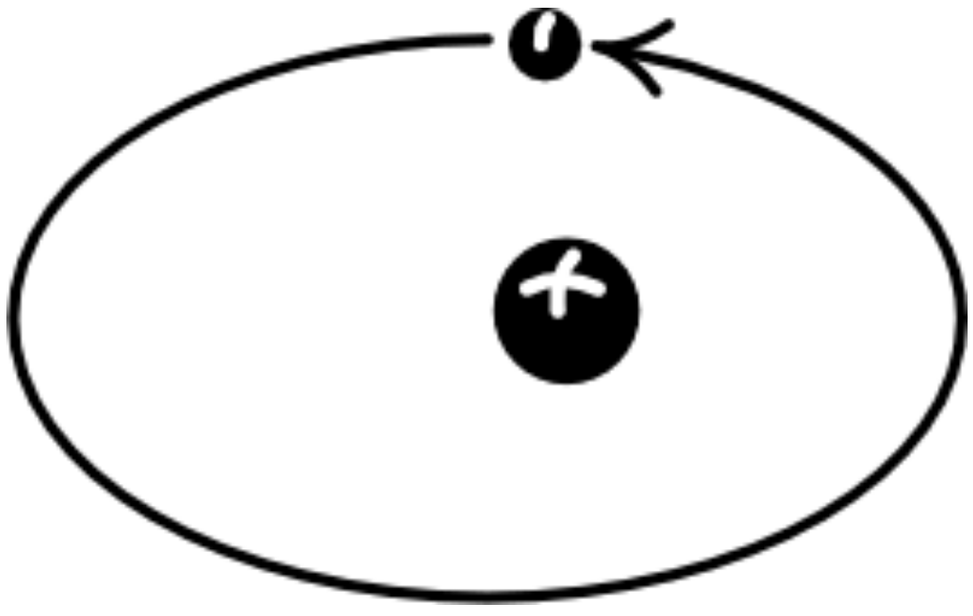
BASIC ELECTRONICS

DEFINITIONS

Electricity is the flow of electrical energy through conductive material. Electricity is the result of the movement of electrons. Electrons create charge, which we can harness to do work.

It's all about the movement of electrons.



Electricity is the flow of electrical energy through conductive materials

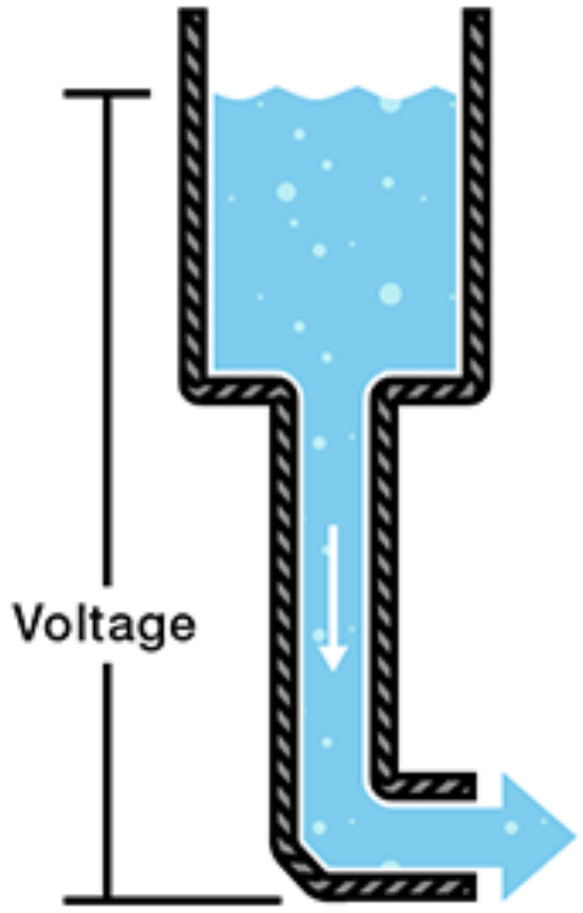
We build **electrical circuits** to do work, or to sense activity in the physical world.

Voltage is the difference in charge between two points.

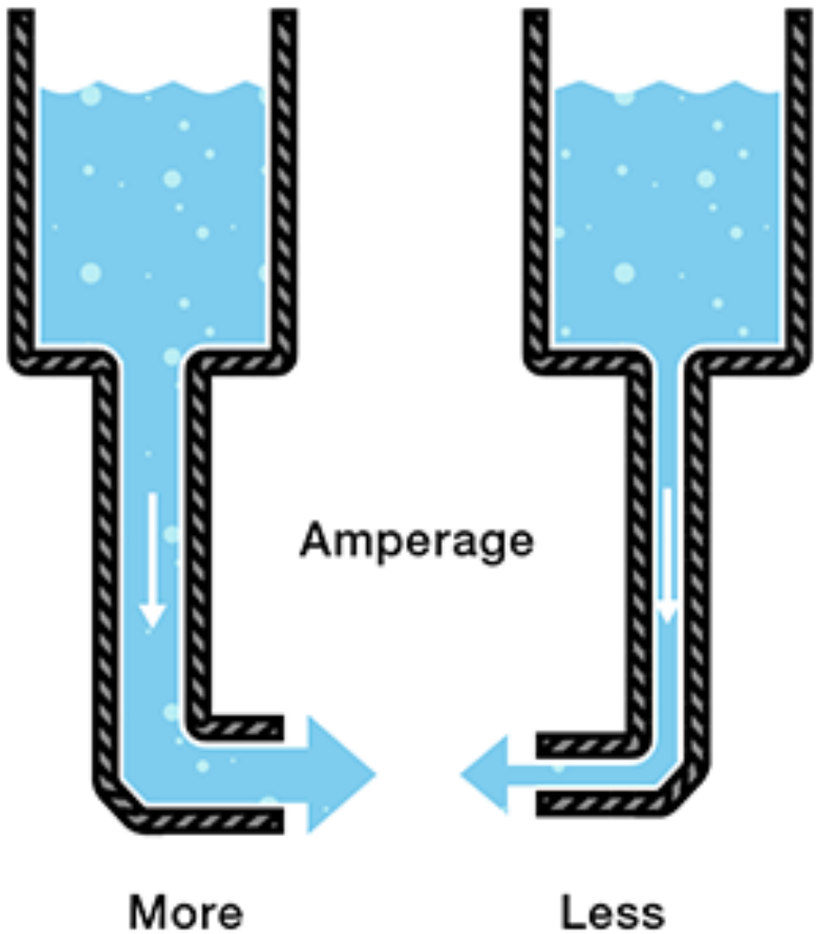
Current is the rate at which charge is flowing.

Resistance is a material's tendency to resist the flow of charge (current).

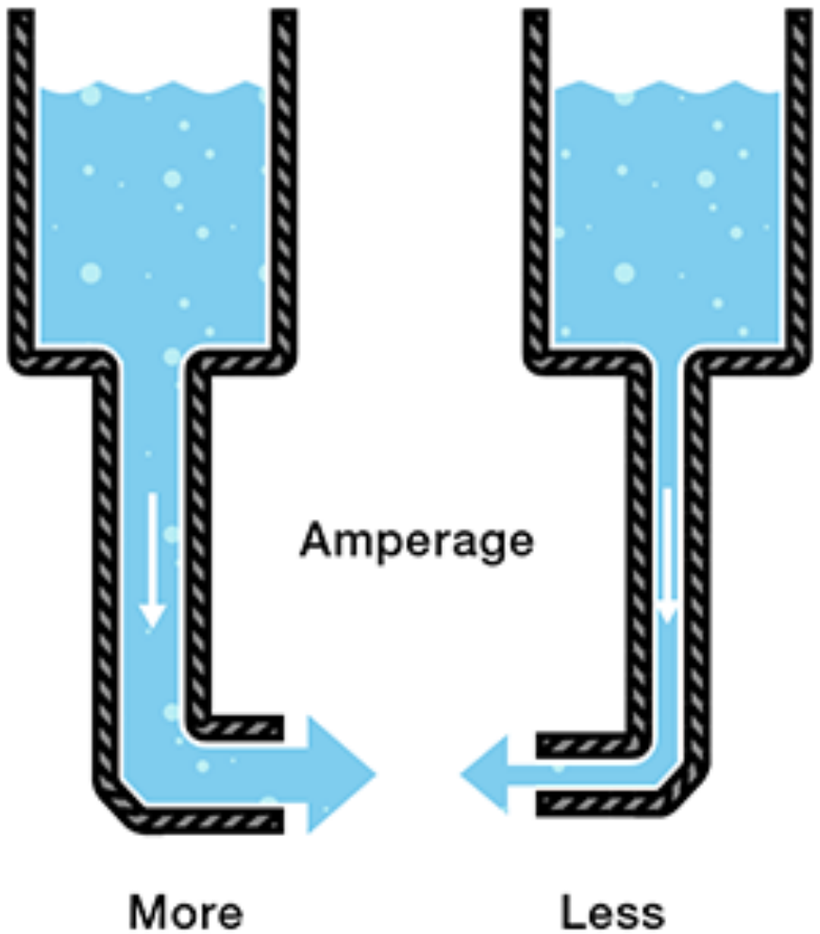
Voltage is the difference in charge between two points in a circuit. It is measured in *Volts*.

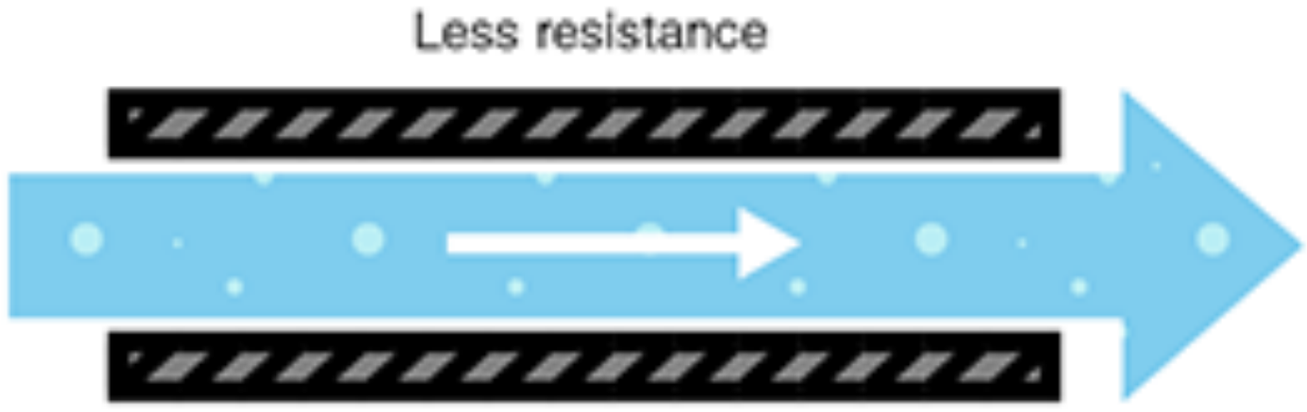


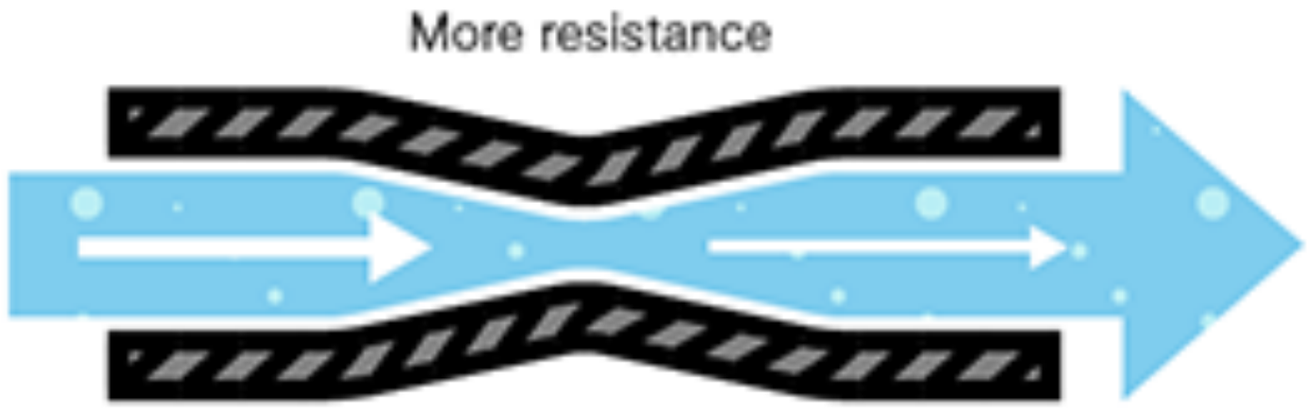
Current is the rate at which charge is flowing.
It is measured in *Amperes*, or *Amps*.



Resistance is a measure of a material's ability to oppose the flow of electricity. It is measured in *Ohms*.




Less resistance


More resistance

OHMS LAW

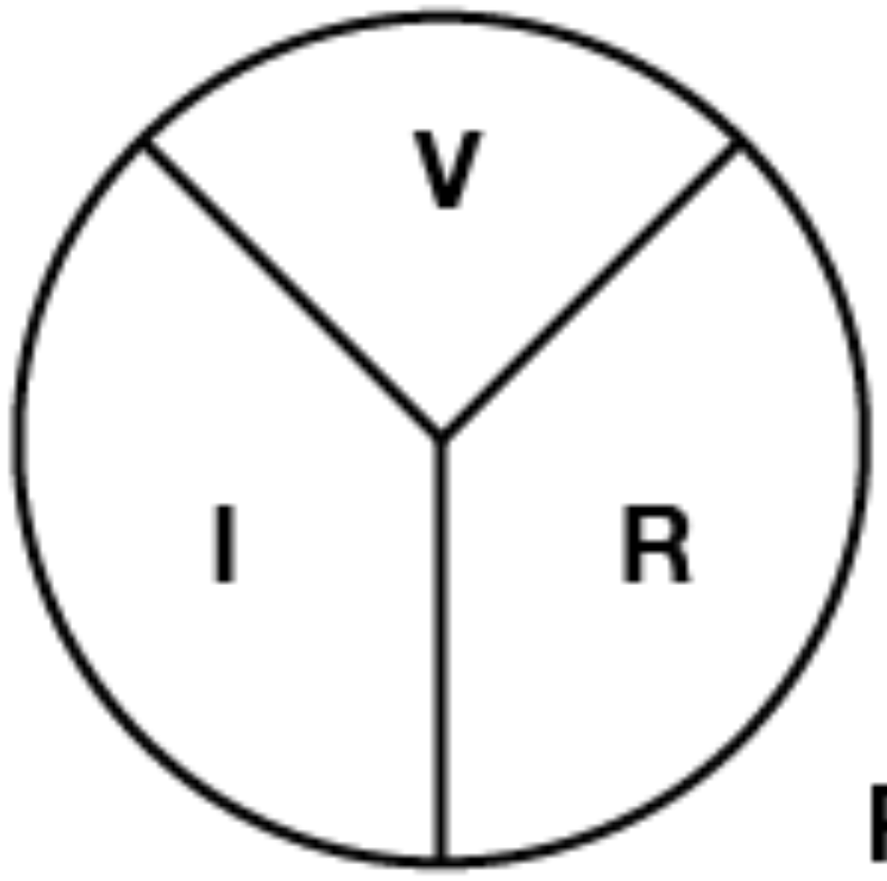
Ohms Law

Voltage *(V)*, **Current** *(I)*, and **Resistance** *(R)* are all related, by the following formula:

Volts = Amps x Ohms

Ohm defines the unit of resistance of "1 Ohm" as the resistance between two points in a conductor where the application of 1 volt will push 1 ampere.

$$V = I * R$$



$$I = V / R$$

$$R = V / I$$

CIRCUITS

Volts are a measurement of electrical potential produced by a power source

In order for electricity to do any work, it needs to be able to move

Electricity needs a **path** to flow through, which must be an electrical conductor such as copper wire

Every source of electricity has **two sides**

- Two sides, or *terminals*: + and -
- Positive side = higher voltage
- Negative side = lower voltage

Electricity will flow from a **higher voltage**

to a **lower voltage**

DC (Direct Current) - In a DC circuit, current always flows one direction.

AC (Alternating Current) -In an AC circuit, the direction of current flow is reversed in a regular repeating cycle.

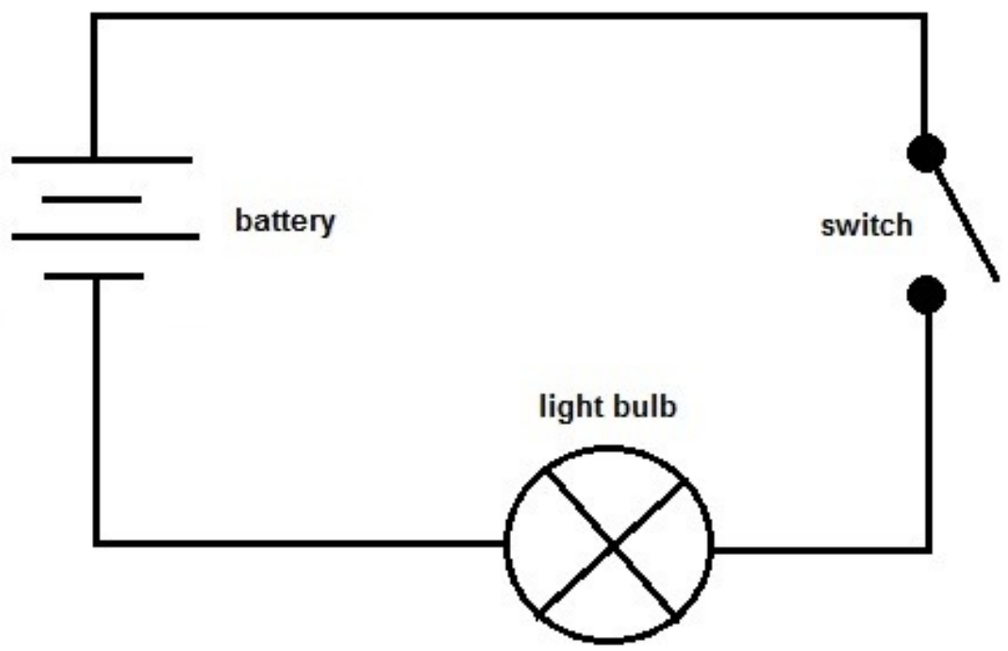
Most of the circuits we'll talk about in this class will be DC circuits.

DC voltage sources always have **two sides**, called *positive* and *negative*

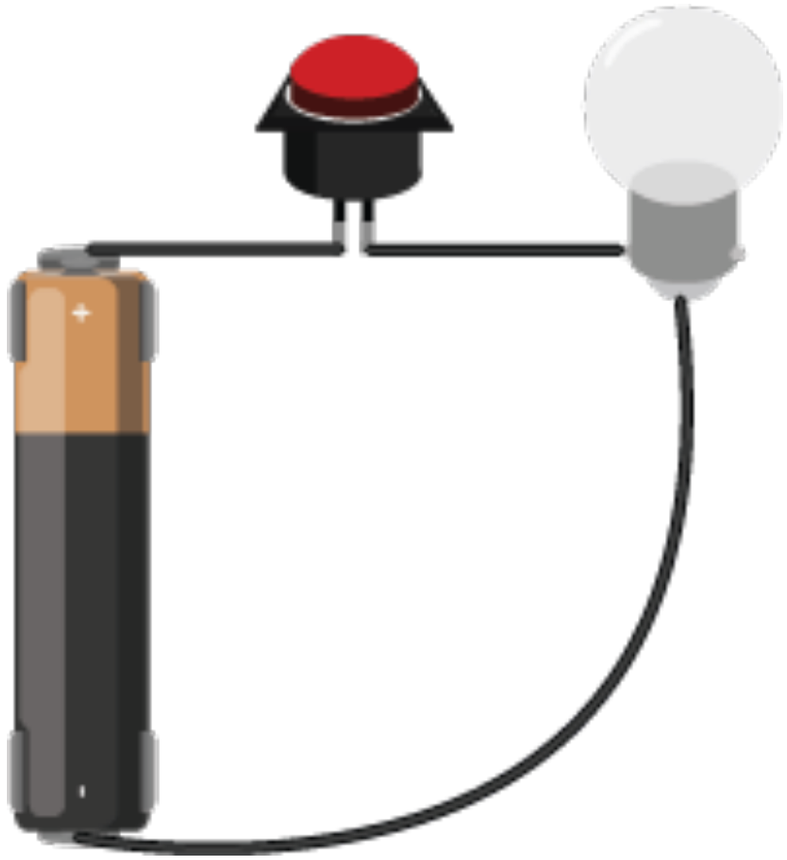
The positive side a higher voltage than the negative side

An **electrical circuit** is made up of two elements: *a power source* and *components* that convert the electrical energy into other forms of energy.

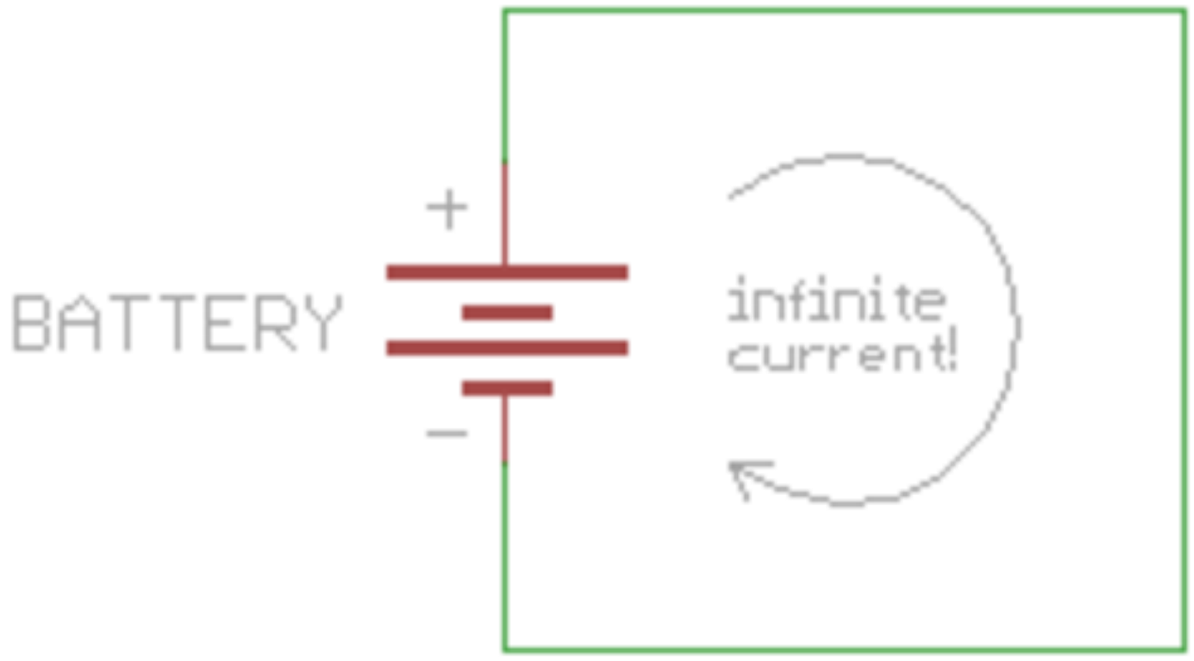
based on the greek word for for circle

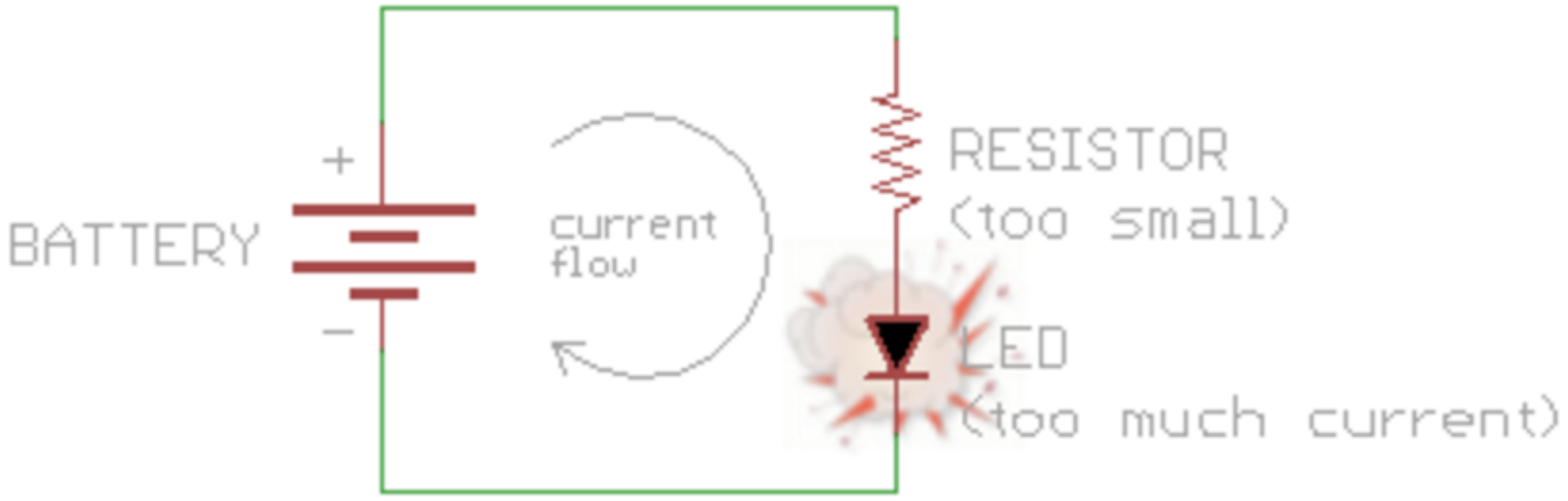


Every circuit has to have a **source** of electrical energy and a **load** that uses the energy.

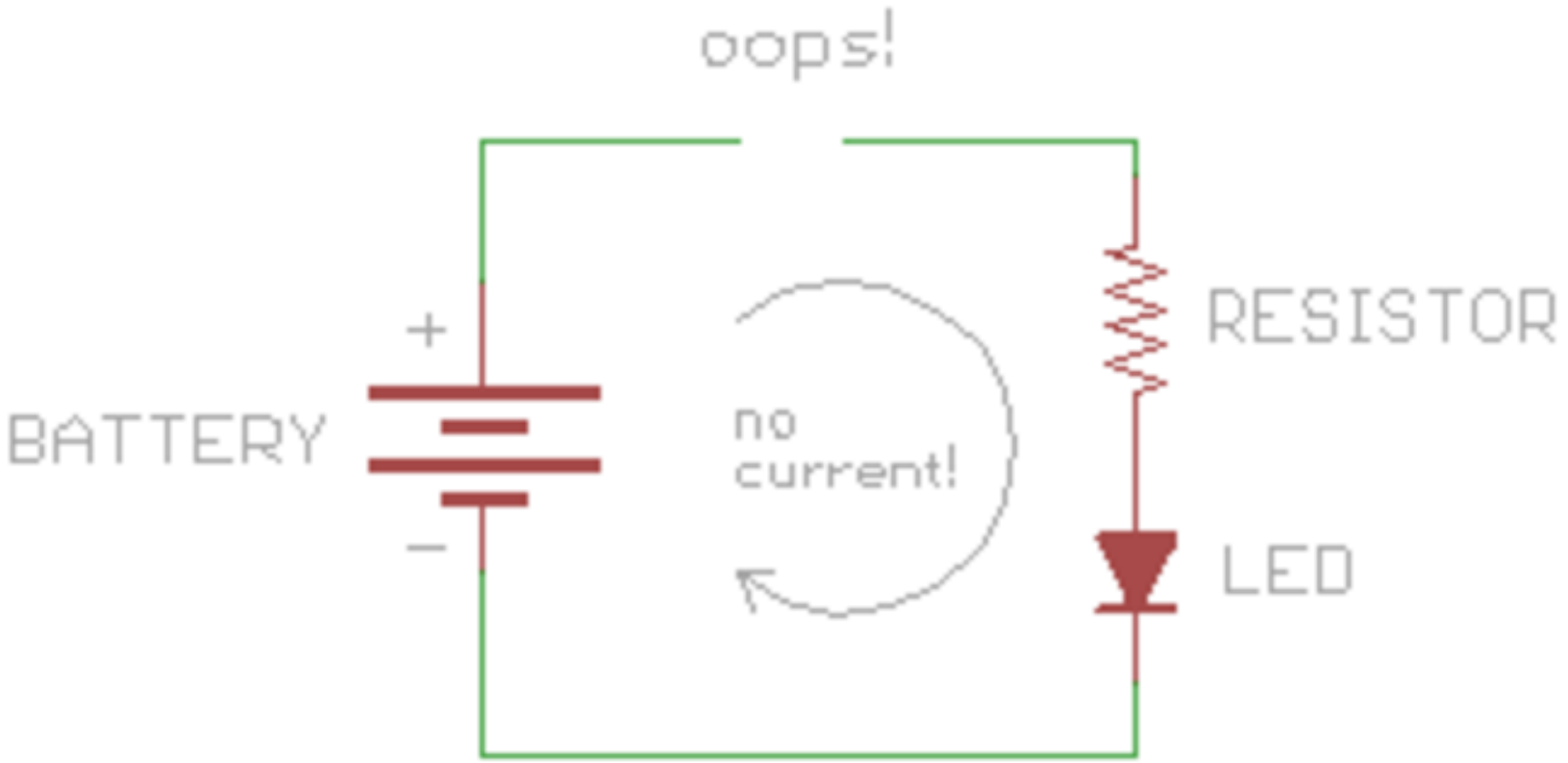


A circuit with no load is called a **short circuit**.




+
BATTERY
−
current
flow
RESISTOR
(too small)
LED
(too much current)

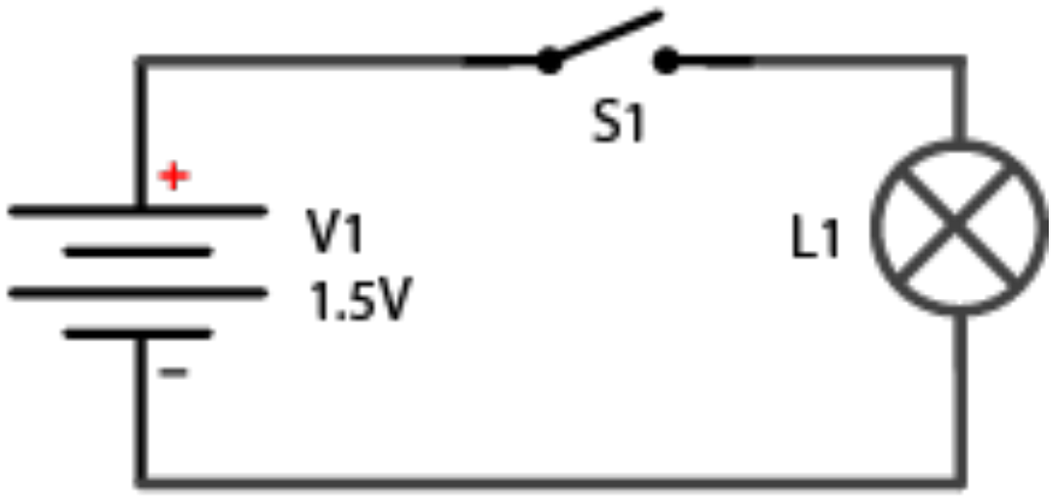
The opposite of a short circuit is an **open circuit**- where the loop isn't fully connected



Ground is the place in a circuit with where the potential energy of the electrons is zero.

Schematic diagrams are diagrams of circuits that represent the electrical relationships between the components in the circuit.


1.5V
S1
L1
GND


S1
+
V1
1.5V
-
L1

COMPONENTS

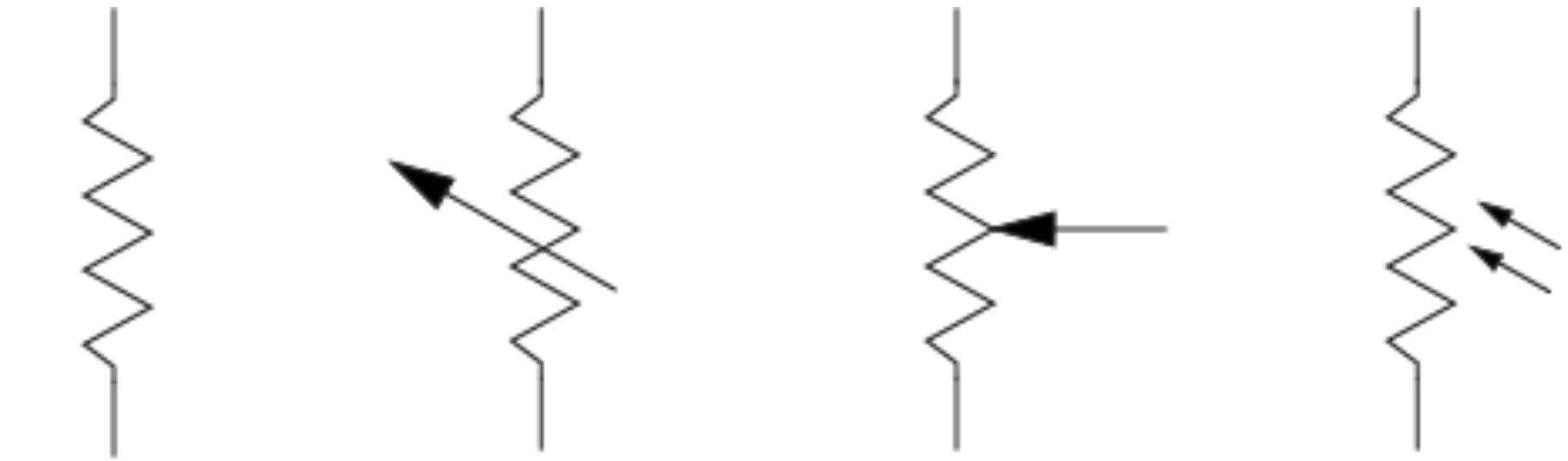
Conductors are materials through which electrical current moves freely.

Insulators are materials which prevent the flow of electricity.

Resistors resist, but do not totally block, the flow of electricity.

They are used to control the flow of current.

Resistors are measured by their resistance in *ohms (Ω)*, often seen in *kilohms (kΩ)*



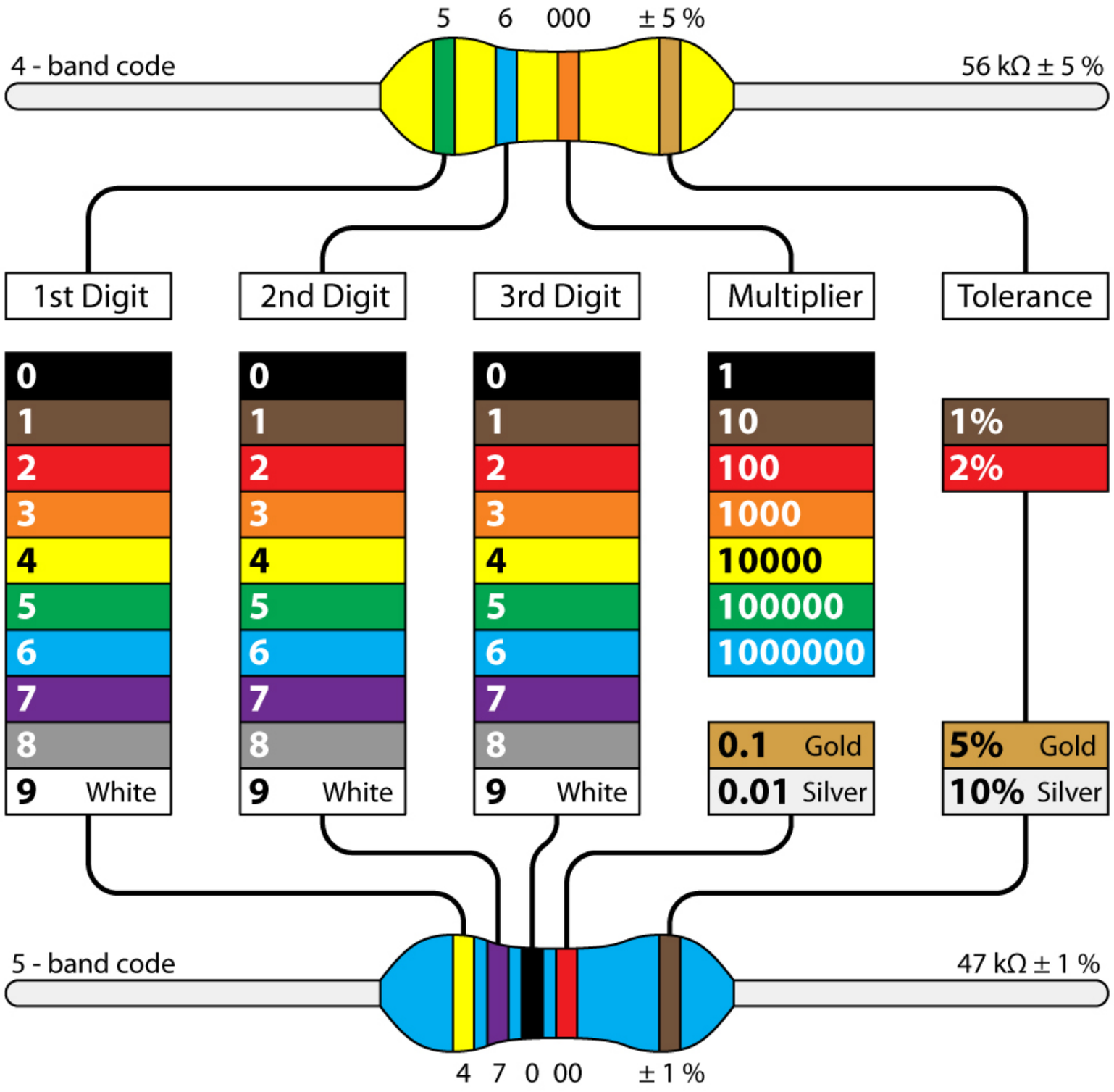
fixed value resistor

variable resistor

potentiometer

photoresistor or light-dependent resistor

Resistor colour code

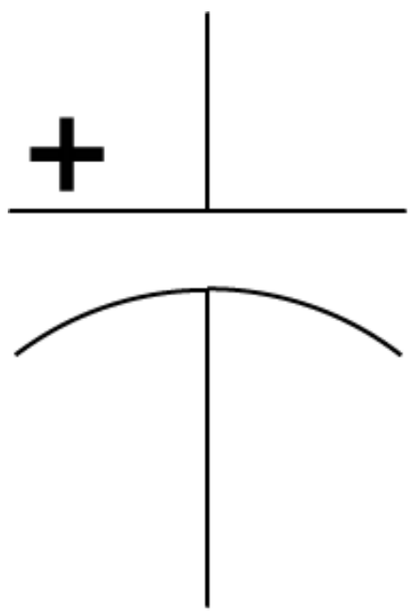


Capacitors store up electricity while current is flowing into them, then release the energy when the incoming current is removed.

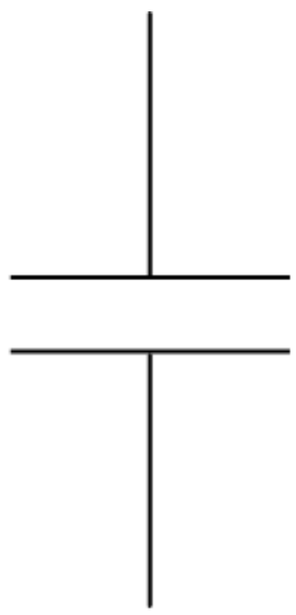
Capacitors are measured by their capacitance in *farads (F)*, most commonly seen in *microfarads (μF)*.

nichicon
4700µF 35V
SPRAGUE
VITAMIN Q
T.M.REG.U.S.PAT.OFF.
CAPACITOR
.22 - 400 D.C.
196P22404T16
909047-33
35V 470µF
189-505-5
193-10 8216
4.7µF 35V
103K
500V
224K
100V
561
1KV
10
7
151
15
22µF 35V
100µF 16V

Sometimes they are **polarized**, meaning current can only flow through them in a specific direction, and sometimes they are not.



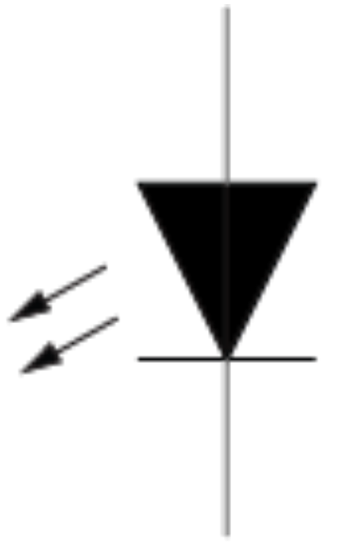
polarized capacitor



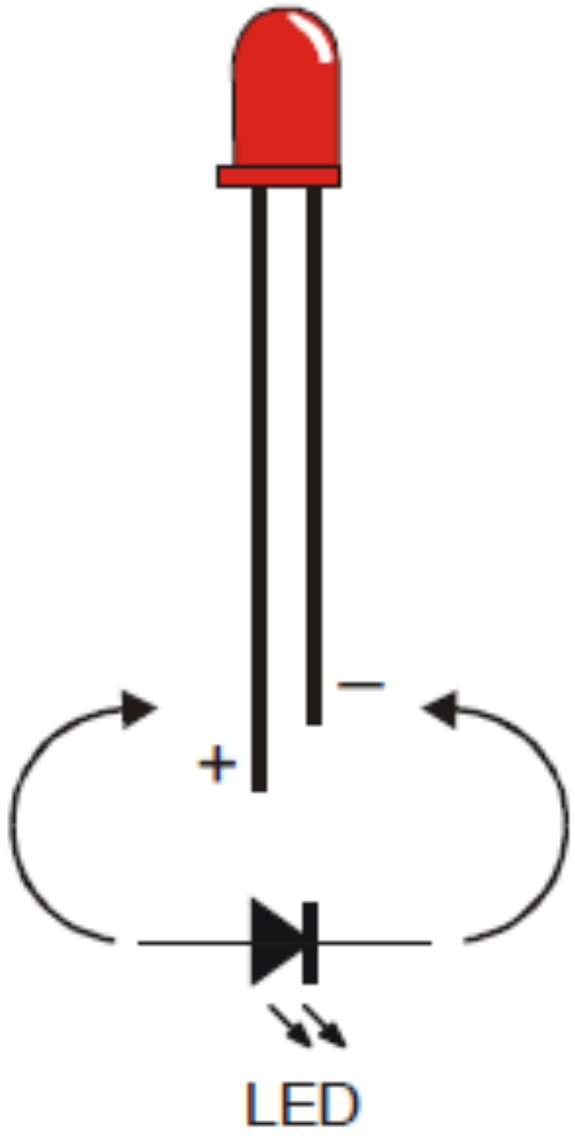
non-polarized capacitor

Diodes permit the flow of electricity in one direction, and block it in the other direction. Because of this, they can only be placed in a circuit in one direction.

Light-Emitting Diodes (LED's) are special types of diodes which emit light when current flows through them.

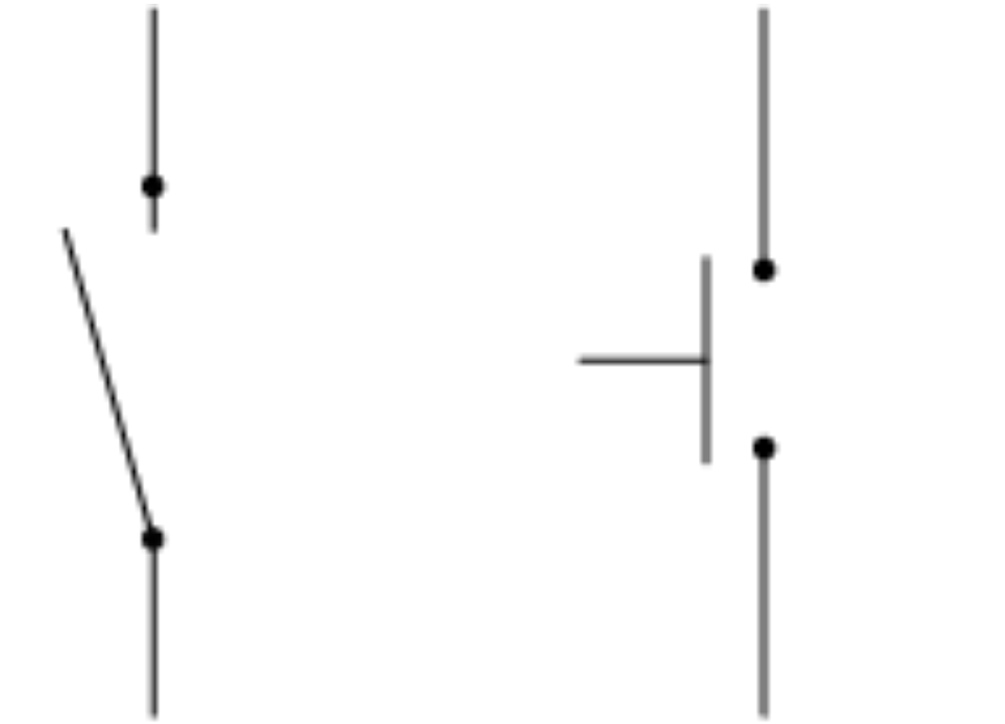


light-emitting diode (LED)



LED

switches and **pushbuttons** control the flow of current through a junction in a circuit:



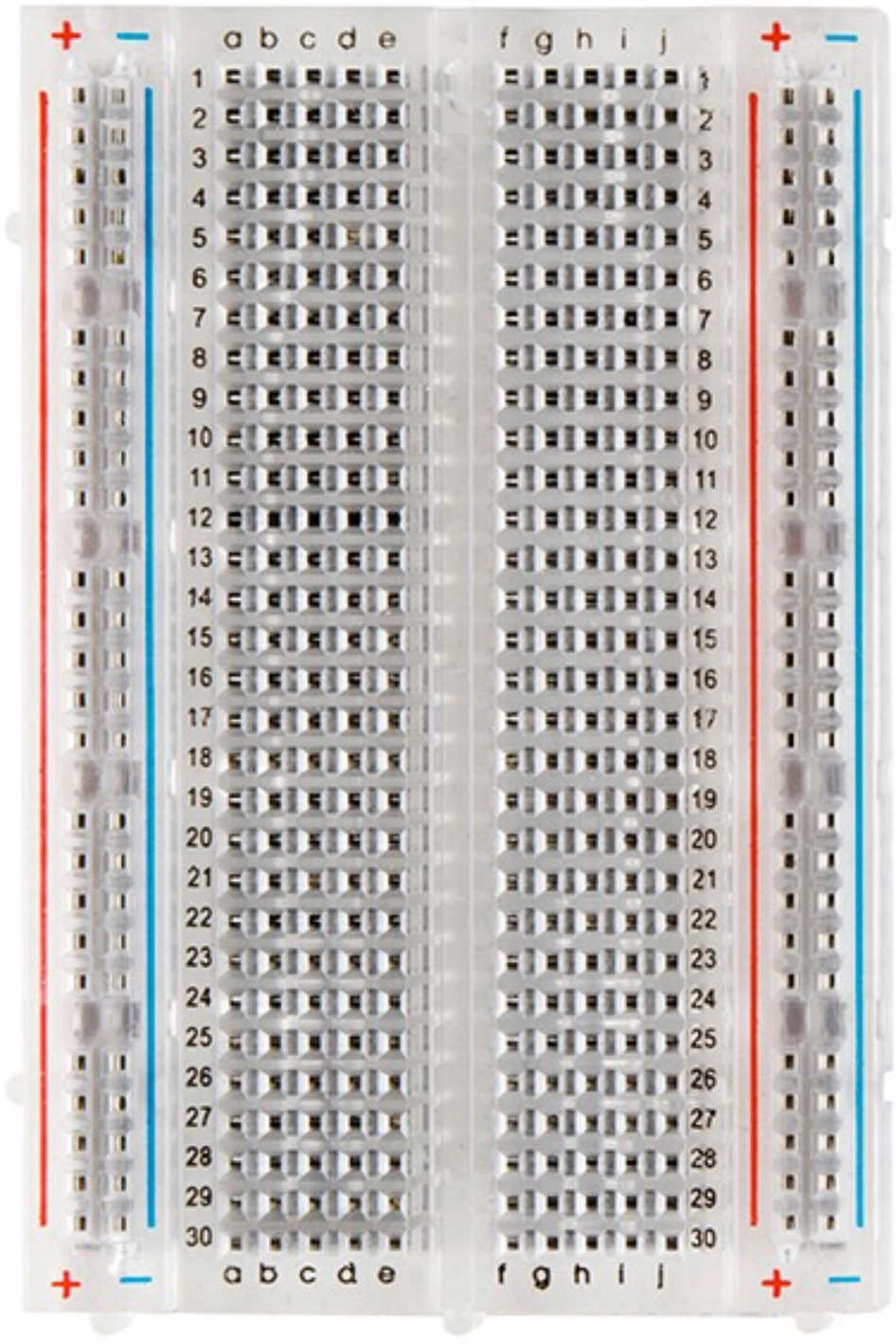
switch pushbutton

Sensors are components that convert other forms of energy into electrical energy so we can read the changes in those other forms.

Switches, knobs, light and motion sensors are all sensors.

Actuators are components that convert electrical energy into other forms.

Light bulbs, motors, LEDs, and heaters are all actuators.


+ −
a b c d e
f g h i j
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30