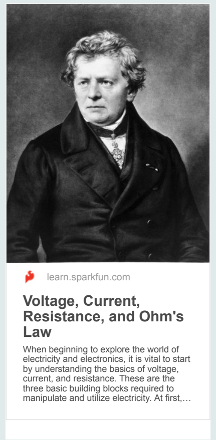
Current

- Symbol: I
- Unit: Ampere/Amp (A)

Current is the flow of electric charge.

In our water analogy, current would be the water current or water flow. The amount of water that flows in a water pipe.




learn.sparkfun.com

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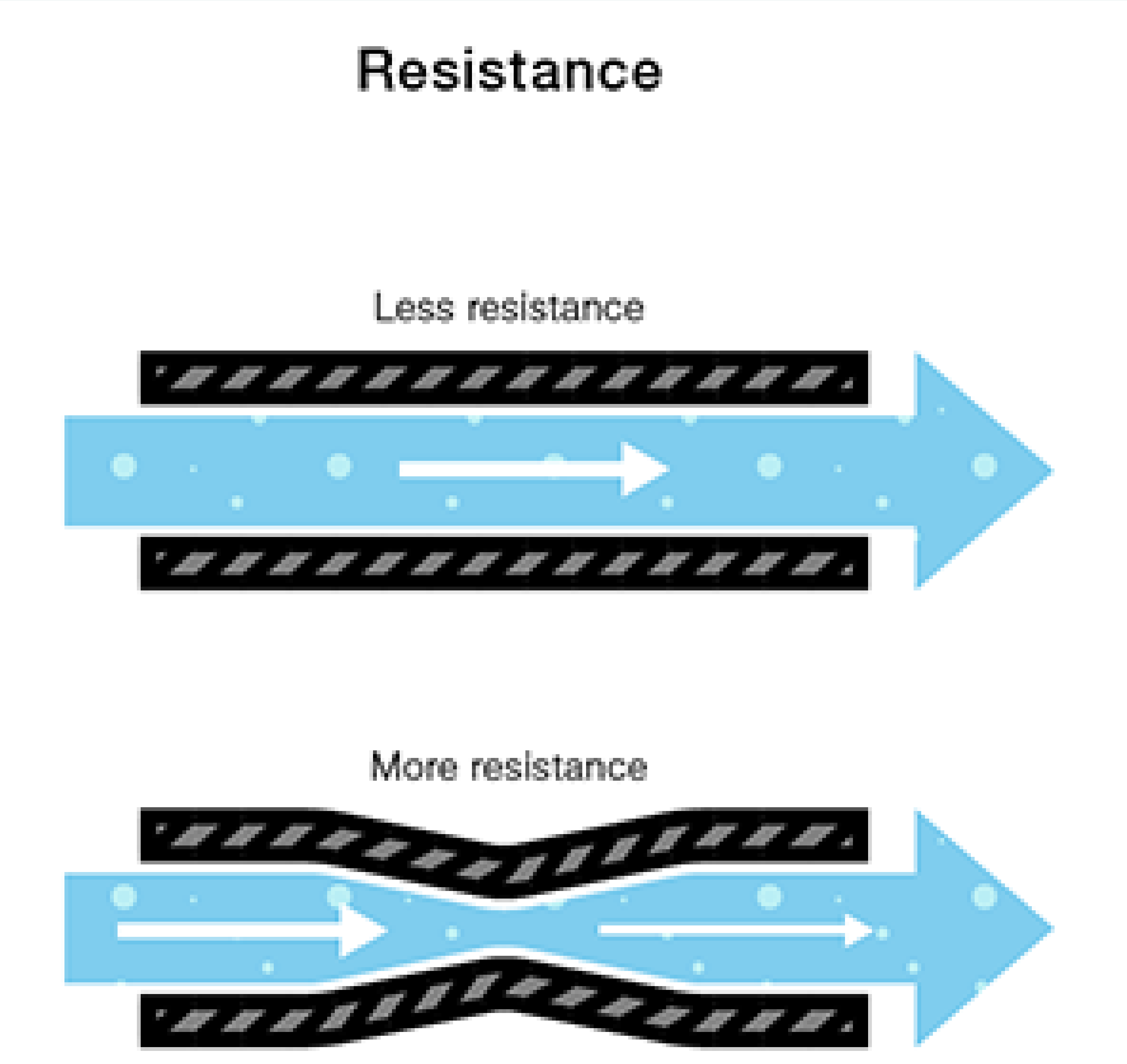
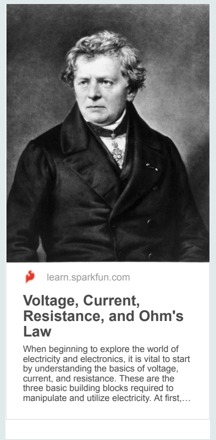
Resistance

- Symbol: R
- Unit: Ohm (Ω)

Resistance is the measure of a material's ability to oppose the flow of electricity.

In our water analogy, resistance is like a narrowing or clog in the pipe that makes it harder for the water to flow through.




learn.sparkfun.com

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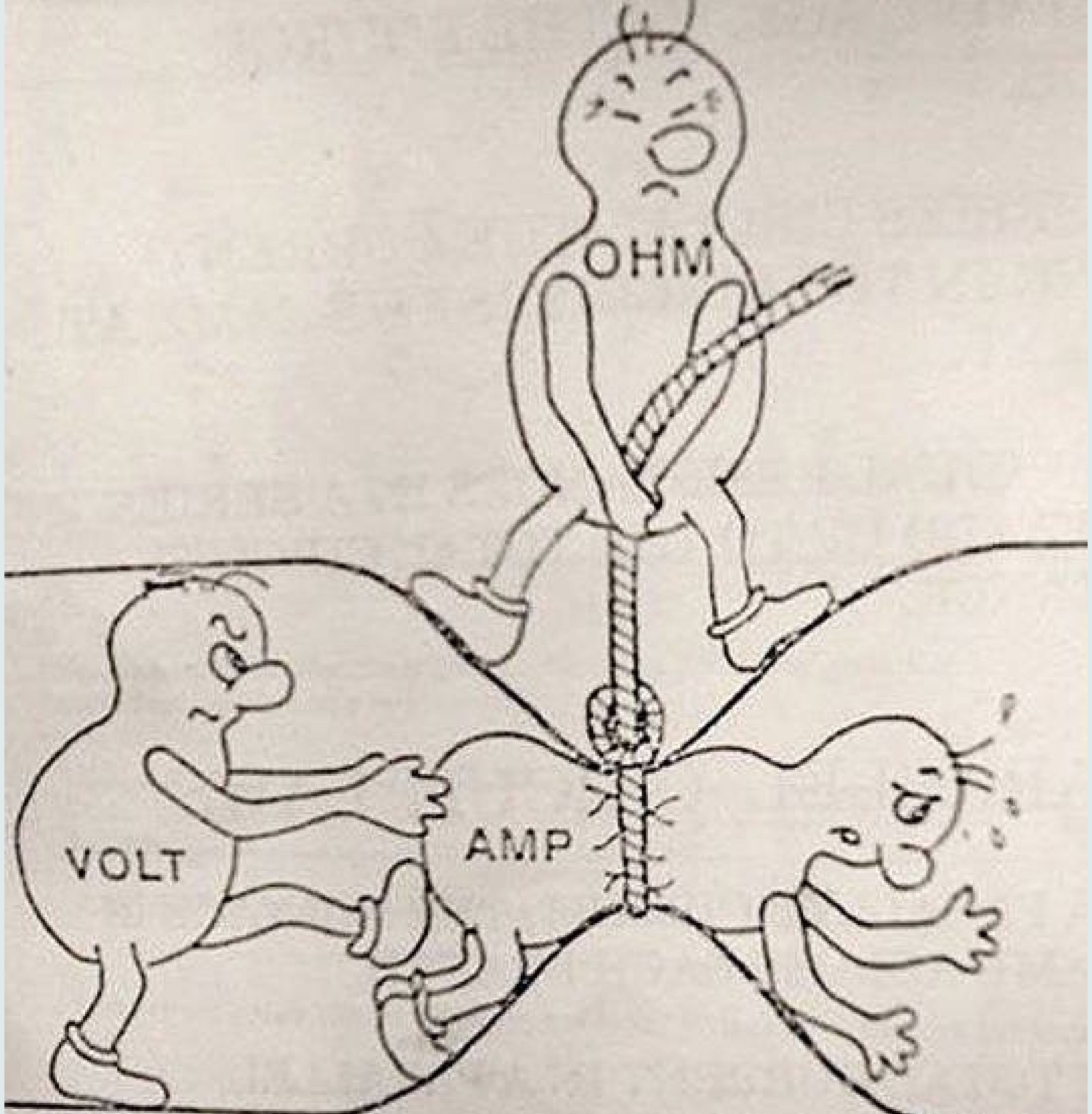
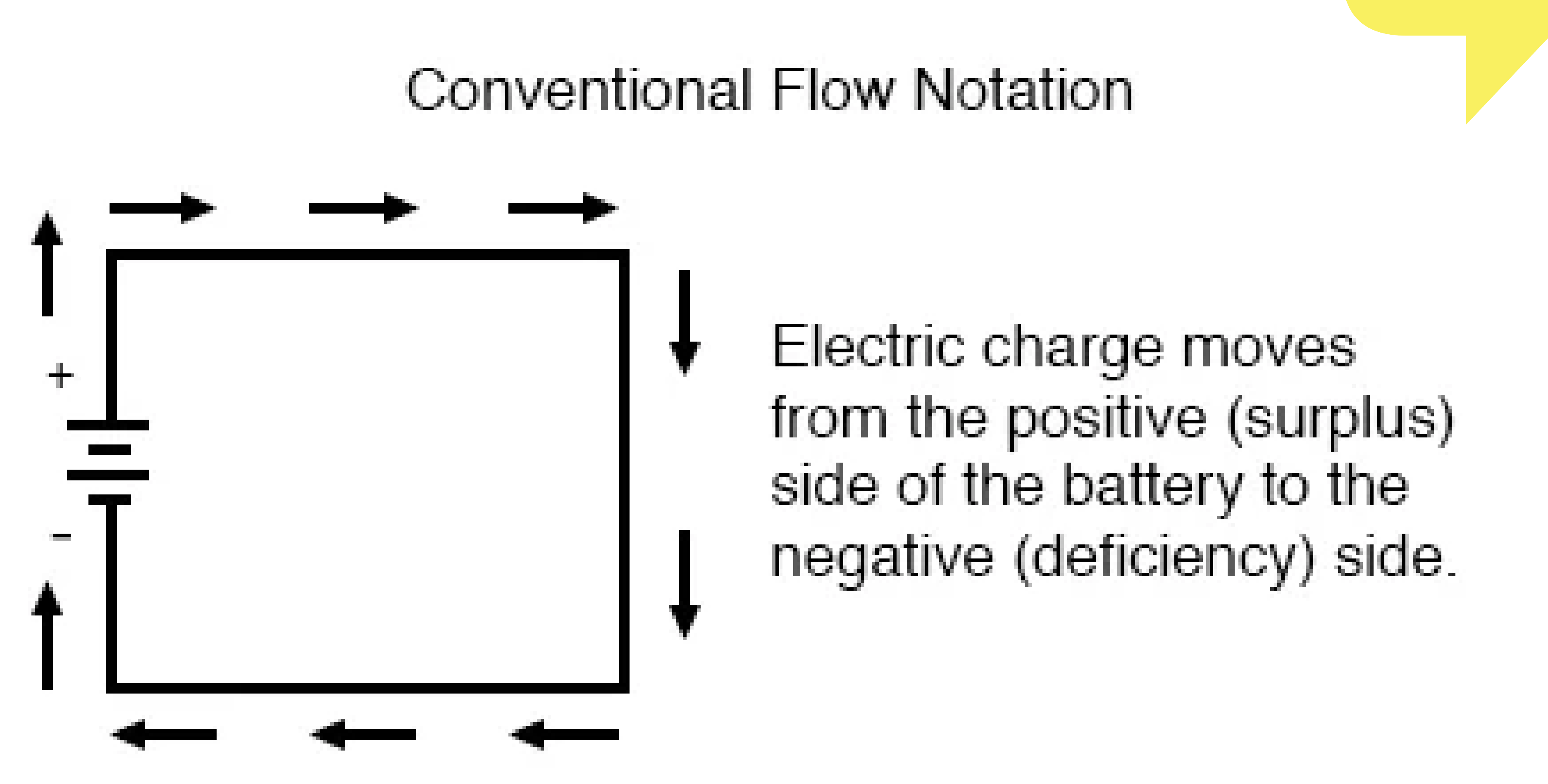

OHM
VOLT
AMP

Conventional Flow

This direction was decided before we knew how atoms work



Conventional Flow Notation

Electric charge moves from the positive (surplus) side of the battery to the negative (deficiency) side.

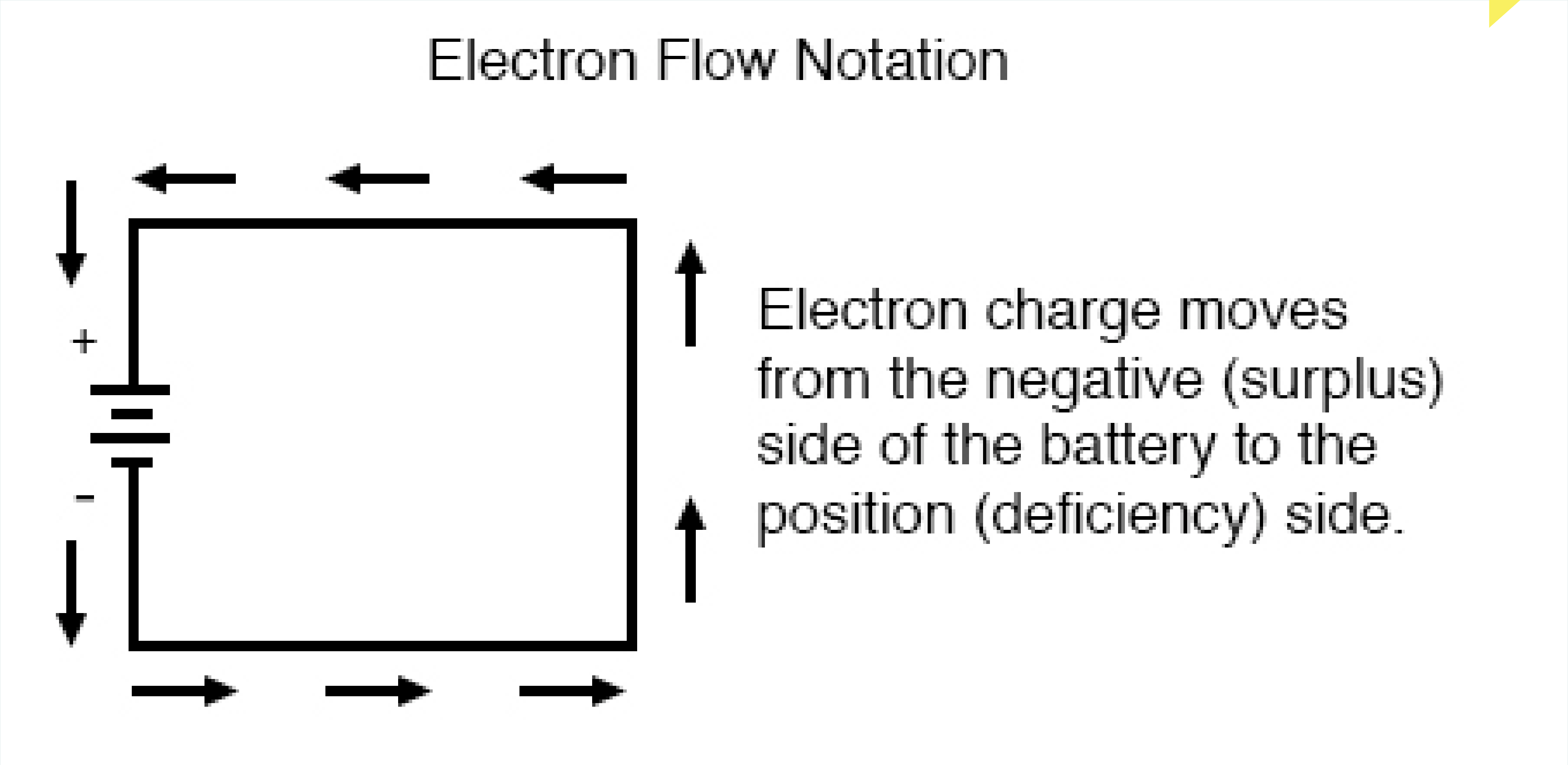
www.allaboutcircuits.com

Conventional Versus Electron Flow | Basic Concepts Of Electricity | Electronics Textbook

Read about Conventional Versus Electron Flow (Basic Concepts Of Electricity) in our free Electronics Textbook

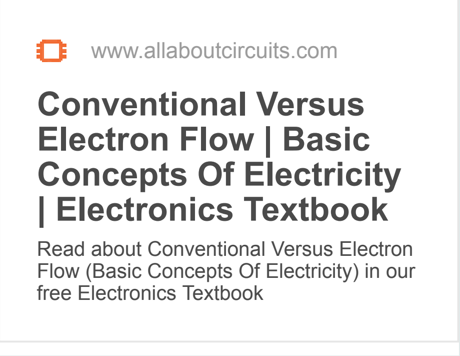
Electron Flow

This direction is physically accurate



Electron Flow Notation

Electron charge moves from the negative (surplus) side of the battery to the position (deficiency) side.



www.allaboutcircuits.com

Conventional Versus Electron Flow | Basic Concepts Of Electricity | Electronics Textbook

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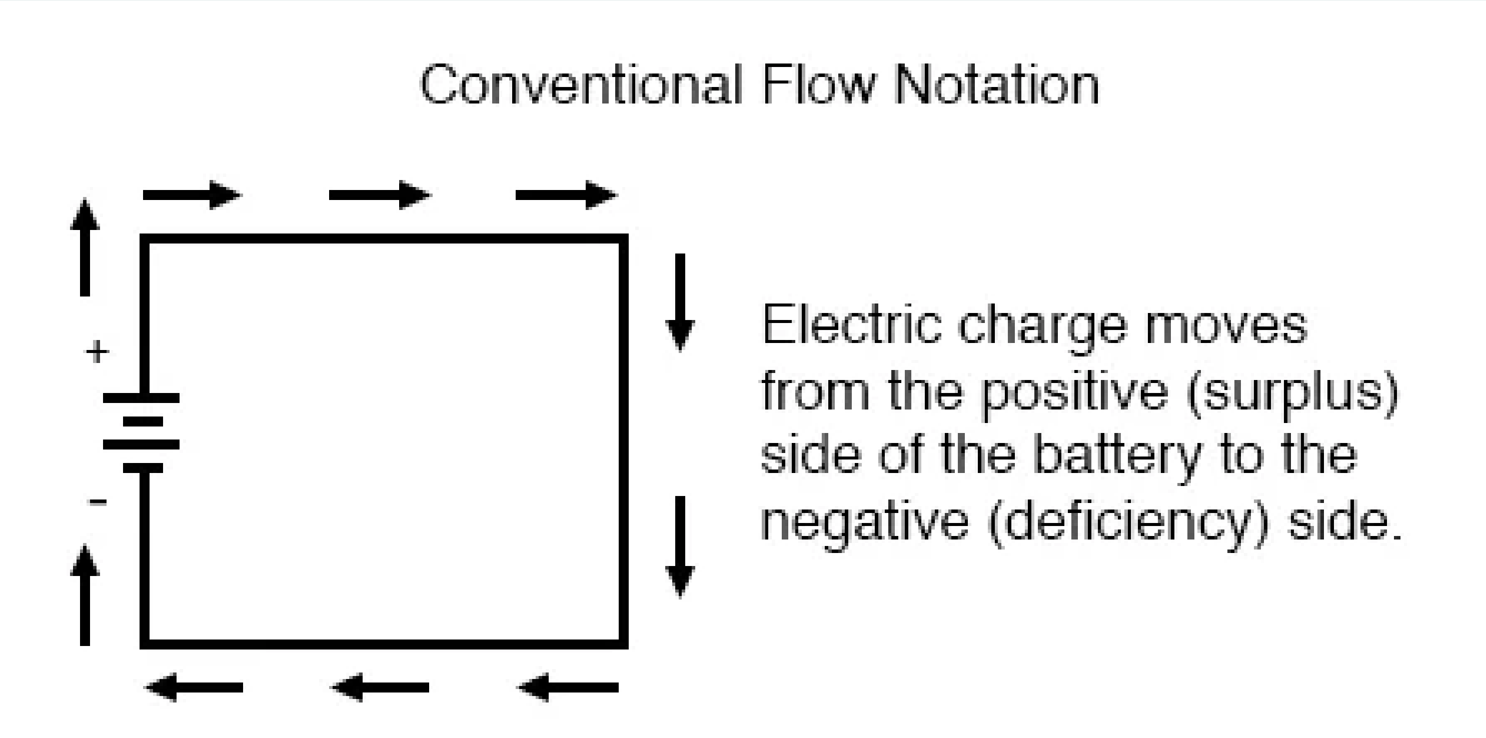
Which one to use?

We are going to use the conventional flow, since many schematic symbols are easier to learn when you think of current flowing from + to -

Our water analogy works also better this way.

The math and pretty much everything else works the same no matter which way you to imagine the current flowing.



Conventional Flow Notation

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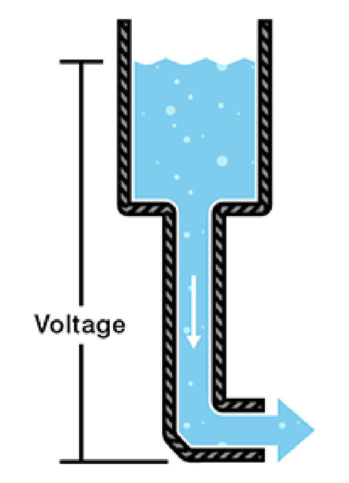
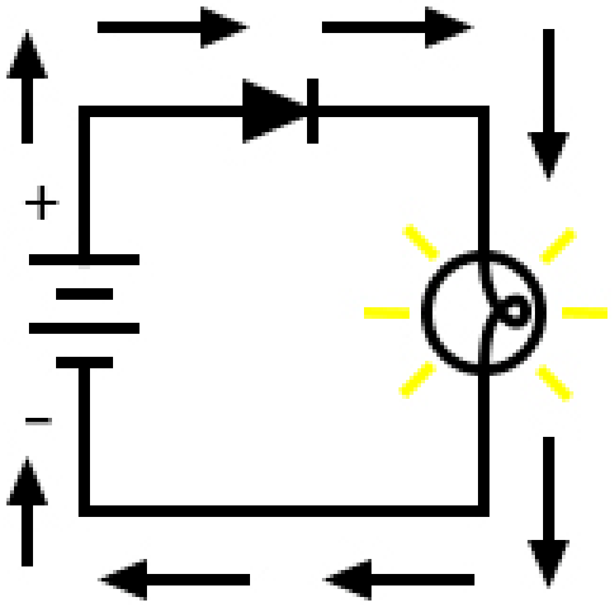


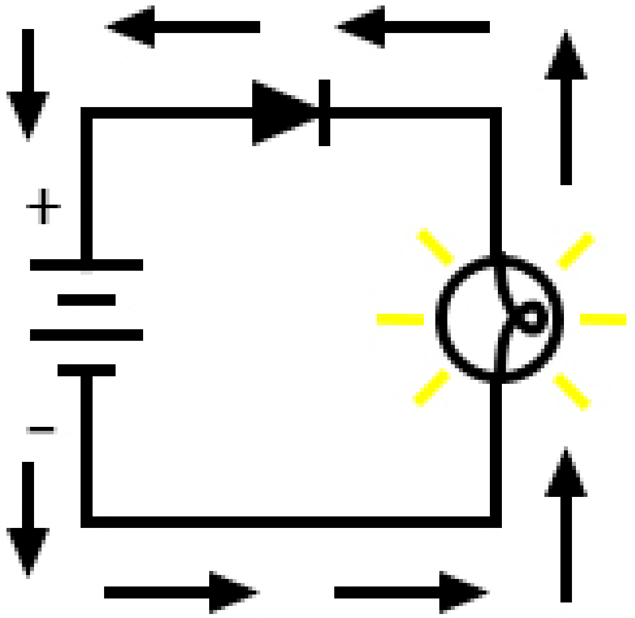
Lab Time
Multimeter

Lab Time
Breadboard

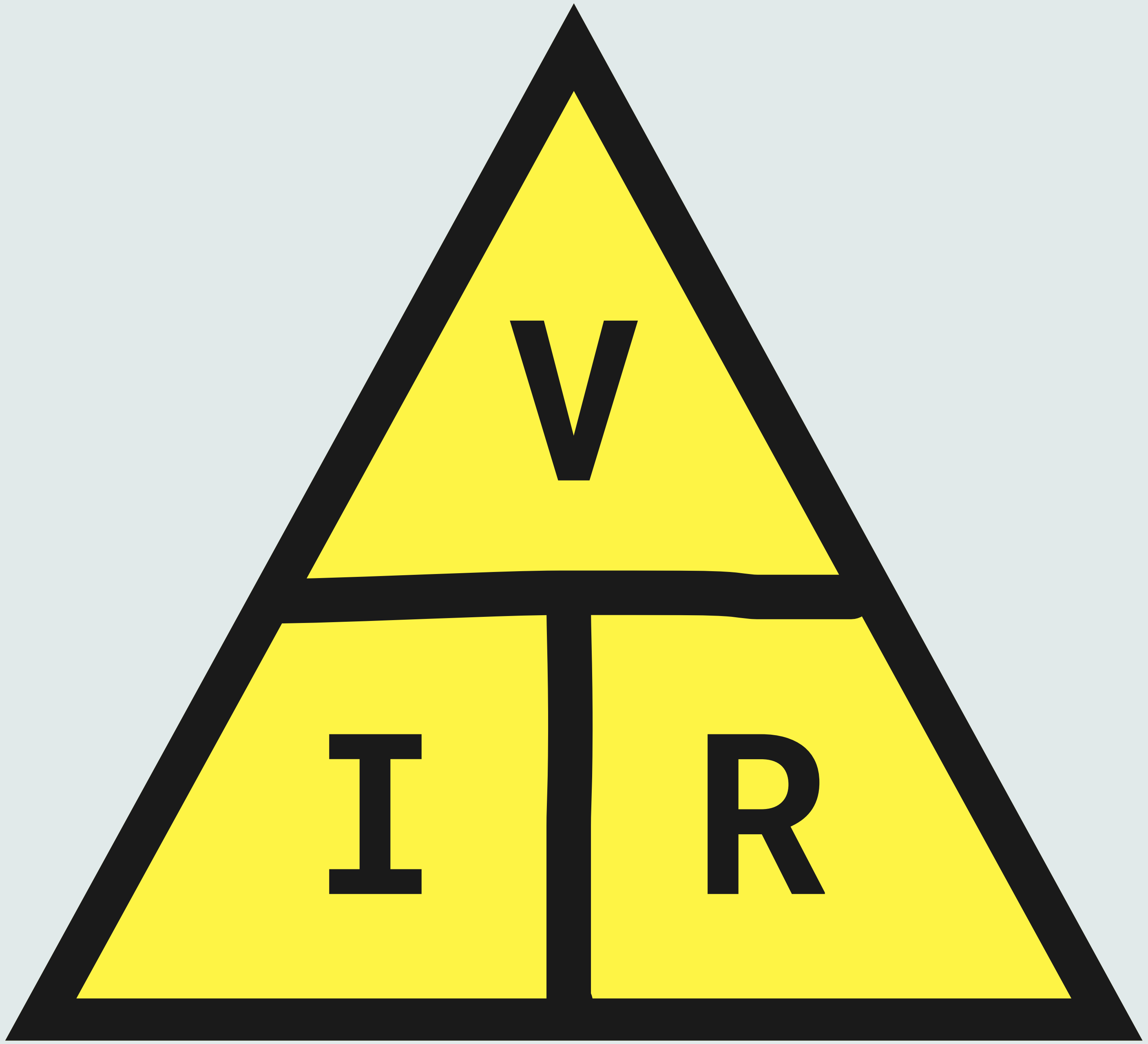
Current shown using conventional flow notation



Current shown using electron flow notation



Ohm's Law

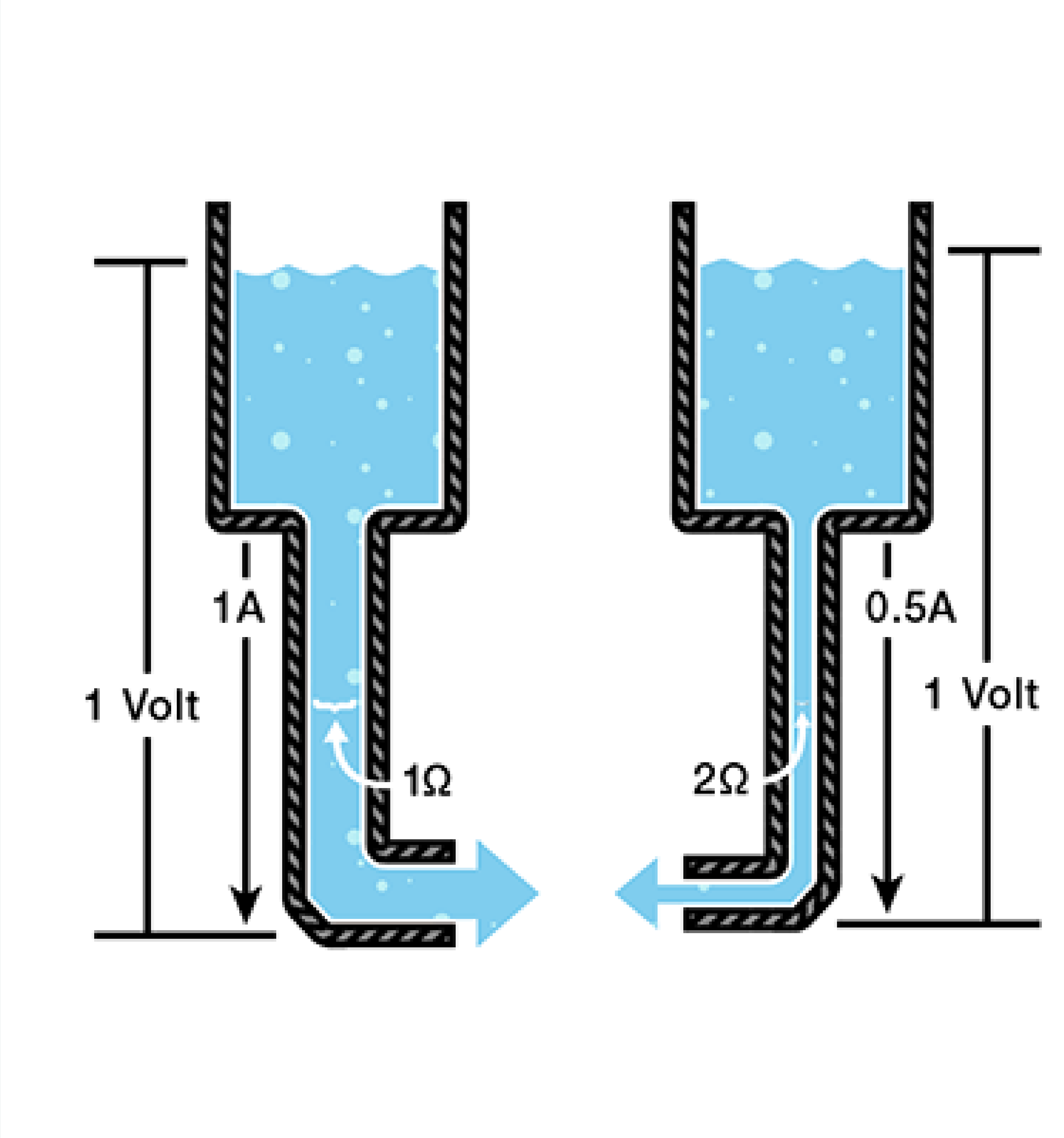


$V=I*R$

$I=V/R$

$R=V/I$

Ohm's Law


1 Volt
1A
1Ω
2Ω
0.5A
1 Volt

$$V=I*R$$

$$1V=0.5A*2\Omega$$

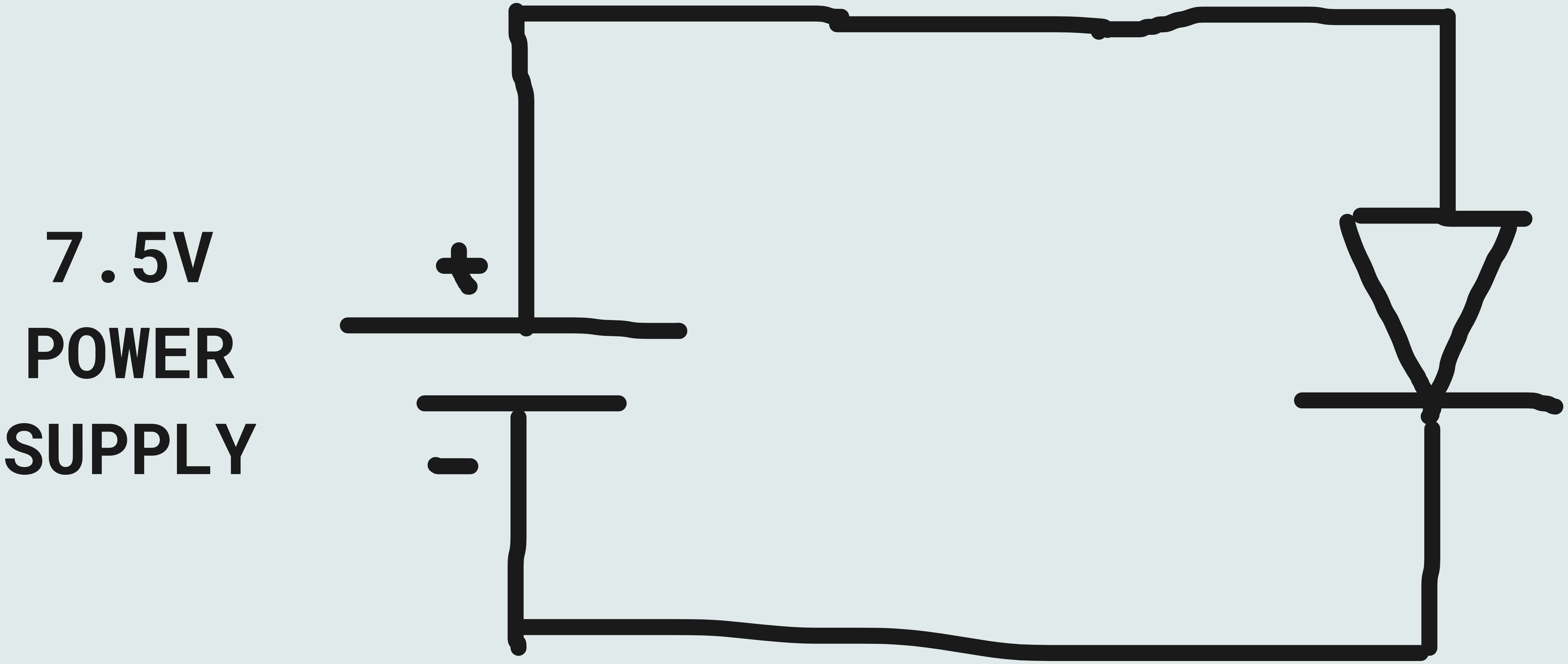
$$I=V/R$$

$$0.5A=1V/2\Omega$$

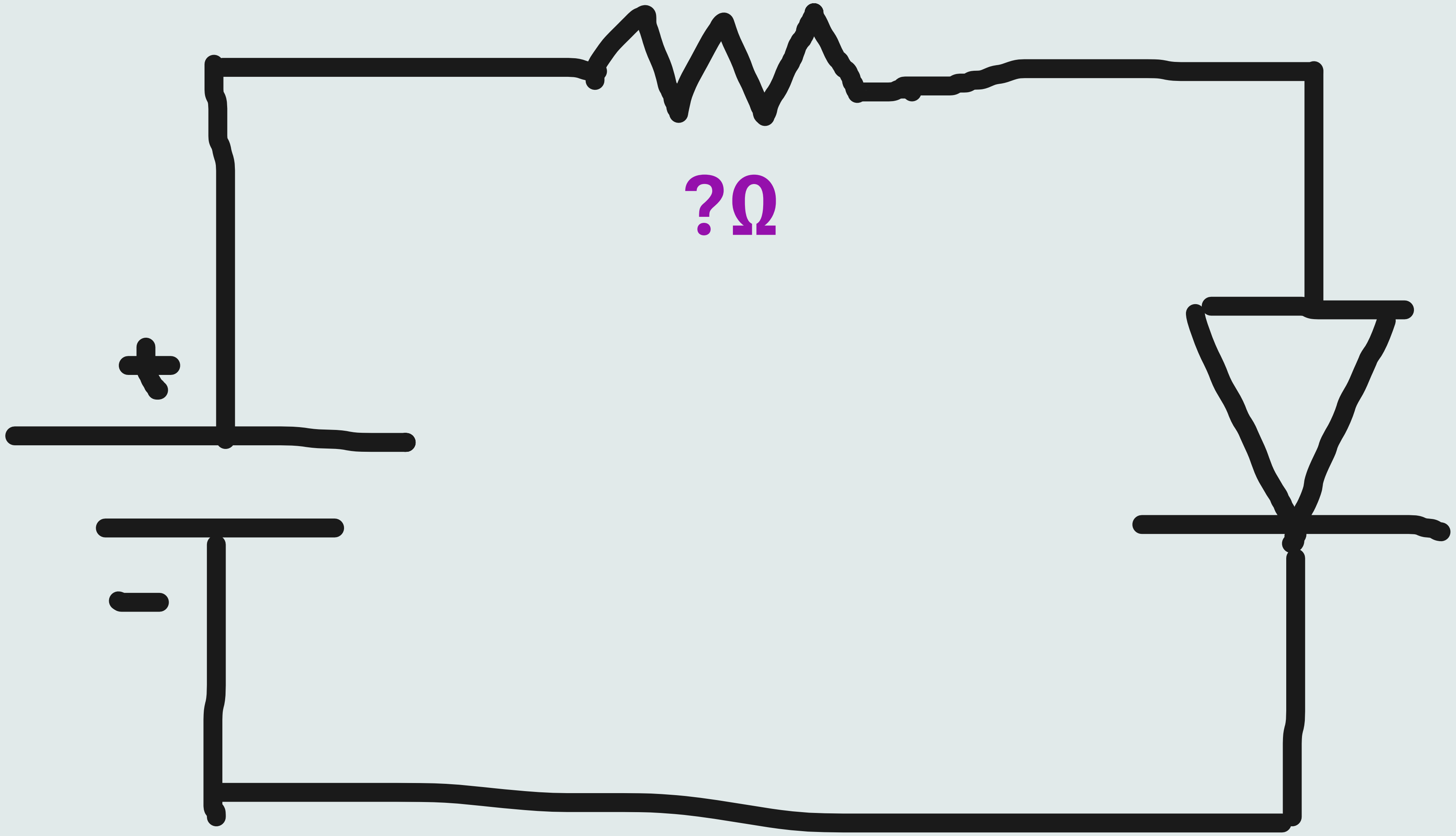
$$R=V/I$$

$$2\Omega=1V/0.5A$$

If we would do this, the LED would burn very brightly for a few seconds and then most likely break



LEDs can only handle a certain amount of current. You need to add some resistance to the circuit to reduce the current.



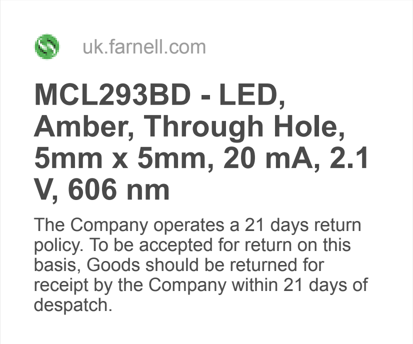
RESISTOR

?Ω

7.5V
POWER
SUPPLY

LED

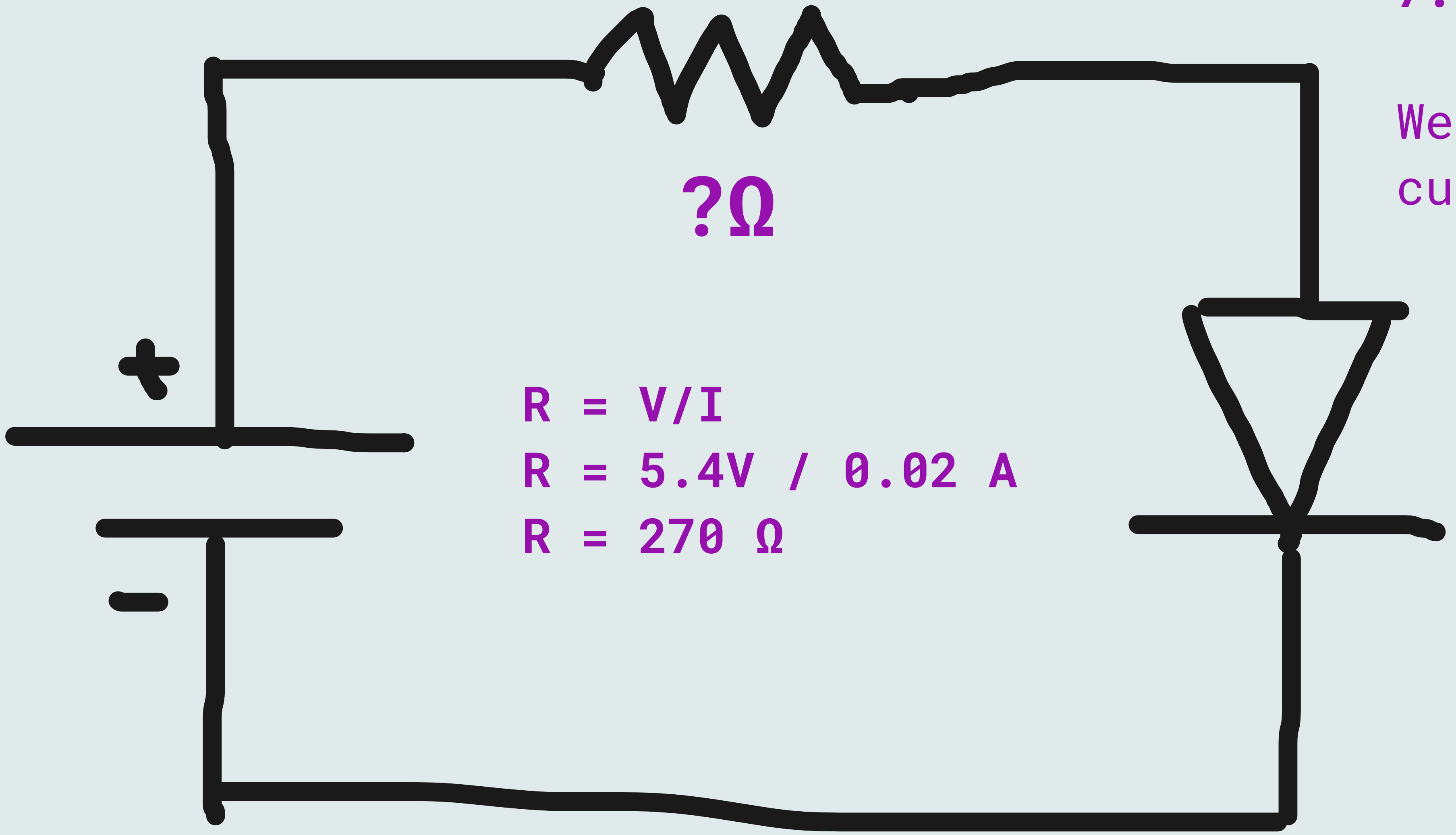
Forward voltage: 2.1V
Forward current: 20mA



uk.farnell.com

MCL293BD - LED, Amber, Through Hole, 5mm x 5mm, 20 mA, 2.1 V, 606 nm

The Company operates a 21 days return policy. To be accepted for return on this basis, Goods should be returned for receipt by the Company within 21 days of despatch.



RESISTOR

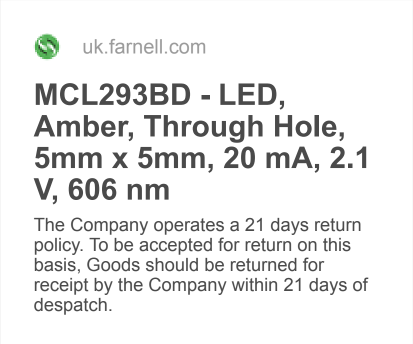
?Ω

7.5V
POWER
SUPPLY

R = V/I
R = 5.4V / 0.02 A
R = 270 Ω

LED

Forward voltage: 2.1V
Forward current: 20mA



uk.farnell.com

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The LED drops the voltage by the forward voltage amount

7.5V - 2.1V = 5.4V

We need to limit the current to 20mA (0.02A) ohmslawcalculator.com

Ohms Law Calculator

Simple to use Ohm's Law Calculator. Calculate Power, Current, Voltage or Resistance. Just enter 2 known values and the calculator will solve for the others.

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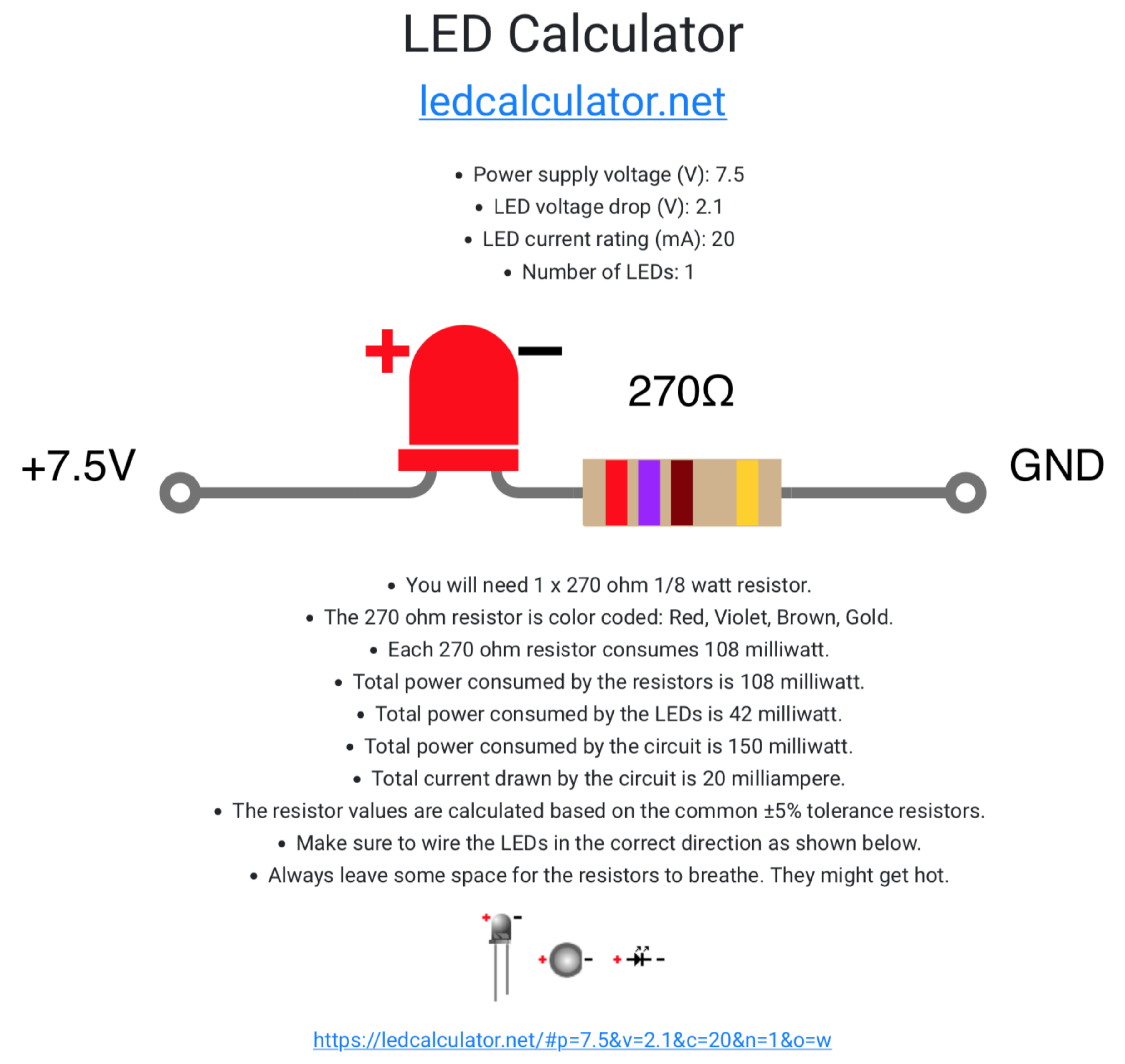
ledcalculator.net

LED Calculator - Current limiting resistor calculator for LED arrays

This LED calculator will help you calculate the resistor values you will need when designing a series/parallel LED array circuit.



LED Calculator

ledcalculator.net

- Power supply voltage (V): 7.5
- LED voltage drop (V): 2.1
- LED current rating (mA): 20
- Number of LEDs: 1

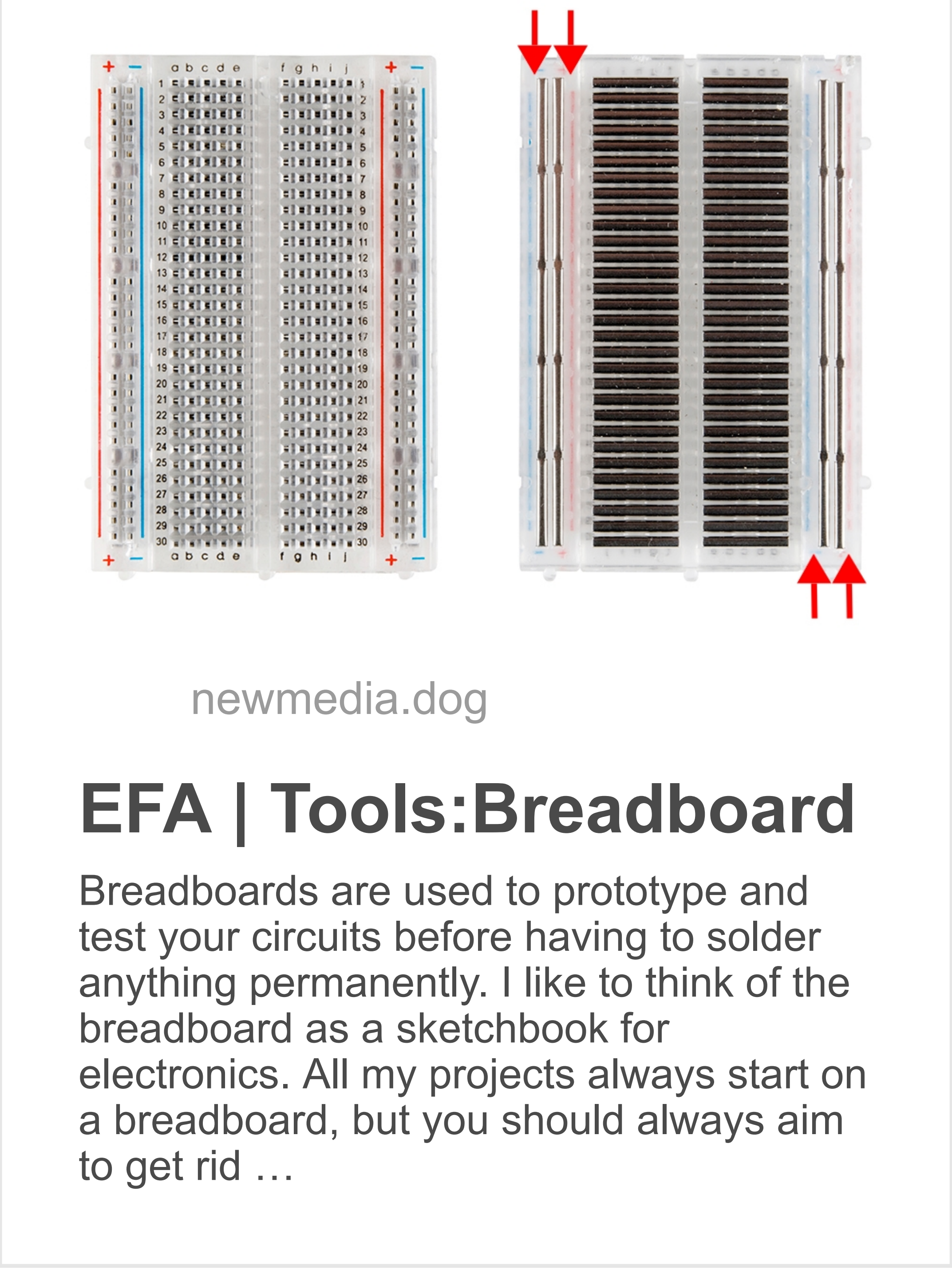
- You will need 1 x 270 ohm 1/8 watt resistor.
- The 270 ohm resistor is color coded: Red, Violet, Brown, Gold.
- Each 270 ohm resistor consumes 108 milliwatt.
- Total power consumed by the resistors is 108 milliwatt.
- Total power consumed by the LEDs is 42 milliwatt.
- Total power consumed by the circuit is 150 milliwatt.
- Total current drawn by the circuit is 20 milliampere.
- The resistor values are calculated based on the common ±5% tolerance resistors.
- Make sure to wire the LEDs in the correct direction as shown below.
- Always leave some space for the resistors to breathe. They might get hot.

https://ledcalculator.net/#p=7.5&v=2.1&c=20&n=1&o=w

newmedia.dog

EFA | Tools:Multimeter

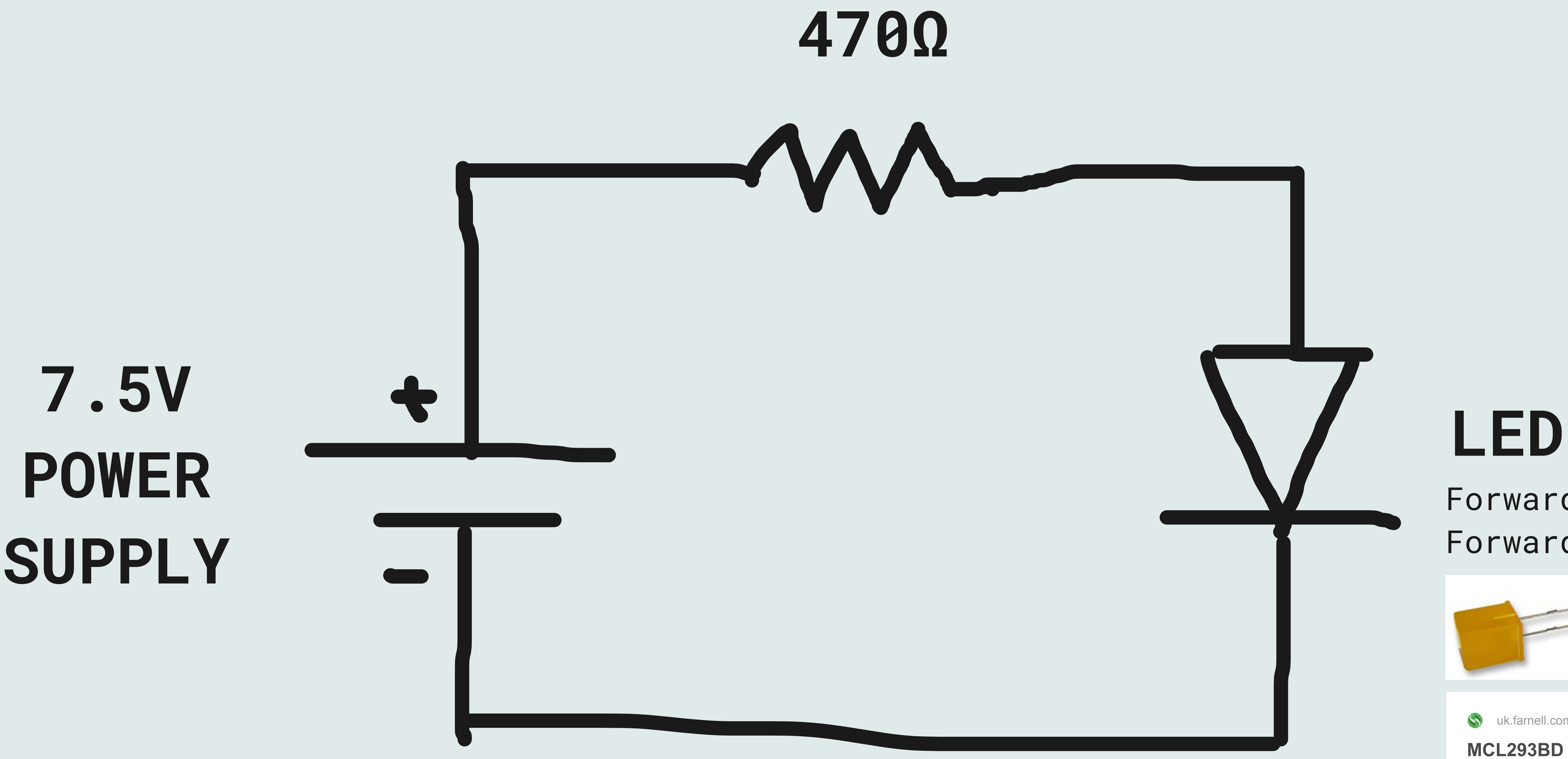
Multimeters are very handy tools for multiple purposes (hence the name MULTImeter). Usually, a multimeter will have different modes for measuring voltage, current, and resistance. Most multimeters also have a special continuity mode where the meter will…



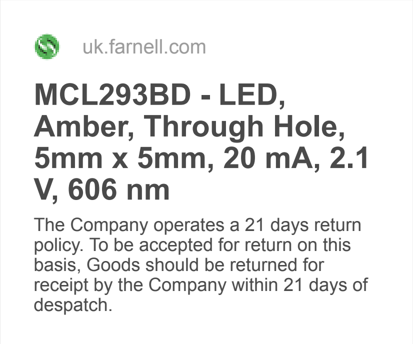
newmedia.dog

EFA | Tools:Breadboard

Breadboards are used to prototype and test your circuits before having to solder anything permanently. I like to think of the breadboard as a sketchbook for electronics. All my projects always start on a breadboard, but you should always aim to get rid …



Forward voltage: 2.1V
Forward current: 20mA



uk.farnell.com

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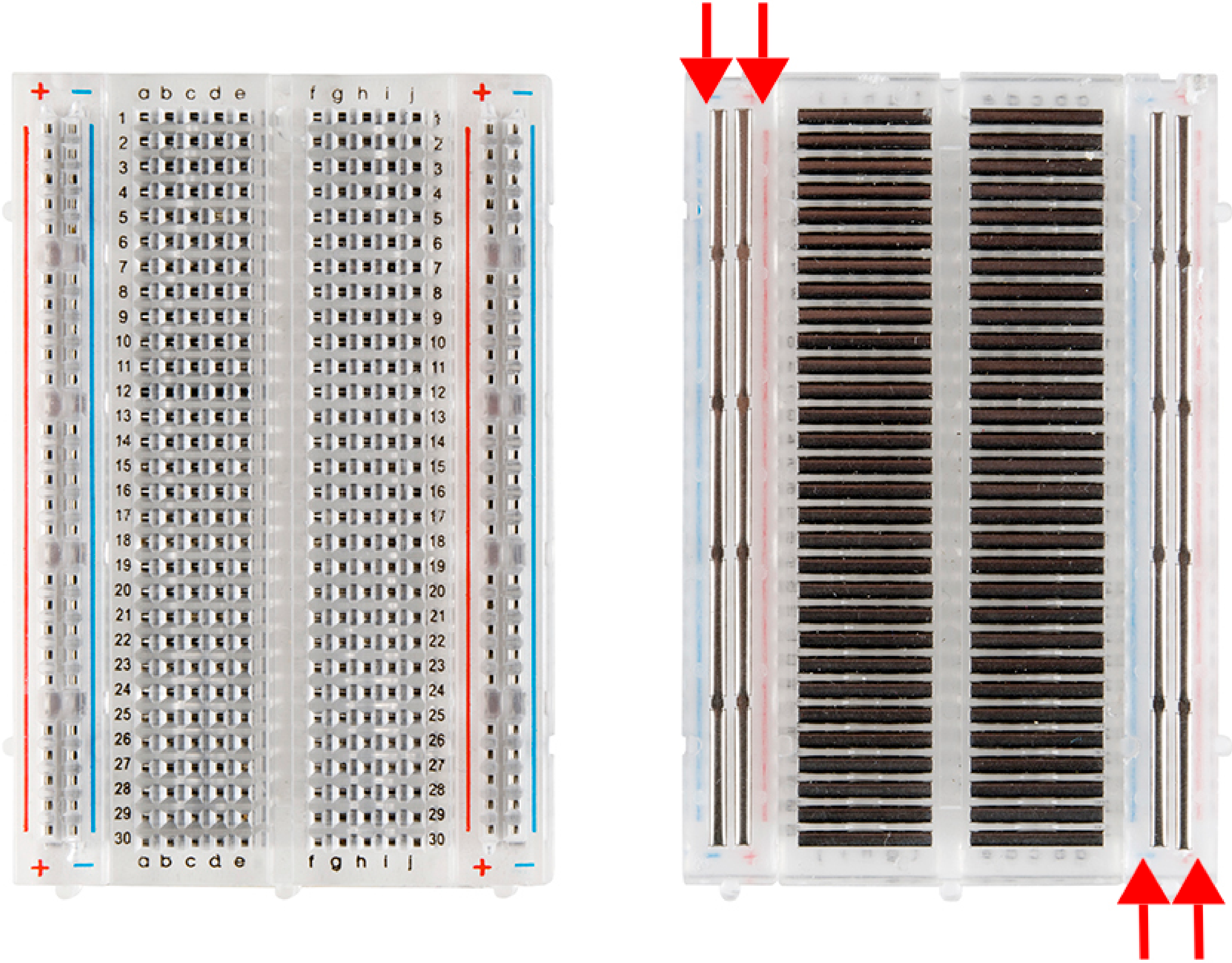
+
−
a b c d e
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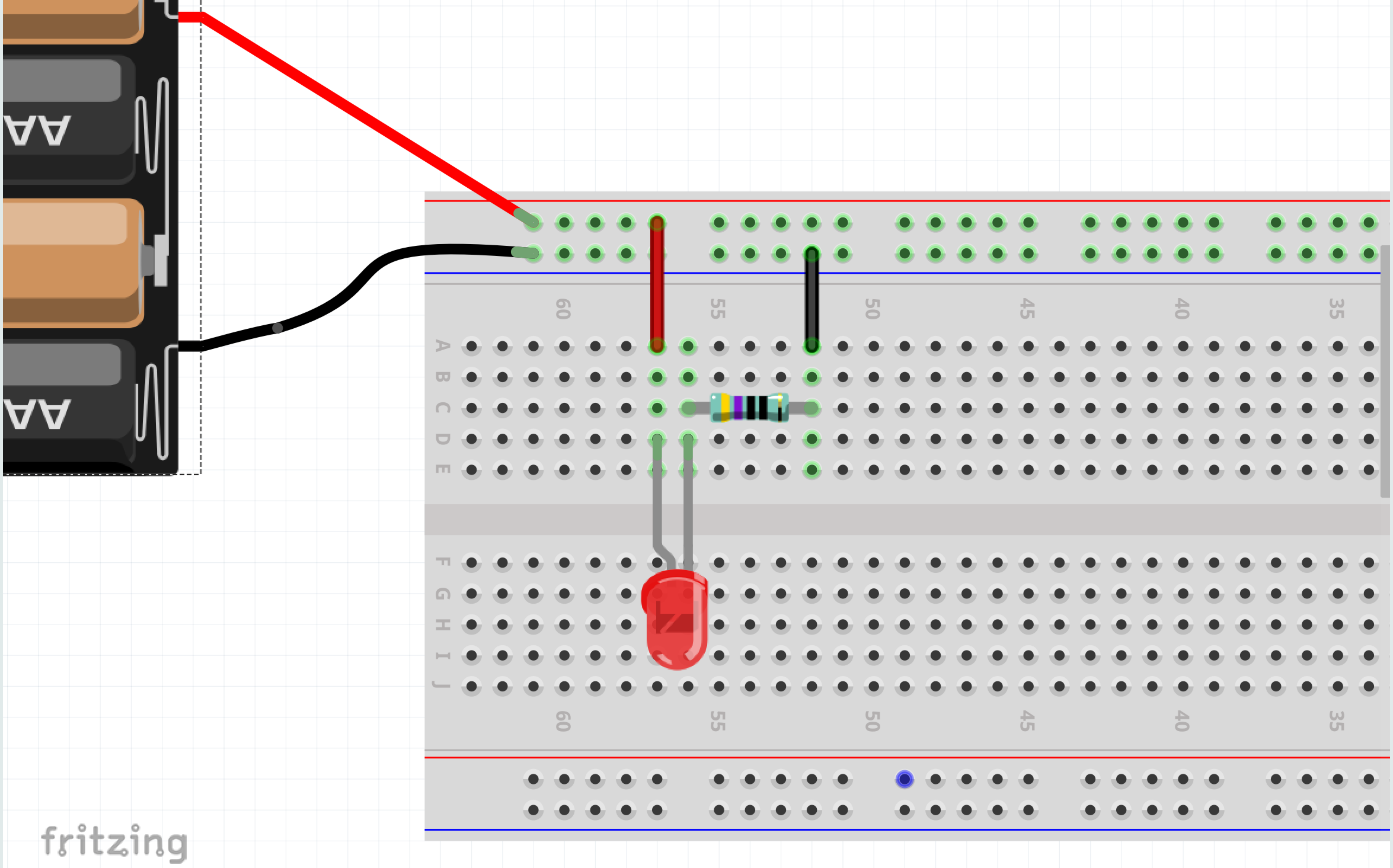
AA
AA
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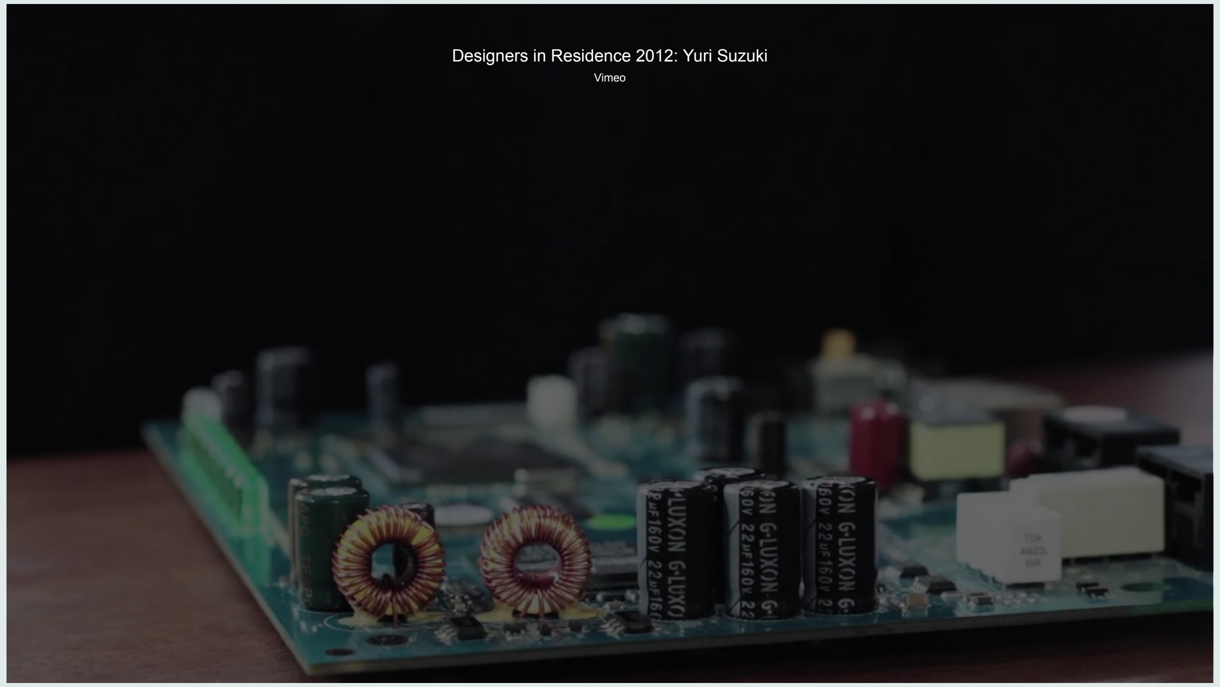
fritzing

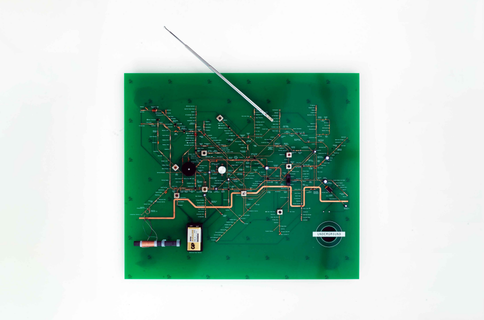
Week #1
Lecture 002

Peter Vogel - The Sound of Shadows (2011)

Vimeo

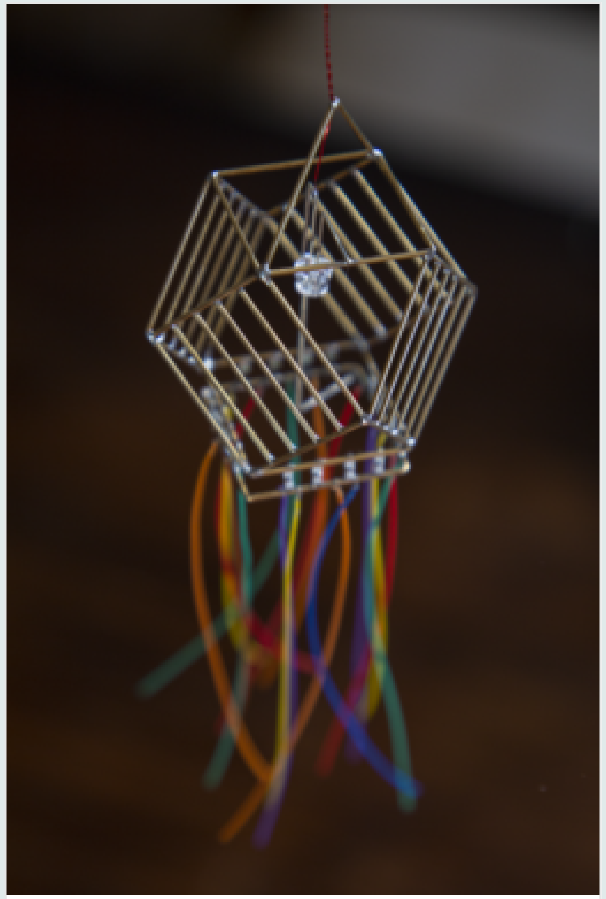

Designers in Residence 2012: Yuri Suzuki

Vimeo

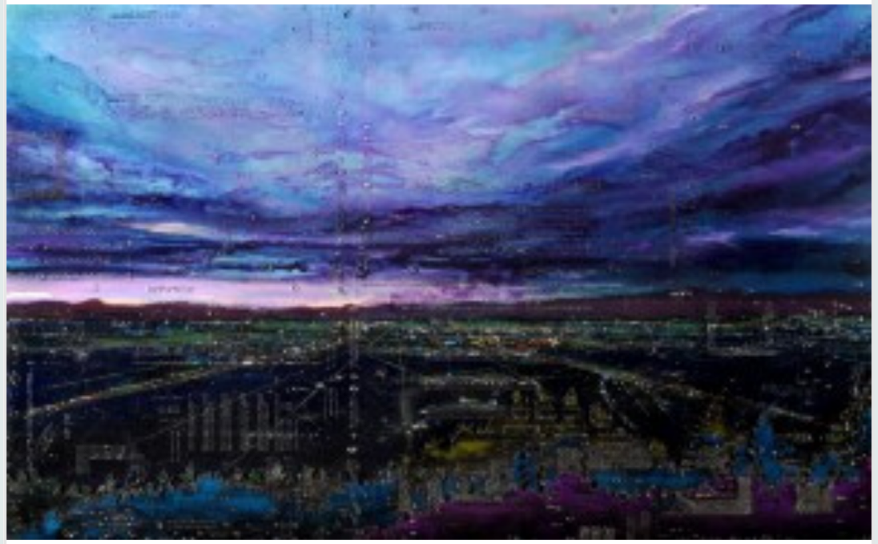

yurisuzuki.com

Yuri Suzuki | Tube Map Radio

Tube Map Radio The map is inspired by a spoof diagram created by the original designer of the London Tube map, Harry Beck, which shows the lines and stations as an annotated electrical circuit. Iconic landmarks on this map are represented by components …


www.bhoite.com

Sculptures

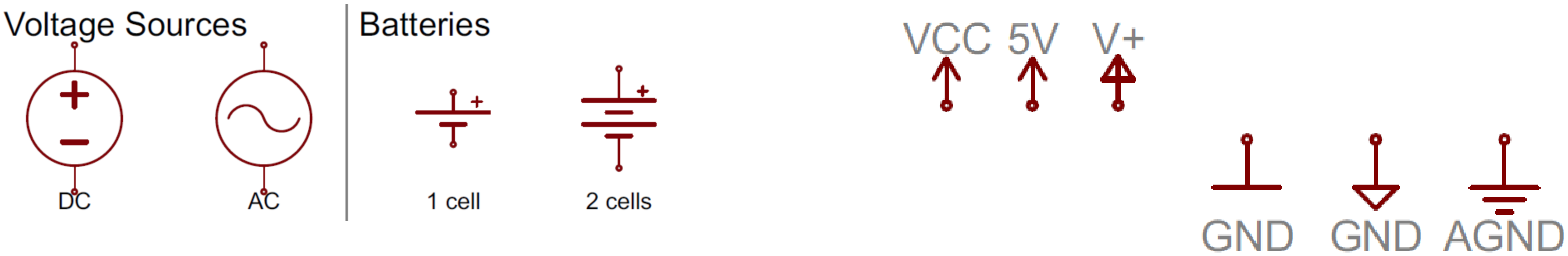

www.petermcfarlane.com

Circuit Board

Circuit Board Series by Peter McFarlane

Schematic Symbols

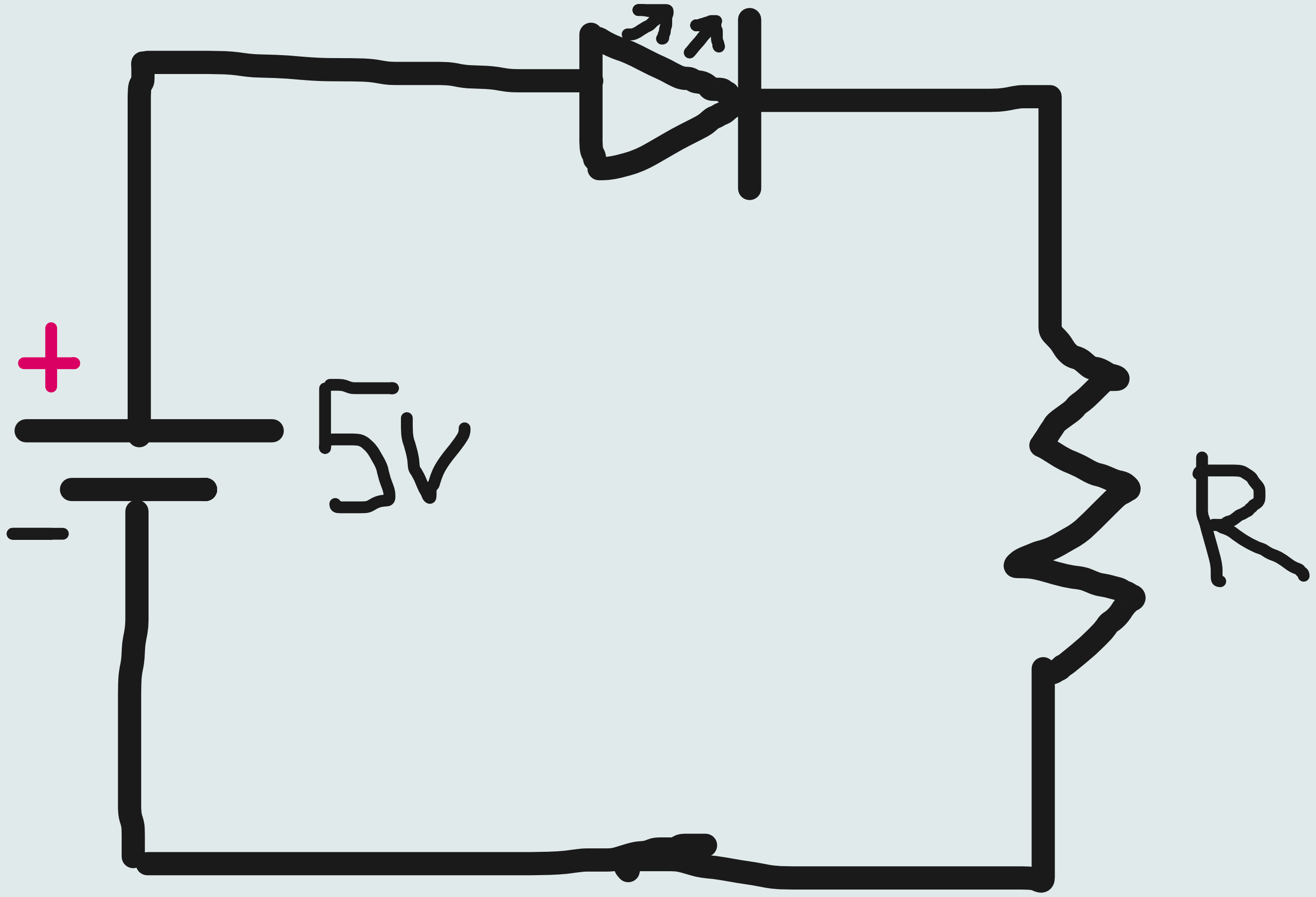
Voltage Sources

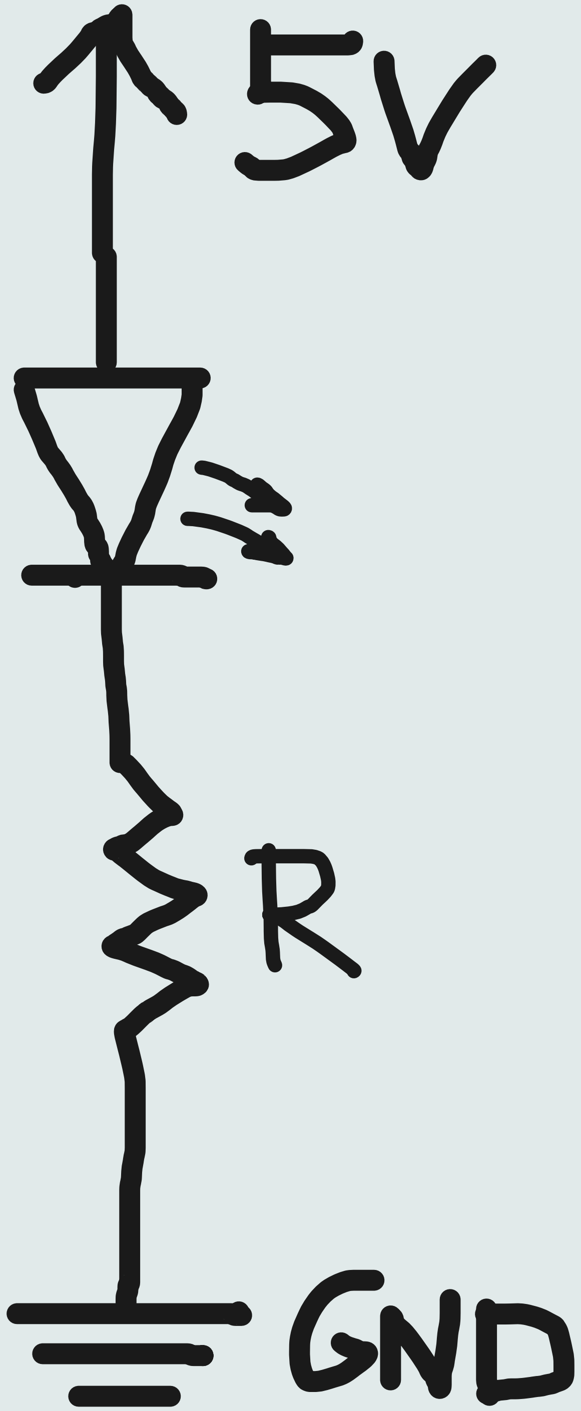

Voltage Sources
Batteries
DC
AC
1 cell
2 cells
VCC
5V
V+
GND
GND
AGND

learn.sparkfun.com

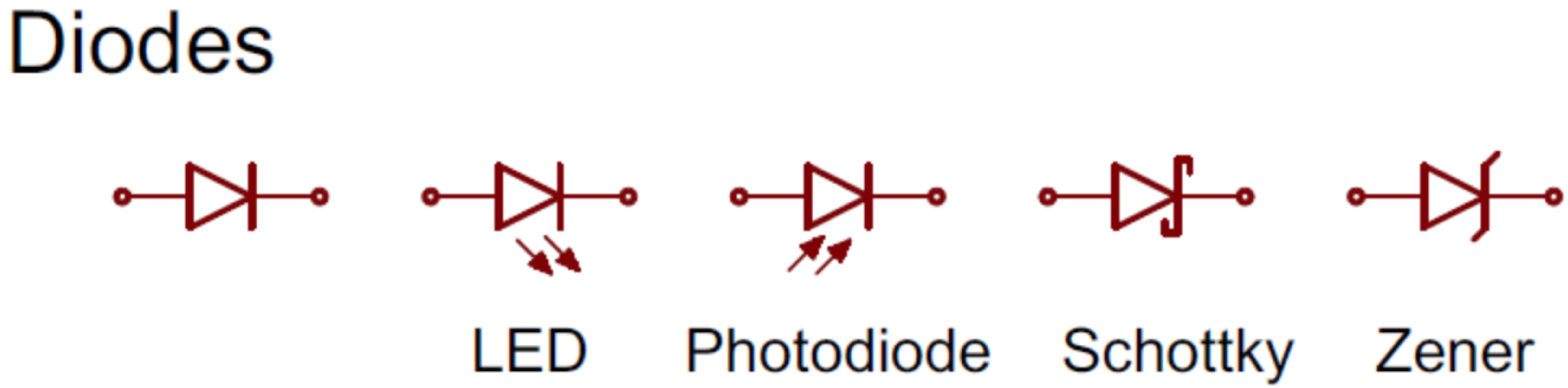
How to Read a Schematic

Schematics are our map to designing, building, and troubleshooting circuits. Understanding how to read and follow schematics is an important skill for any electronics engineer. This tutorial should turn you into a fully literate schematic reader! We'll …


+
5V
−
R


5V
R
GND

Diode and LED


Diodes
LED
Photodiode
Schottky
Zener

learn.sparkfun.com

How to Read a Schematic

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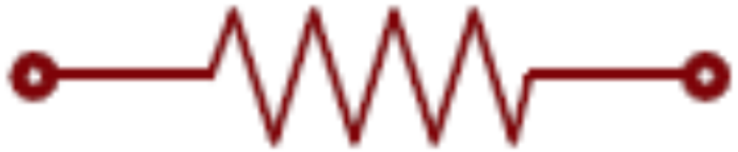
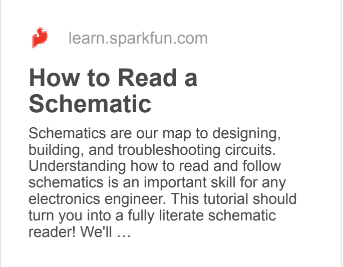
Resistors





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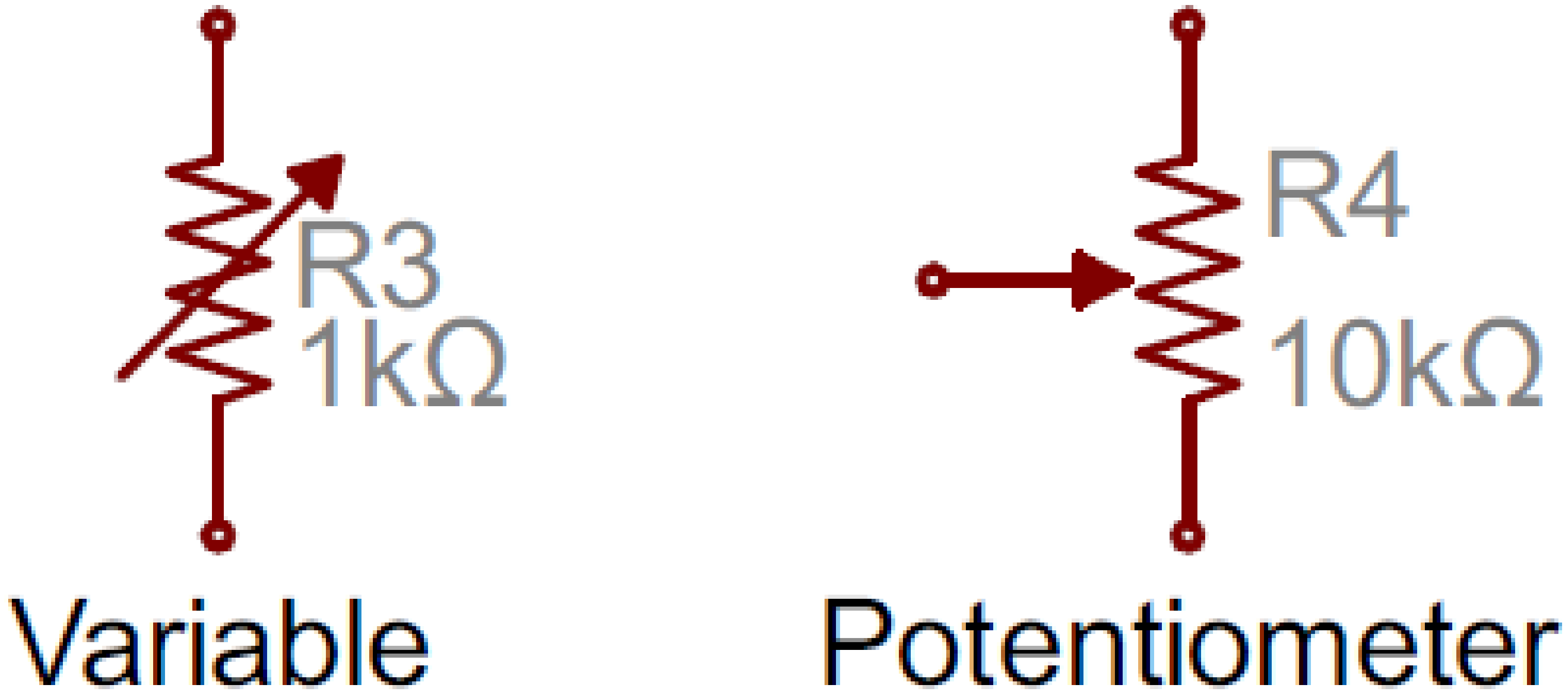
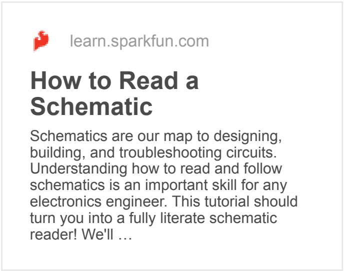
Varistors and Potentiometers

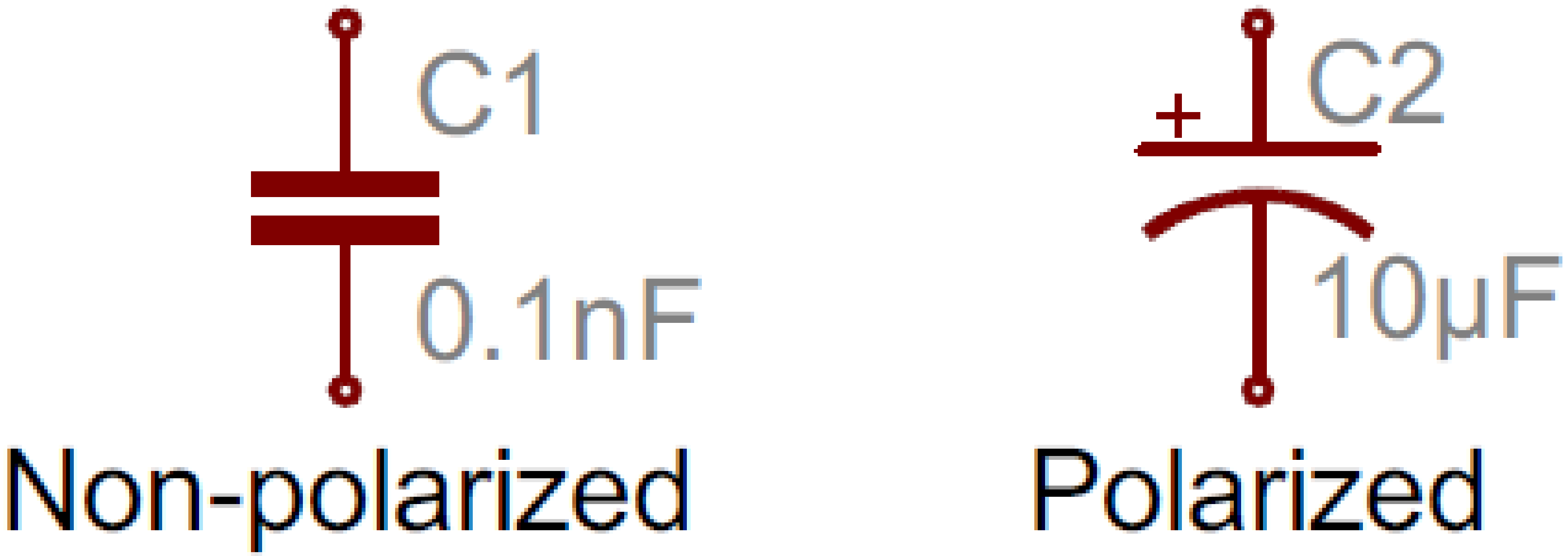

R3
1kΩ
Variable
R4
10kΩ
Potentiometer


learn.sparkfun.com

How to Read a Schematic

Schematics are our map to designing, building, and troubleshooting circuits. Understanding how to read and follow schematics is an important skill for any electronics engineer. This tutorial should turn you into a fully literate schematic reader! We'll …

Capacitors

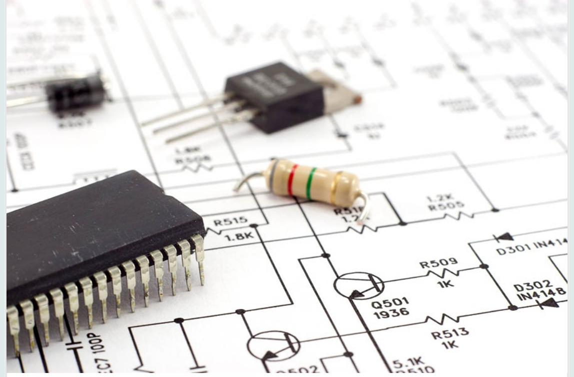

C1
0.1nF
Non-polarized
+
C2
10µF
Polarized

learn.sparkfun.com

How to Read a Schematic

Schematics are our map to designing, building, and troubleshooting circuits. Understanding how to read and follow schematics is an important skill for any electronics engineer. This tutorial should turn you into a fully literate schematic reader! We'll …

Drawing Tools for Schematics



www.circuit-diagram.org

Circuit Diagram

A free, user-friendly program for making electronic circuit diagrams. Create diagrams visually by placing components with your cursor. Extend the built-in functionality with custom components. Export circuits as scalable vector images, or convert to a s...

fritzing.org

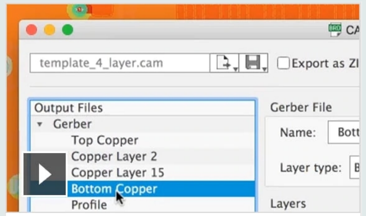
Fritzing

Fritzing is an open-source hardware initiative that makes electronics accessible as a creative material for anyone. We offer a software tool, a community website and services in the spirit of Processing and Arduino, fostering a creative ecosystem that a...

www.kicad.org

KiCad EDA

KiCad includes a 3D viewer which you can use to inspect your design in an interactive canvas. You can rotate and pan around to inspect details that are difficult to inspect on a 2D view. Multiple rendering options allow you to modify the aesthetic appea...



www.autodesk.com

EAGLE | PCB Design And Electrical Schematic Software | Autodesk

EAGLE is electronic design automation (EDA) software that lets printed circuit board (PCB) designers seamlessly connect schematic diagrams, component placement, PCB routing, and comprehensive library content.

www.autodesk.com

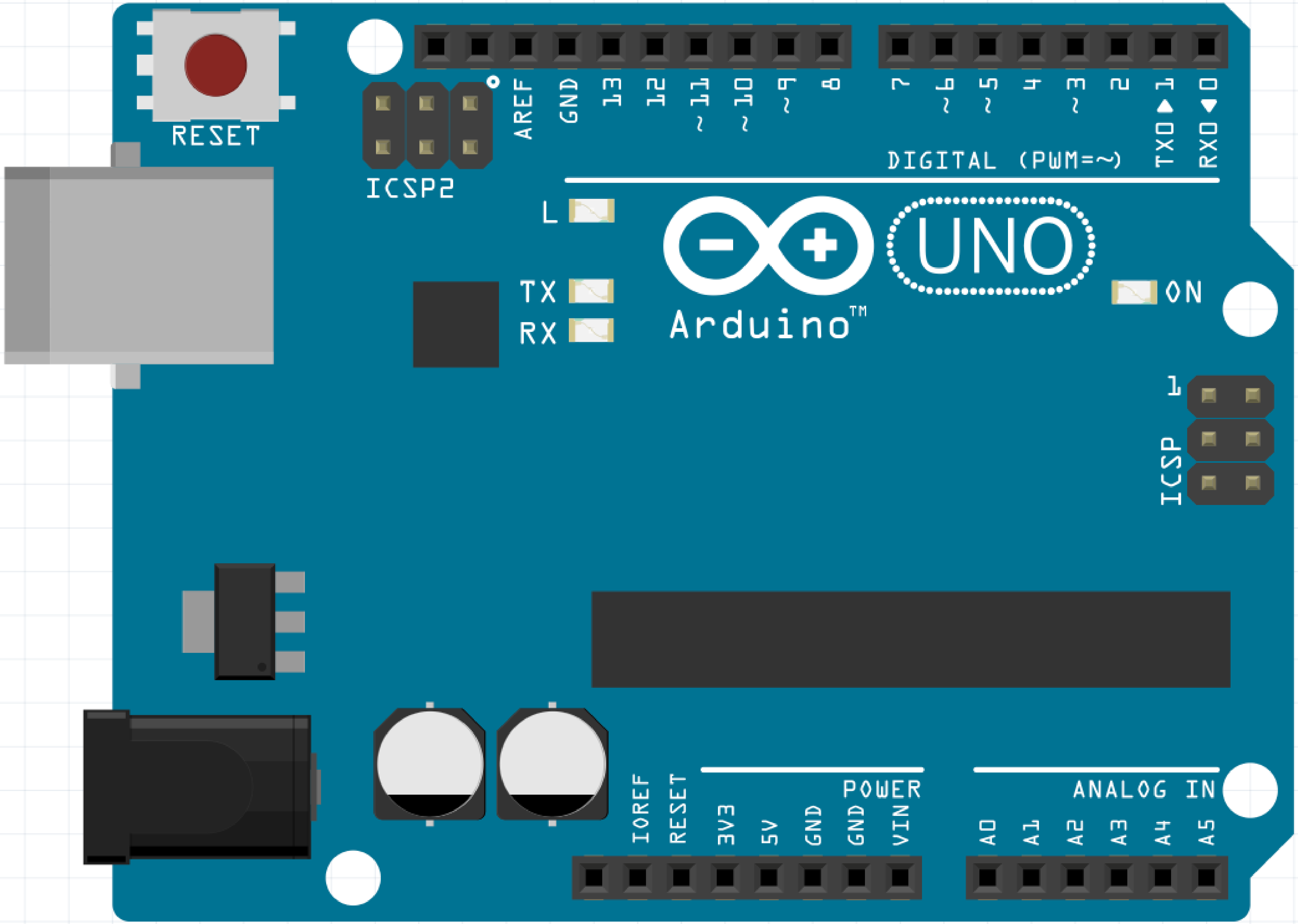
Fusion 360 | 3D CAD, CAM, CAE & PCB Cloud-Based Software | Autodesk

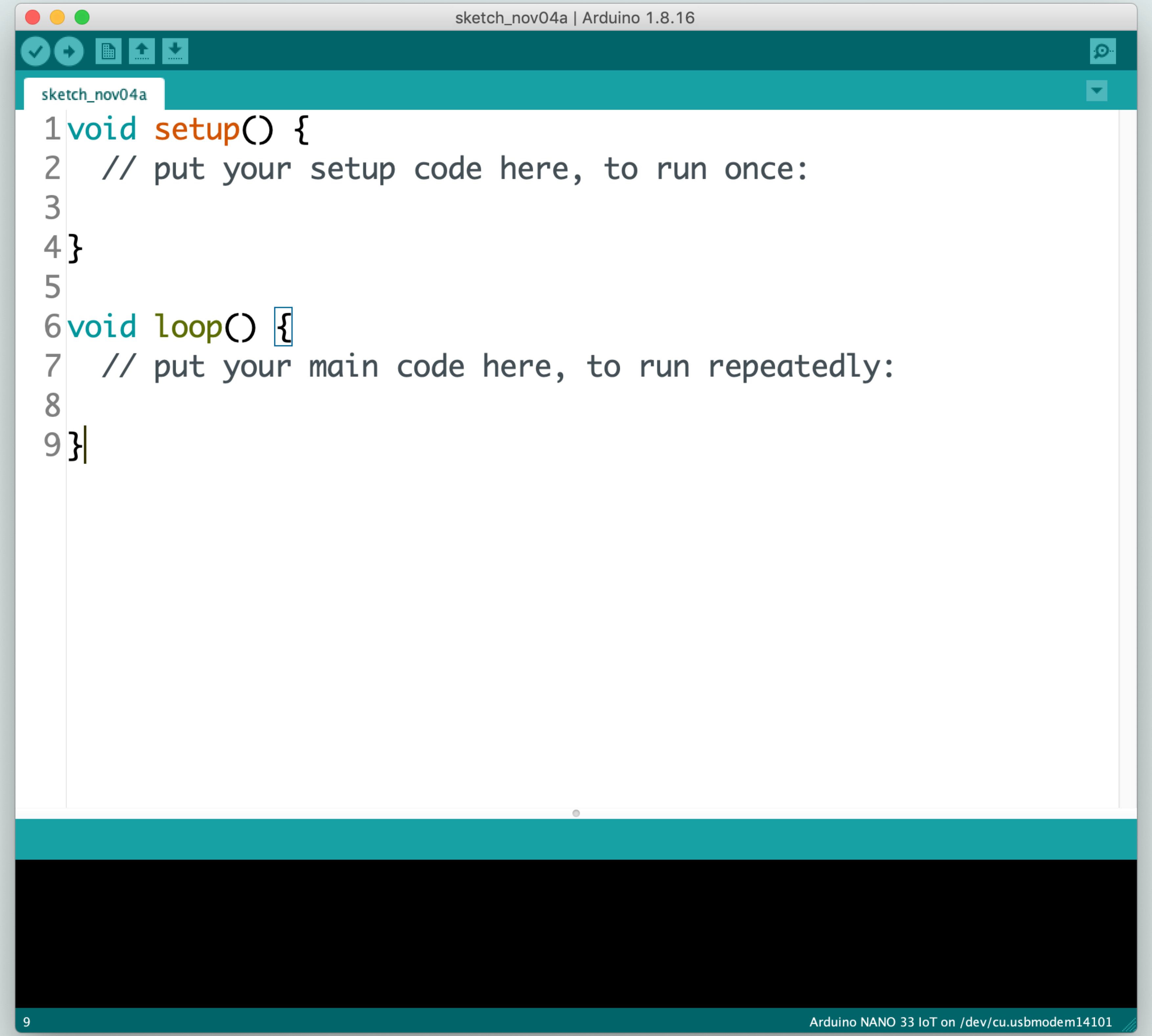
Fusion 360 is software for 3D CAD, modeling, manufacturing, industrial design, electronics & mechanical engineering. Subscribe for $495/year or download for free.

Falstad Circuit Simulator

http://falstad.com/circuit/

Arduino Basics


RESET
ICSP2
AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX▶1
RX◀0
DIGITAL (PWM=~)
L
TX
RX
Arduino™
UNO
ON
1
ICSP
IOREF
RESET
3V3
5V
GND
GND
VIN
POWER
ANALOG IN
A0
A1
A2
A3
A4
A5

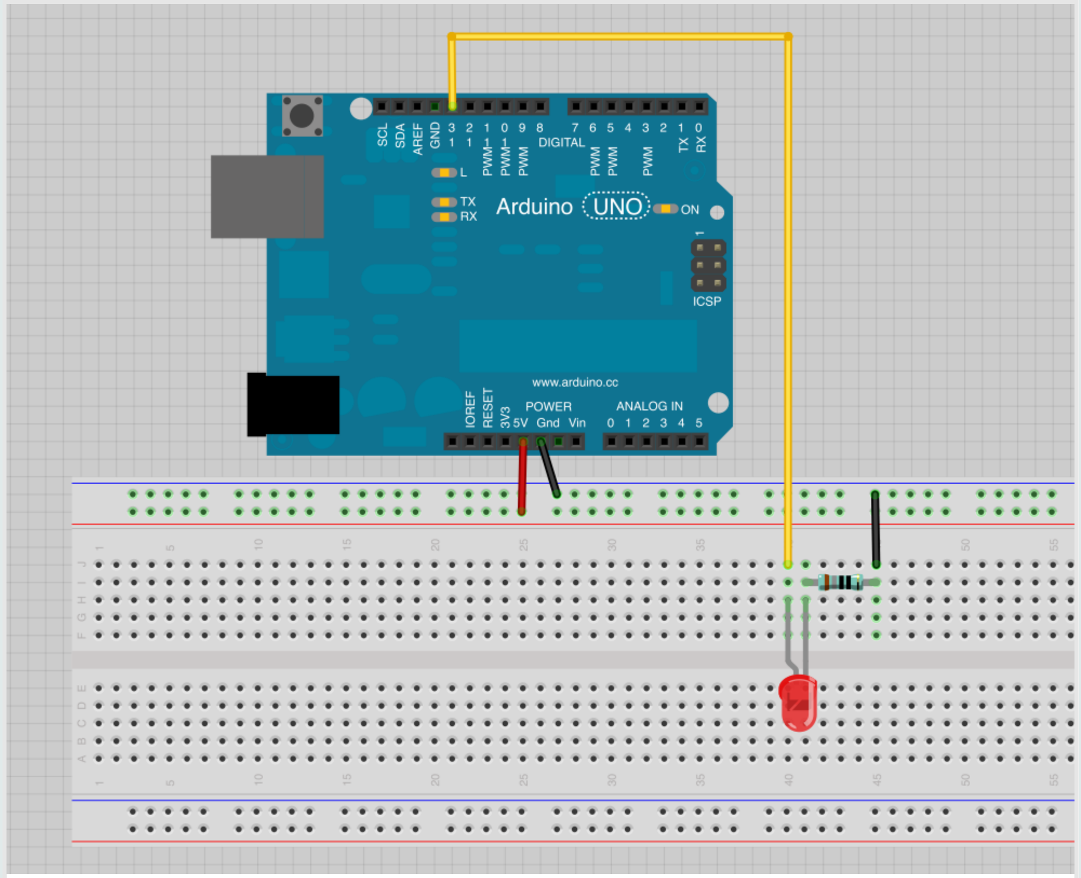

sketch_nov04a | Arduino 1.8.16
sketch_nov04a
9
Arduino NANO 33 IoT on /dev/cu.usbmodem14101

```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:

}
```


Arduino UNO
DIGITAL
PWM
TX
RX
ON
ICSP
www.arduino.cc
POWER
ANALOG IN
5V Gnd Vin

newmedia.dog

EFA | Arduino:Basics

This page explains the basic functionality of the Arduino in one place. See the sidebar menu for more detailed examples. Or explore the Arduino reference and tutorials. Arduino is an open-source microcontroller platform that is designed to make it easie…