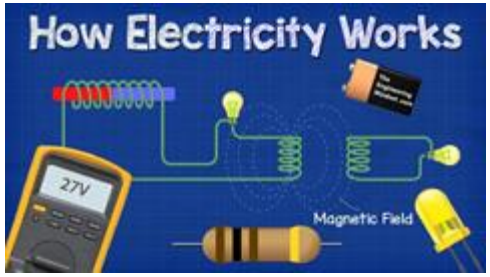
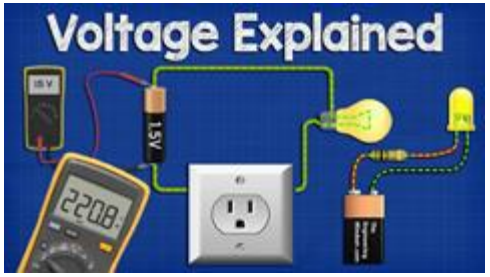
EP1000

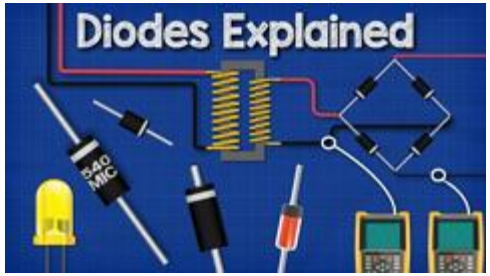
A Short Introduction to Electricity & Electronics

What is electricity?





Youtube: The Engineering Mindset
[Electrical Engineering Basics Playlist]



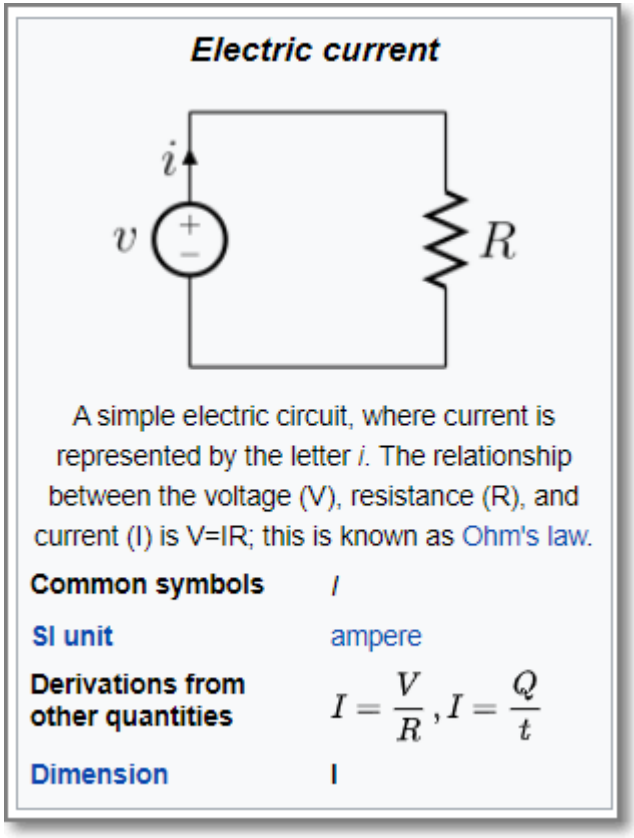
Electronic Components

YouTube: Great Scott!
[Essential Electronics Components that you will need for creating projects!]

Open University:
[An Introduction to Electronics]

Electricity

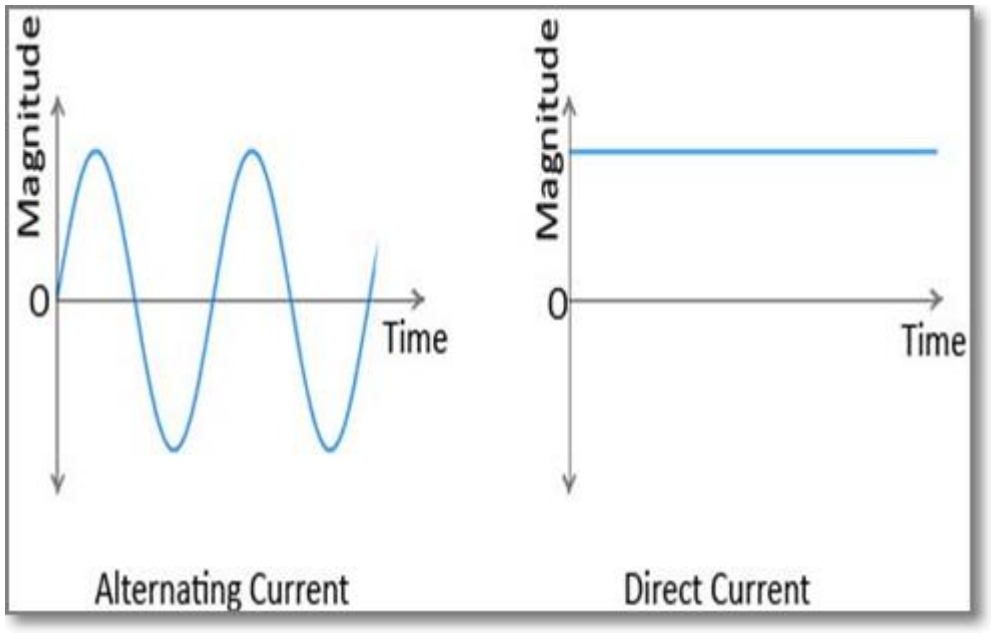
- The flow of electrons in a closed circuit.
- Voltage is the difference in electrical potential between 2 points (volts)
- Current is the rate of flow of electrical charge past a point (amps)
- Resistance is a measure of the opposition to the flow of electronics (ohms)



Types of electrical currents

- Alternating current (AC) where voltage moves from positive to negative values
- E.g. Home electricity

- Direct current (DC) where the potential is at a fixed value
- E.g. Battery

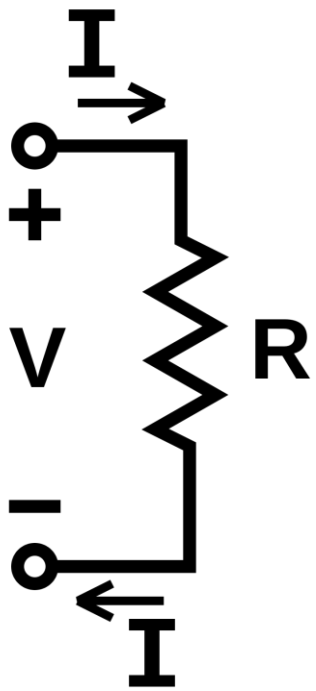


Ohm's Law

- Voltage = Current * Resistance

$$V = I\,R \qquad I = \frac{V}{R} \qquad R = \frac{V}{I}$$

- Resistance calculation
  - Series $R = R_1 + R_2 + R_3$
  - Parallel $R = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

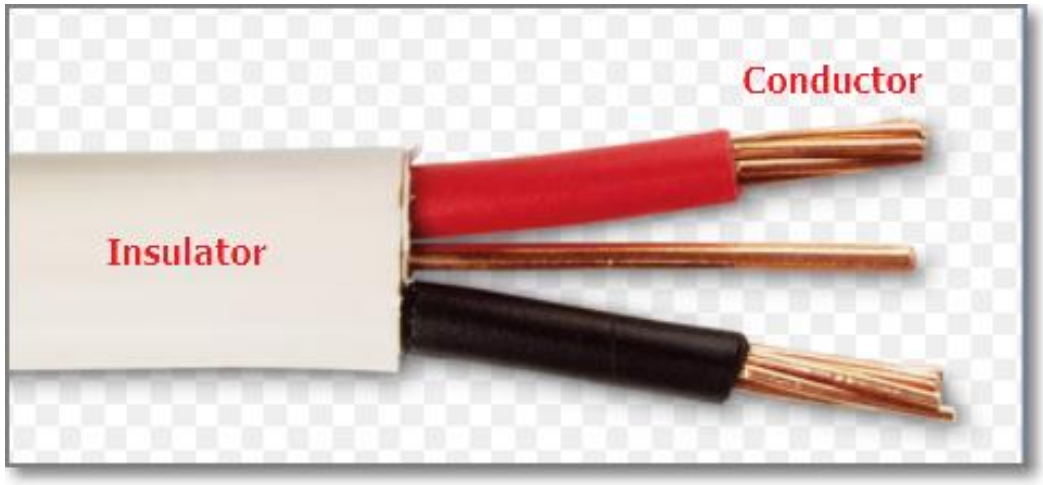


Kirchoff's Laws

- Current Law
  At any junction, or node, in an electrical circuit, the sum of the currents flowing into the node is the sum of the currents flowing out of a node.

- Voltage Law
  When the direction is taken into account, the sum of the potential differences in any closed circuit is zero.

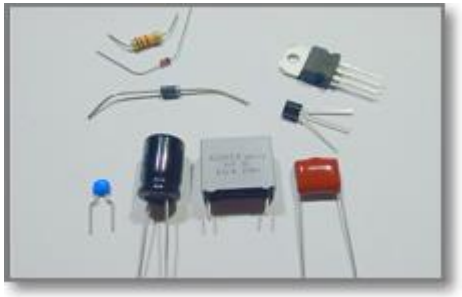
Electrical components



- Insulators
  Do NOT allow current to flow
- Conductors
  Do allow current to flow
- Semiconductors
  Allows current to flow if some electrical conditions are met e.g. diodes.

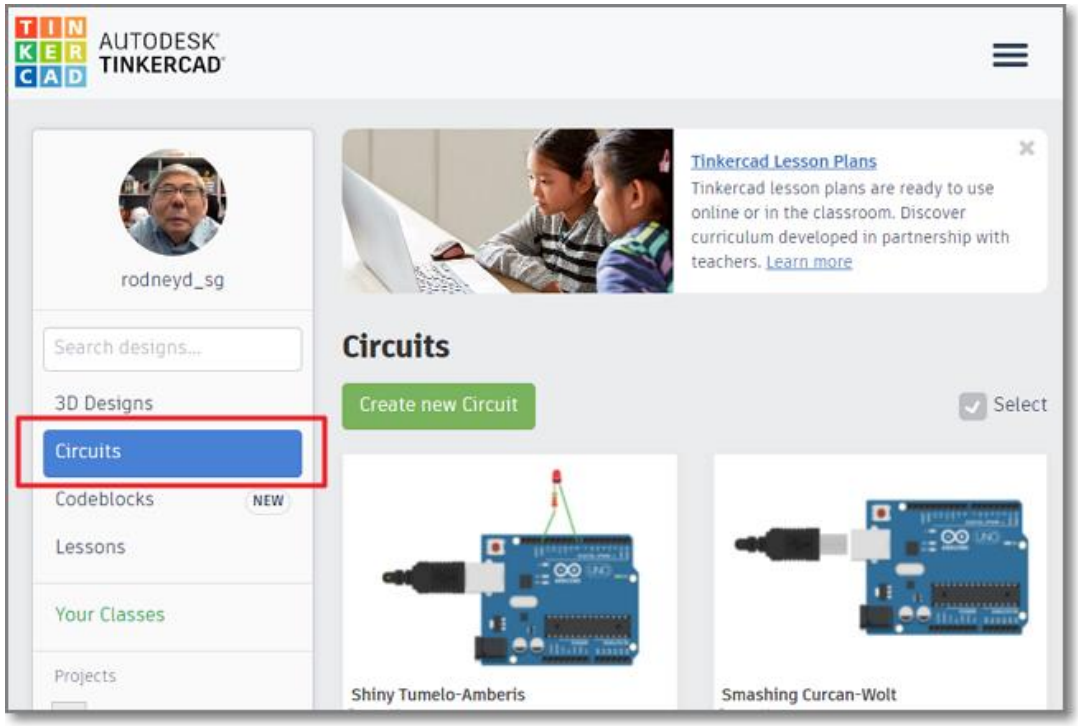
Common components

- Wires - Dupont connector wires
- Switches
- Resistors - Variable resistors, potentiometers
- Capacitors
- Inductors (seldom used)
- Diodes - LED (Light Emitting Diodes)
- Semiconductors - 555 Timer, Voltage Regulators
- Microcontrollers – Arduino family



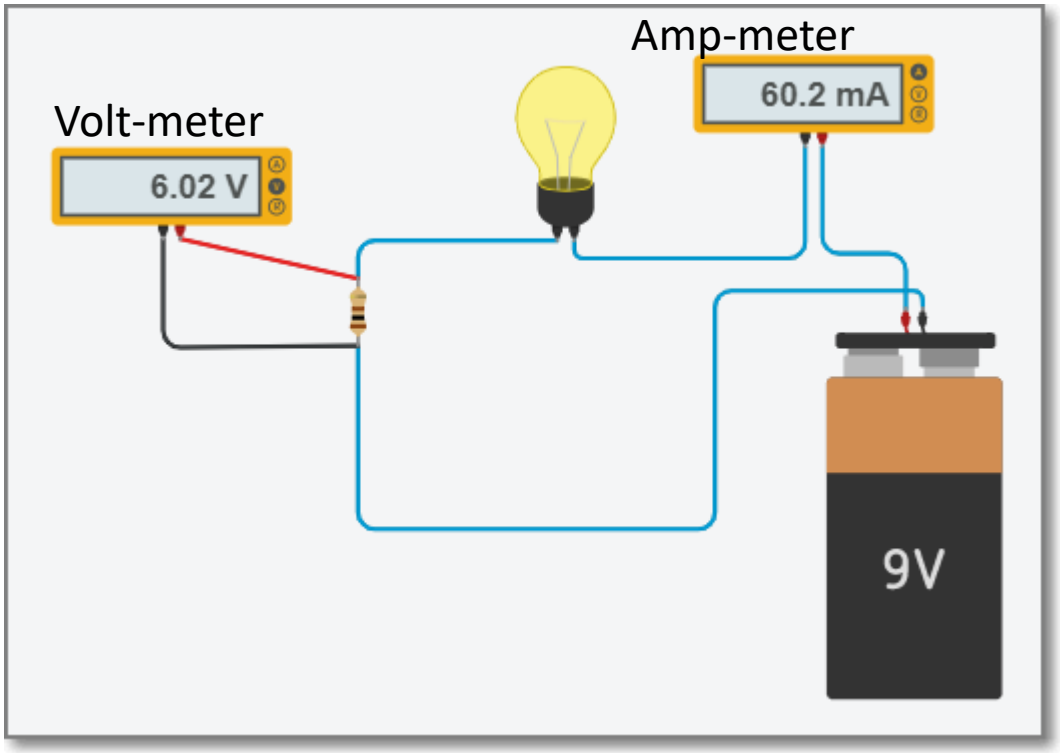
YouTube: bigclivedotcom – A Simple Guide to Electronic components

TinkerCAD



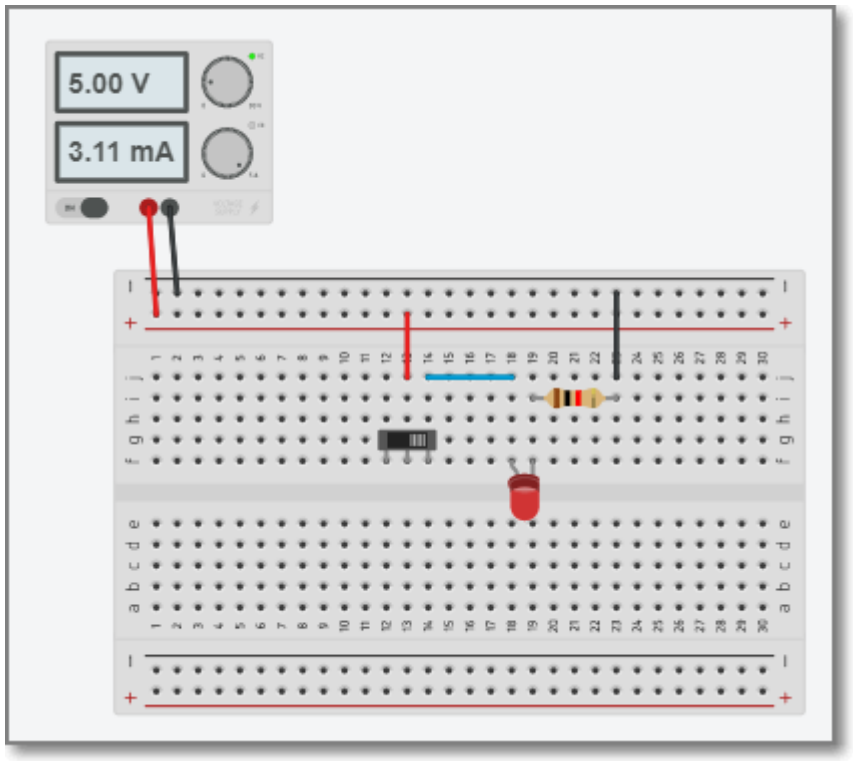
- Allows creation of simple 3D designs
- Circuits – allows simulation of
  - Electronic circuits
  - Arduino interfacing with Processing/C++
  - Micro-bit interfacing with CodeBlocks

Ohms Law



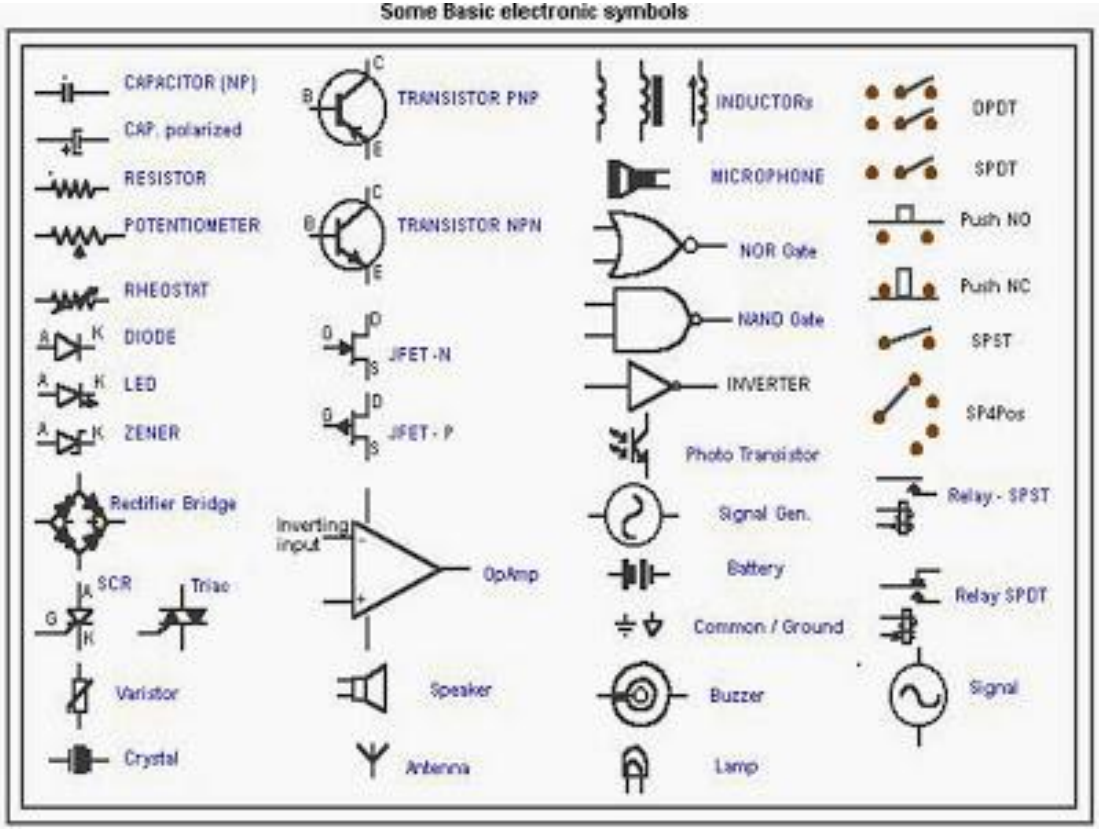
- Change the value of R, check V=IR
- Voltage is measured with voltmeter in parallel
  Current is measured with amp-meter in series

Working with a Breadboard



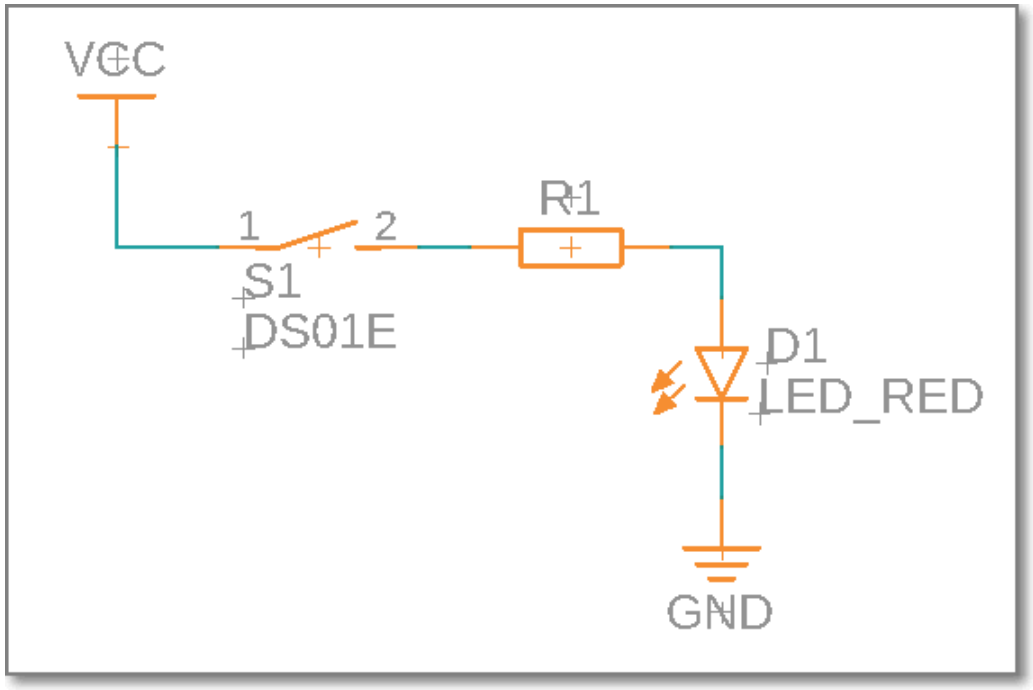
- Breadboard used in many prototyping projects.
- Quick testing of circuits
- Circuit checks effect of R with LED

Electronic Symbols



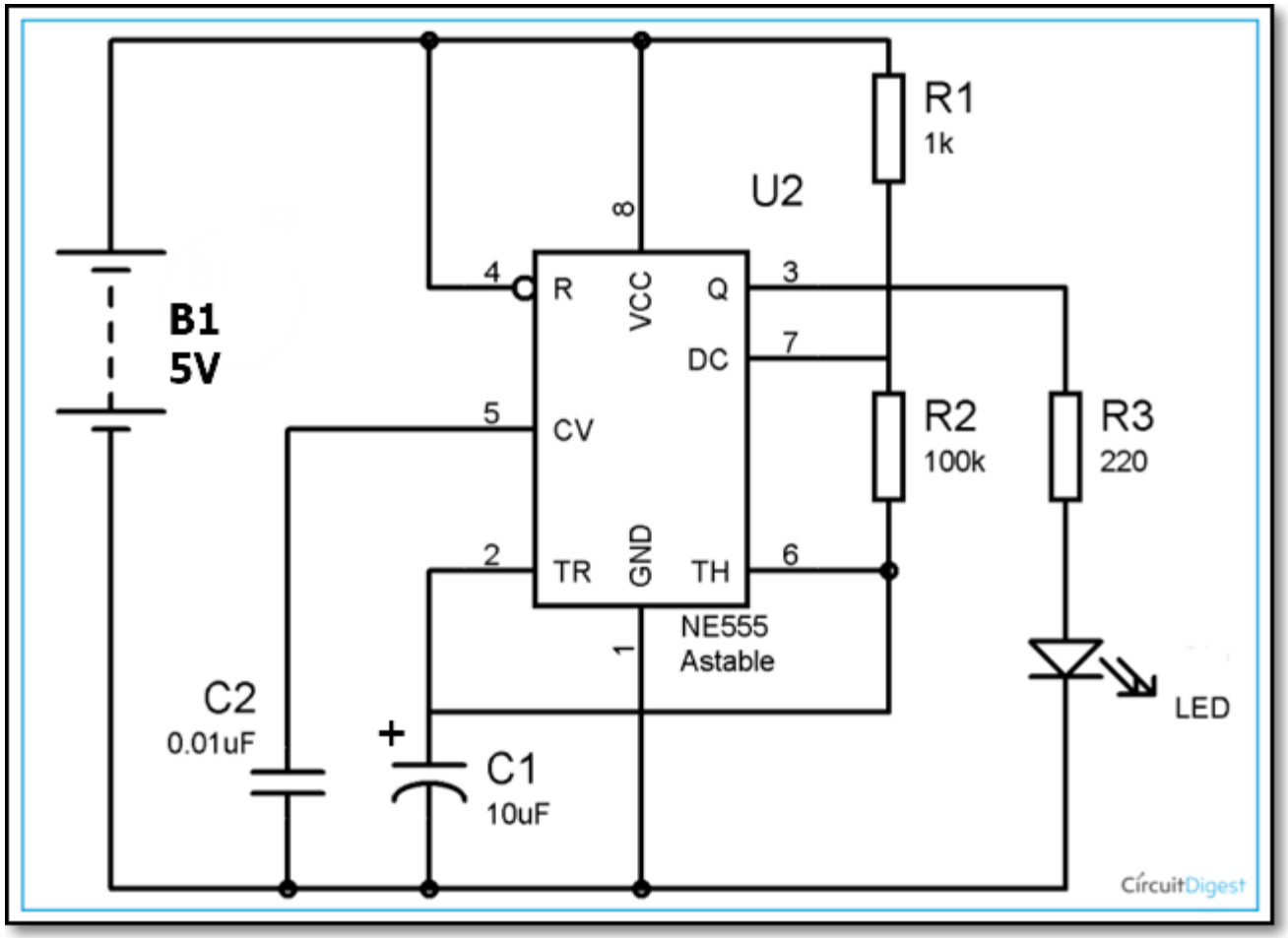
- Provides a short-cut method of drawing/expressing electronics circuits

LED Circuit



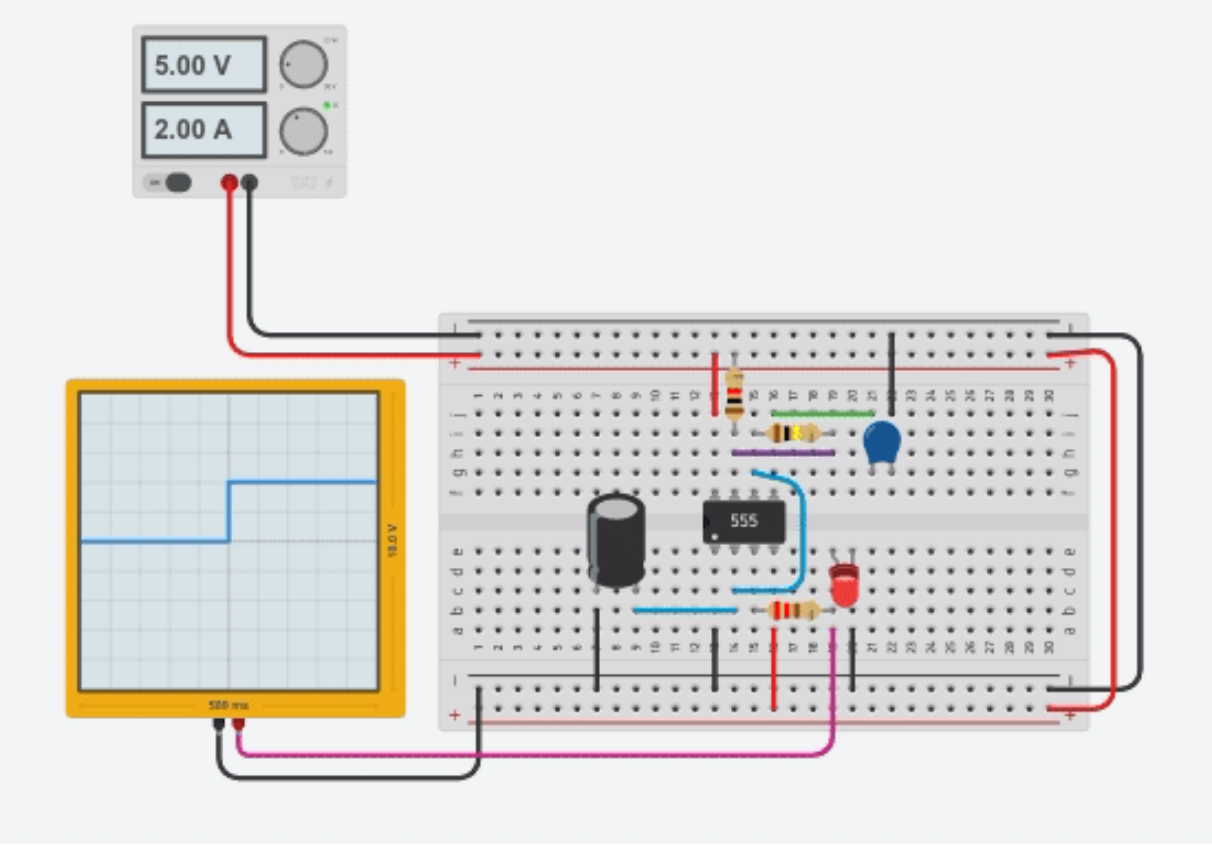
- We use schematics to represent the electrical circuits we create.
- We need to be able to transform from a schematic to a layout and vice versa.

Assignment



- Convert the schematic into TinkerCAD circuits and simulate it.
- This assignment is not graded.

Expected Result



- The 555 timer is configured as an astable using R and C values.
- The result is an alternating ON/OFF signal which flashes the LED

Hints & Tips

- Assignment sheet: Electronics
- Good references:
  - Introduction to TinkerCAD Circuits
  - Introduction to TinkerCAD Digital
  - Introduction to Function Generator & Oscilloscope
- You will be asked to implement the circuit on an actual breadboard in the lab.
- Document your experiences

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End