Engineering Technology (ENGR 101)

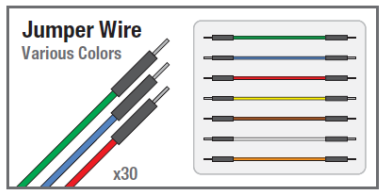
Electrical Engineering Basics

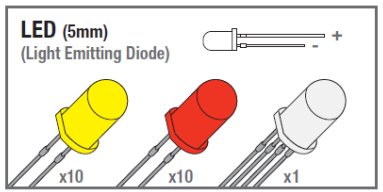
Basic electronic components

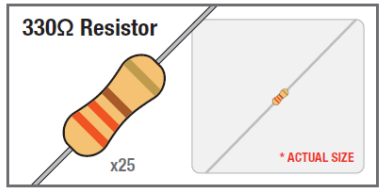
Name	Image	Type	Function	Notes
Push Button		Digital Input	Switch - Closes or opens circuit	Polarized, needs resistor
Trim potentiometer		Analog Input	Variable resistor	Also called a Trimpot.
Photoresistor		Analog Input	Light Dependent Resistor (LDR)	Resistance varies with light.
Relay		Digital Output	Switch driven by a small signal	Used to control larger voltages
Temp Sensor		Analog Input	Temp Dependent Resistor	
Flex Sensor		Analog Input	Variable resistor	
Soft Trimpot		Analog Input	Variable resistor	Careful of shorts
RGB LED		Dig & Analog Output	16,777,216 different colors	Ooh... So pretty.

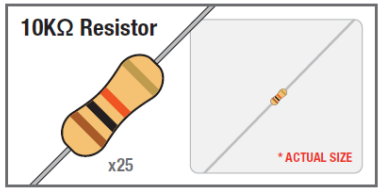
sparkfun. ELECTRONICS

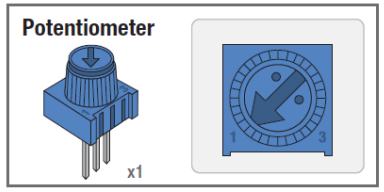
Basic electronic components

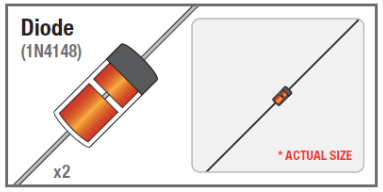


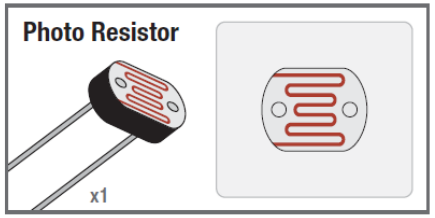


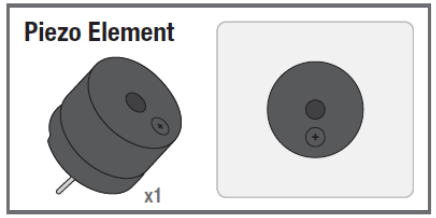


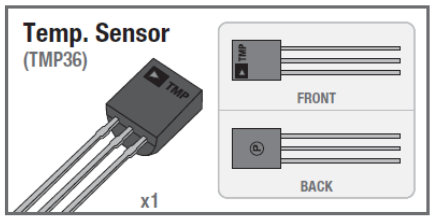


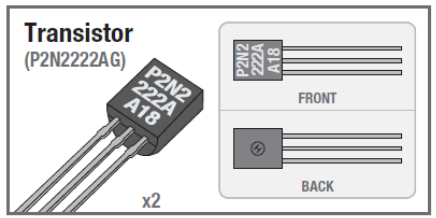


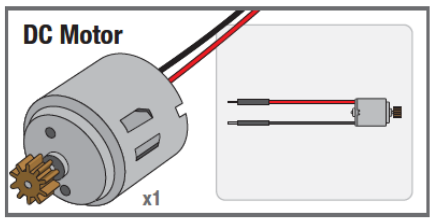


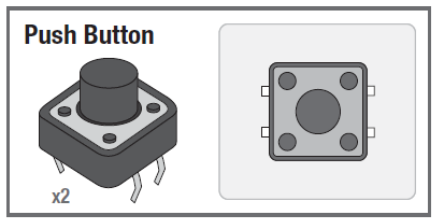


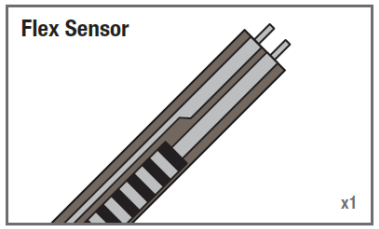


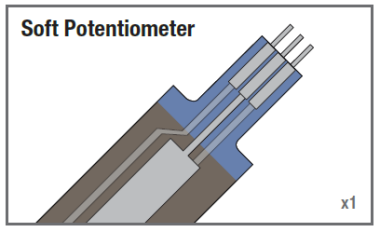


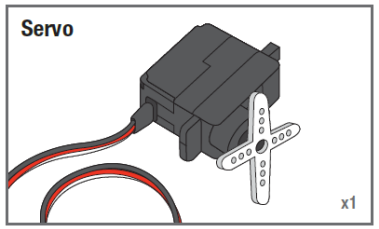


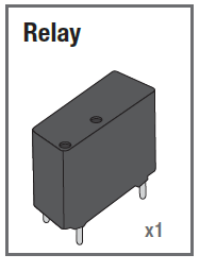


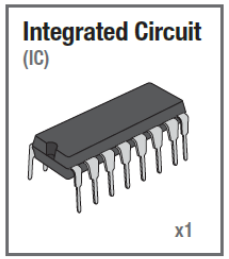


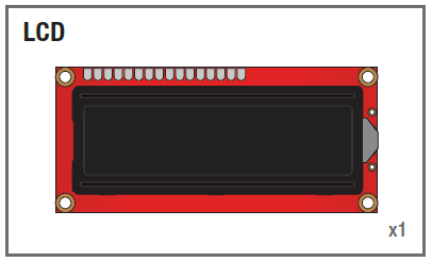


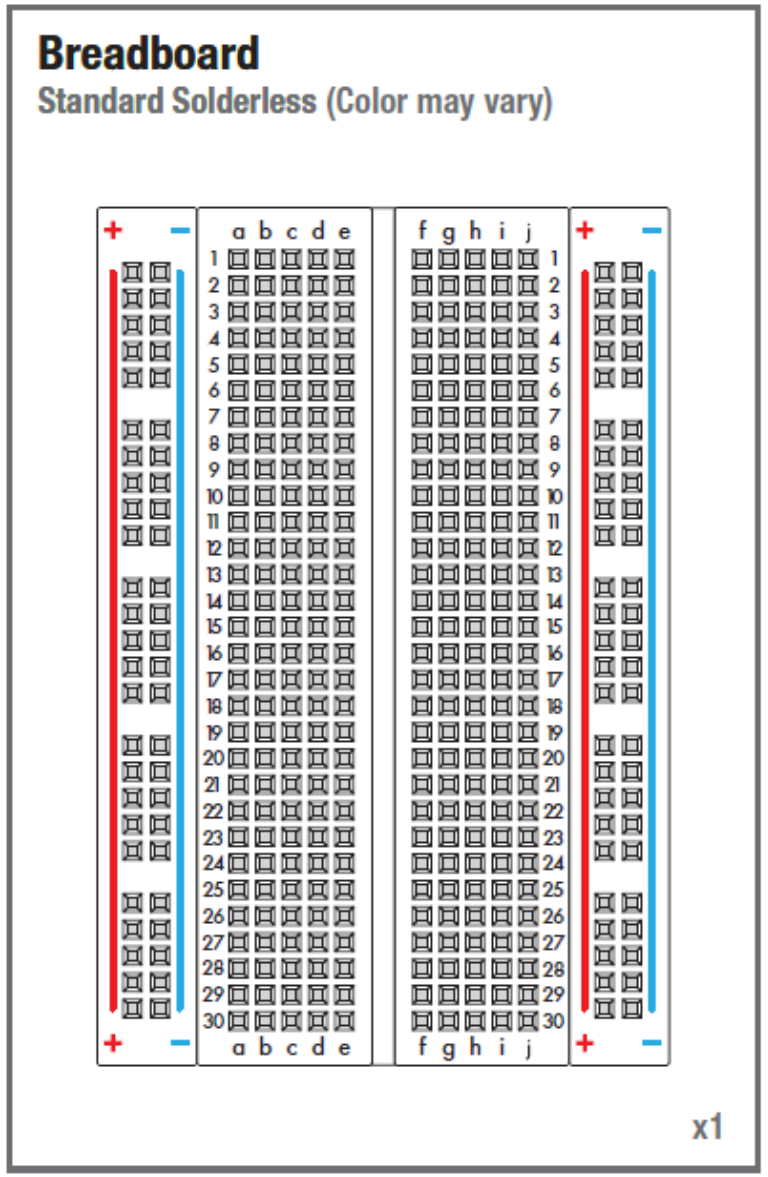






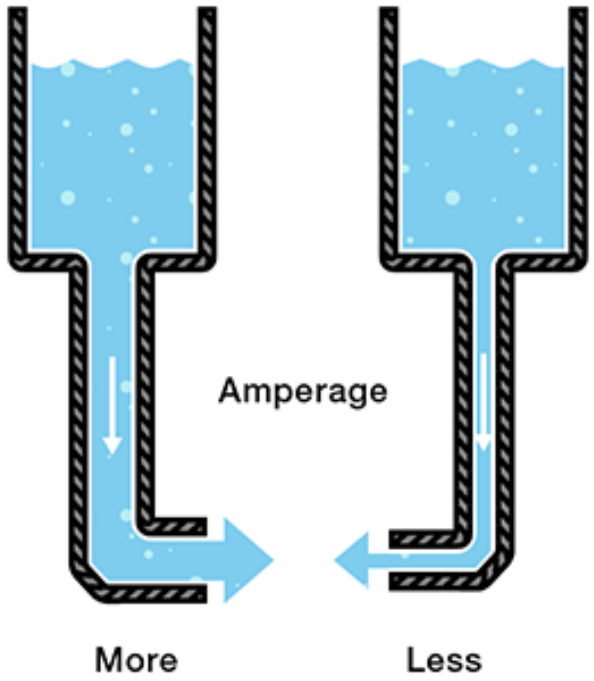






Current Flow Analogy

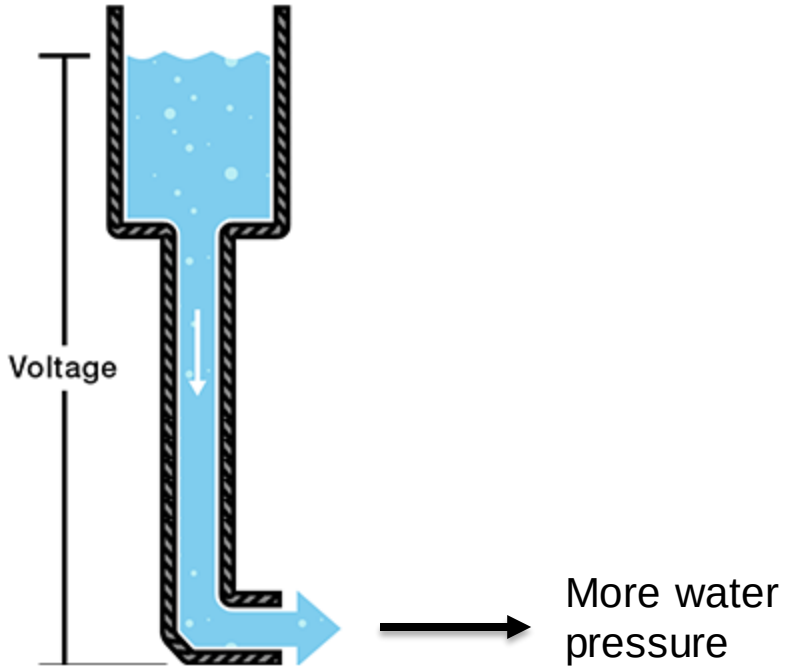
- **Current [amperes (A)]** is the flow of the charged particles (electrons). The current is measured by the number of charged particles passing the point of the circuit, that is being measured, per second.



Current = Flow

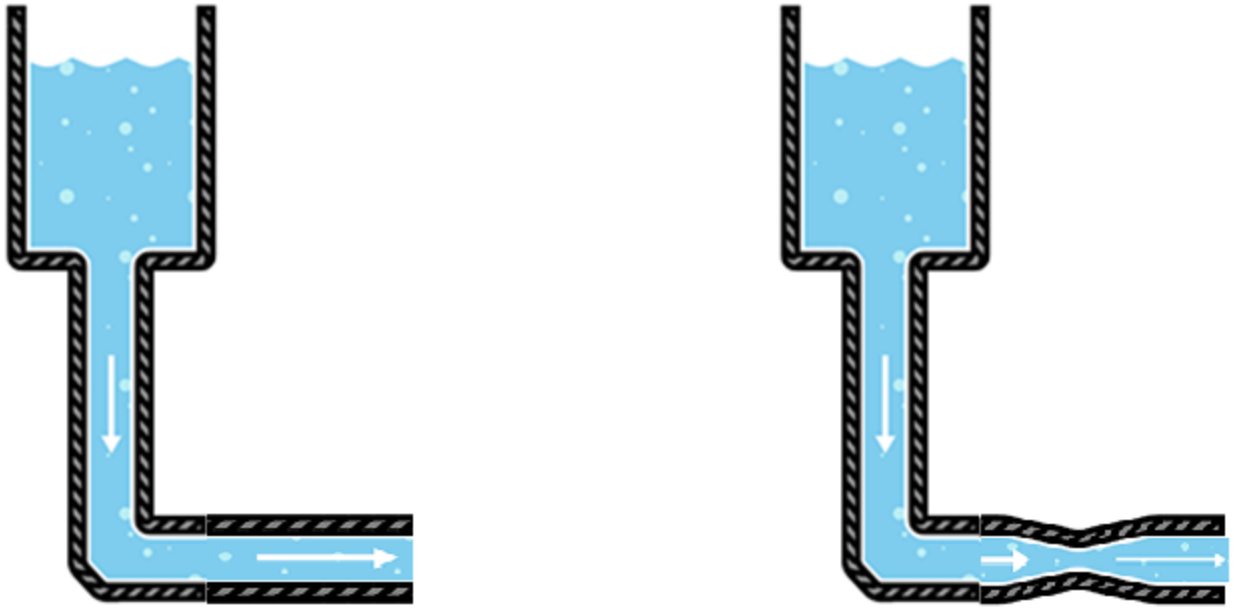
Voltage Analogy

- **Voltage [volts (V)]** is the amount of potential energy between two points, where one point has more charged particles than the other.



Resistance Analogy

- **Resistance [**Ohms (Ω)**]** is how much the flow of current is reduced or impeded. These resistors enable us to limit the flow of charged particles within the circuit.



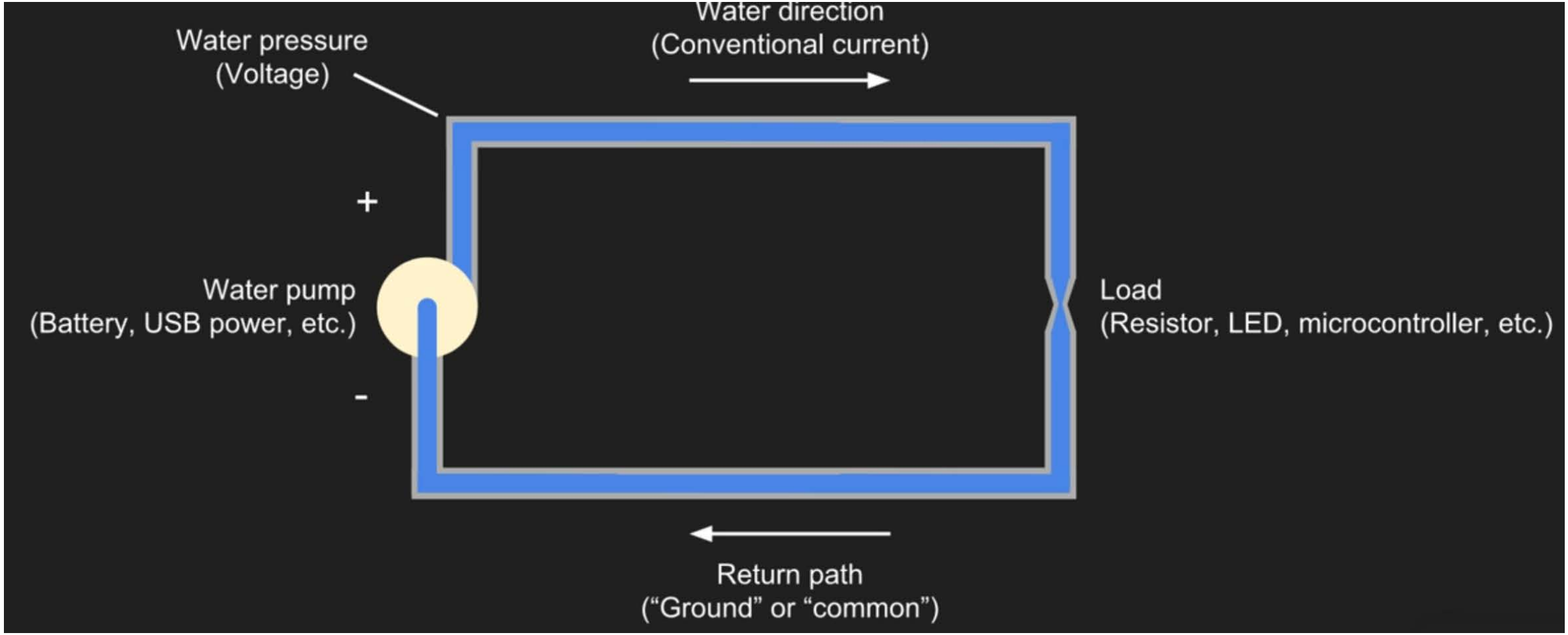
Water pressure = voltage (measured in volts)

Water flow = current (measured in Amperes)

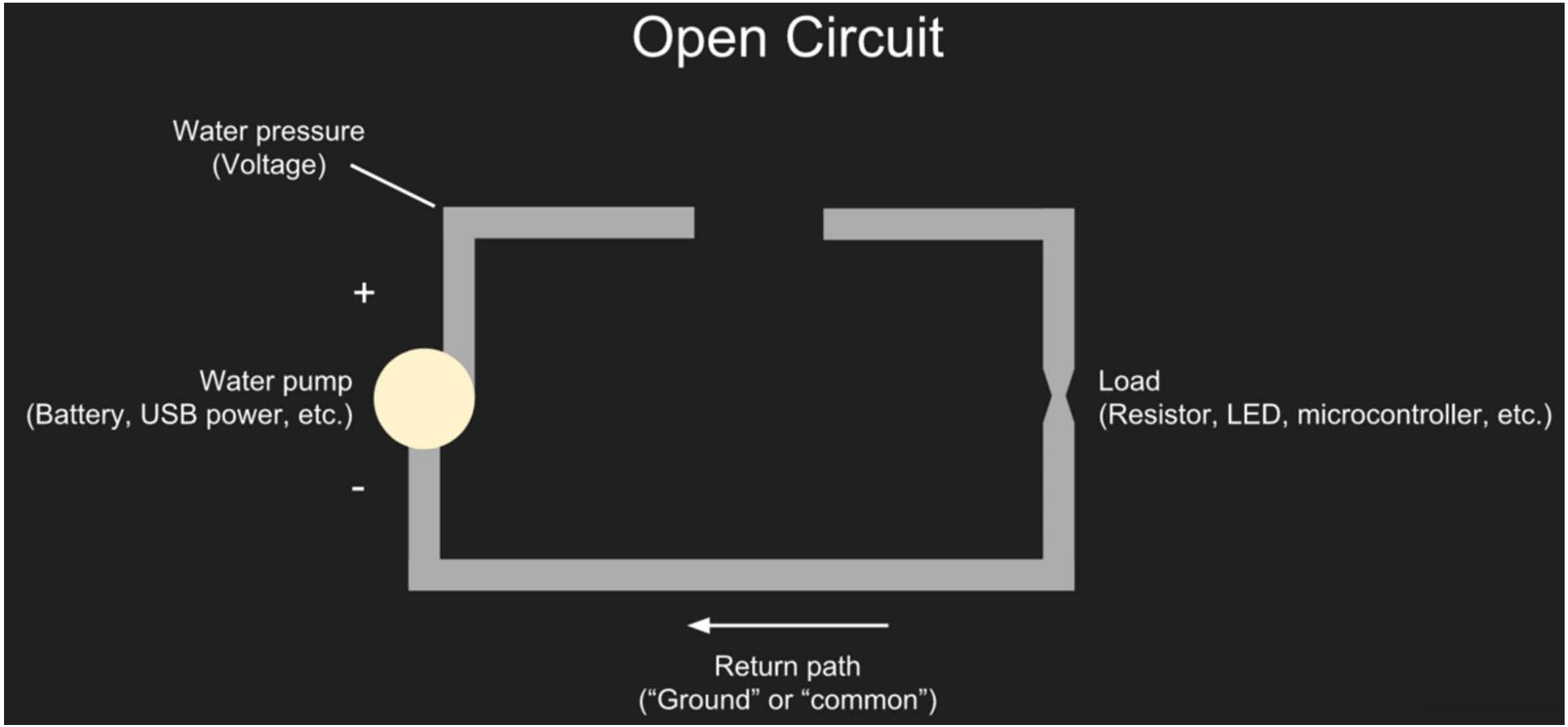
Hose width = resistance (measured in Ohms)

Resistance = Hose width

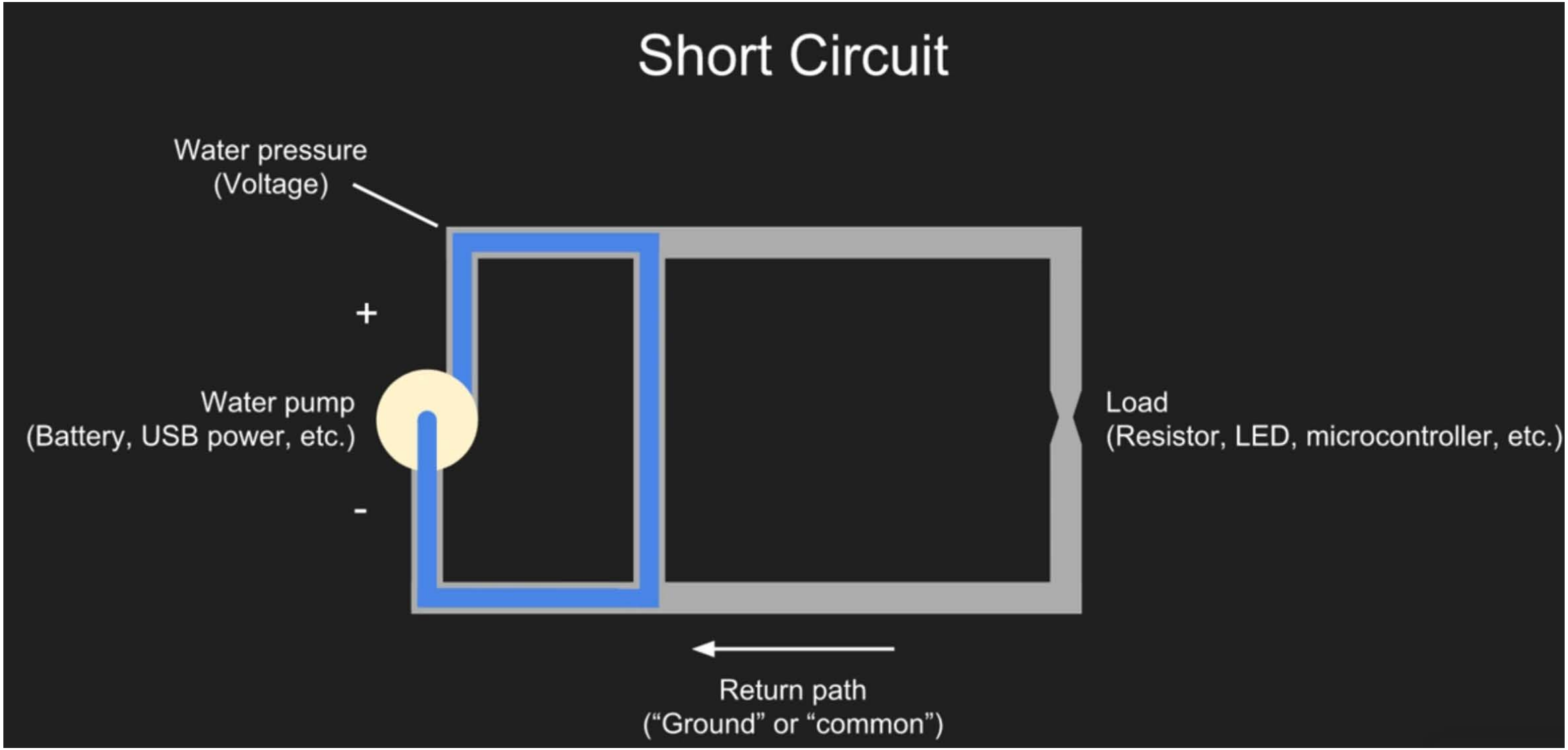
Electricity \ Electronics Basic Concept Review



Electricity \ Electronics Basic Concept Review

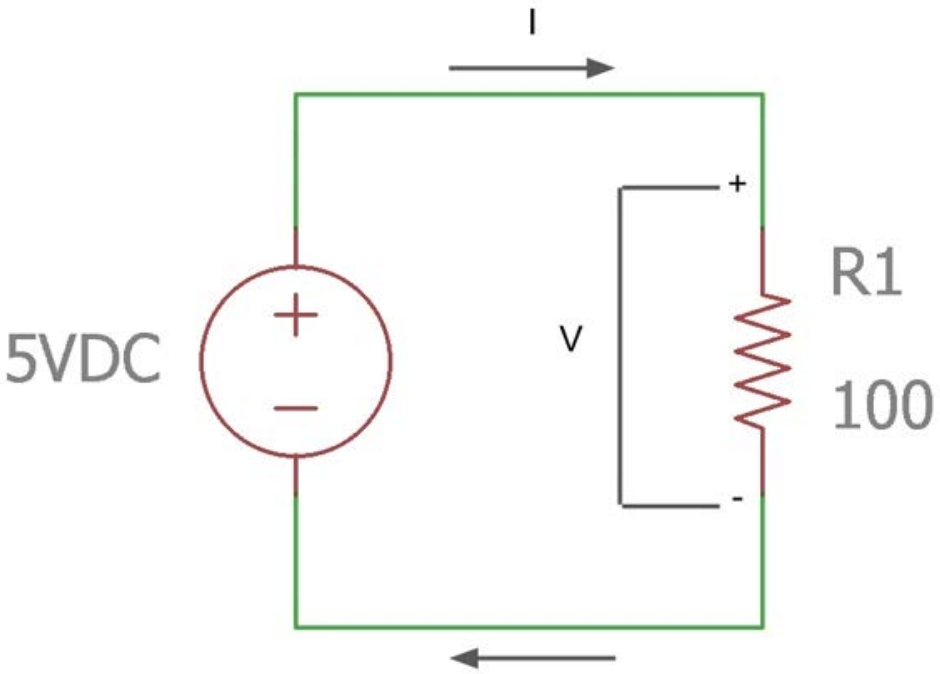


Electricity \ Electronics Basic Concept Review

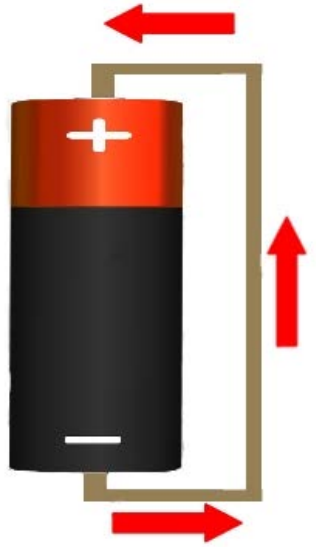


Electricity \ Electronics Basic Concept Review

- **Ohm's Law**, describes the direct relationship between the Voltage (V), Current (I) and Resistance (R)



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



Power

- **Power (P)** is the amount of electrical energy transformed into another type of energy (heat, light or work) per second. It is measured in Watts.

$$P = V \times I$$

- If we created a circuit with a battery and a resistor, the resistor will convert the electrical energy to heat (or thermal) energy.

- All resistors also have a maximum power rating that they can handle therefore to ensure that we do not damage the resistors in a circuit we will need to know how to calculate power.

Power

- Most of the low-cost resistors are rated at 1/4 (or 0.25) Watts.

- If we are running a voltage of 10V across a 100 Ohm resistor, do you think the resistor will be able to handle it?

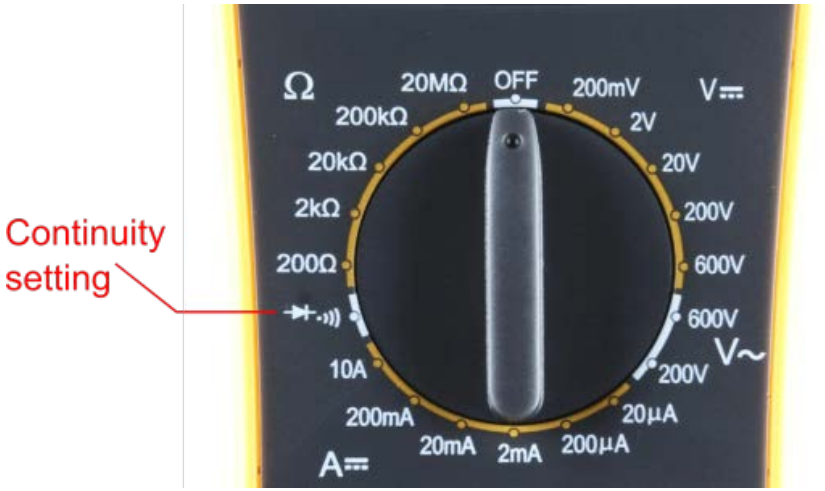
$$I = \frac{10V}{100} = 0.1\ Amps \text{ then } P = 0.1A \times 10V = 1\ Watt$$

- which is four times what the resistor is rated for, therefore the resistor will get very hot and may even get damaged.

Continuity – Is it a Circuit?

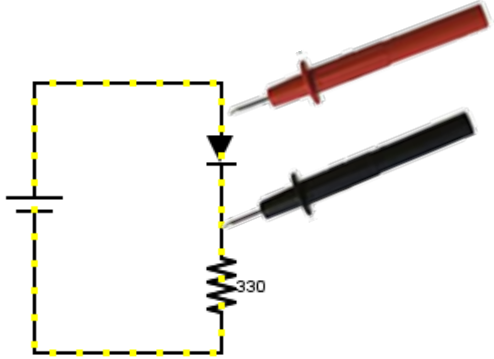
- The word “circuit” is derived from the circle. An Electrical Circuit must have a continuous LOOP from Power (V_{cc}) to Ground (GND).

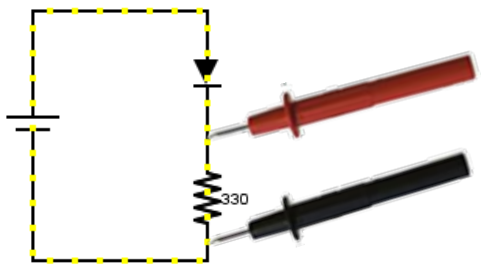
- Continuity is important to make portions of circuits be connected. Continuity is the simplest and possibly the most important setting on your multi-meter. Sometimes we call this “ringing out” a circuit.

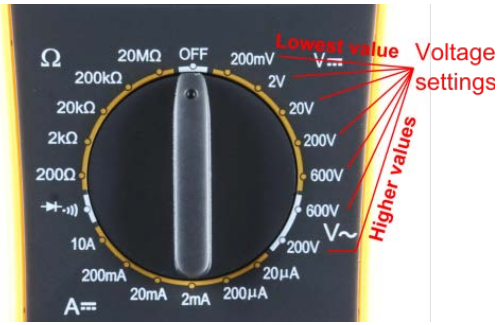


Measuring Electricity – Voltage and Current

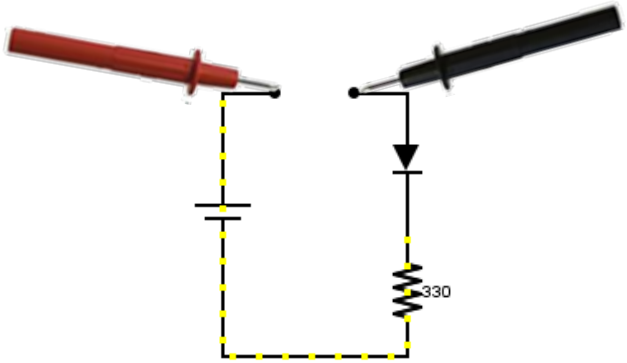
- Voltage is a measure of potential electrical energy. A voltage is also called a potential difference – it is measured between two points in a circuit – across a device.

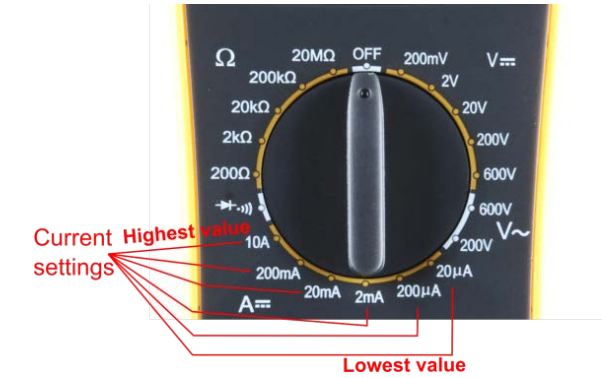






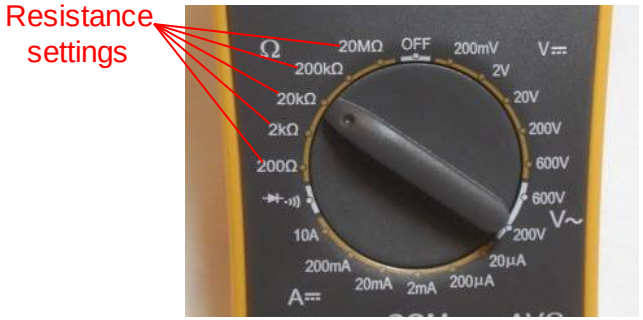
- Current is the measure of the rate of charge flow. For Electrical Engineers – we consider this to be the movement of electrons.
- In order to measure this – you must break the circuit or insert the meter in-line (series).





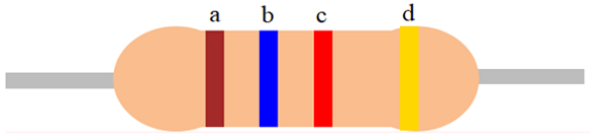
Measuring Electricity -- Resistance

- Resistance is the measure of how much opposition to current flow is in a circuit.
- Components should be removed entirely from the circuit to measure resistance. Note the settings on the multi-meter. Make sure that you are set for the appropriate range.

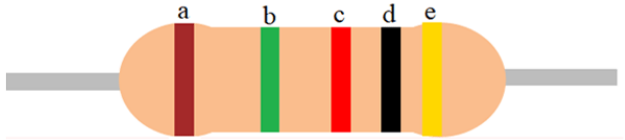


- The value of a resistor is marked on its body using colour bands. The majority of the resistors contain four bands but there are also some resistors that have five and six bands.

Resistor color codes

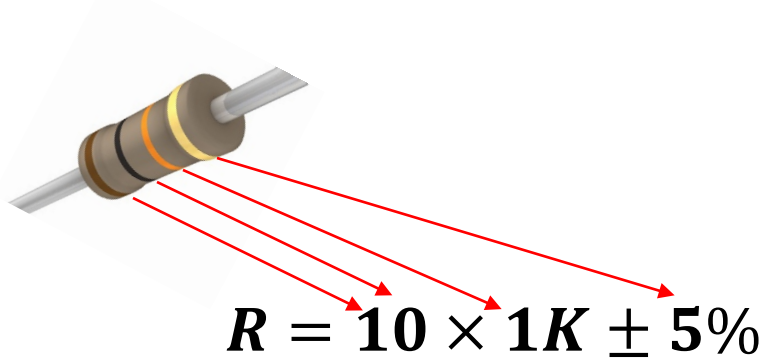


- Four-band resistor
  - The first two bands, from left to right, indicate the resistor's value.
  - The third band is the multiplier and the fourth band is the tolerance.
  - $\boldsymbol{R = ab \times c \pm d\%}$



- Five bands resistor
  - first three bands to indicate the resistor's value
  - the fourth band is the multiplier
  - the fifth band is the tolerance
  - $\boldsymbol{R = abc \times d \pm e\%}$

Color	Numeric Value	Multiplier	Tolerance	Temperature coefficient
BLACK	0	1Ω		250
BROWN	1	10 Ω	±1%	100
RED	2	100 Ω	±2%	50
ORANGE	3	1K Ω		15
YELLOW	4	10 Ω		25
GREEN	5	100 Ω	±0.5%	20
BLUE	6	1M Ω	±0.25%	10
VIOLET	7		±0.1%	5
GREY	8			1
WHITE	9			
GOLD			±5%	
SILVER			±10%	



$\boldsymbol{R = 10 \times 1K \pm 5\%}$

Images: https://circuitdigest.com

Solderless Breadboard

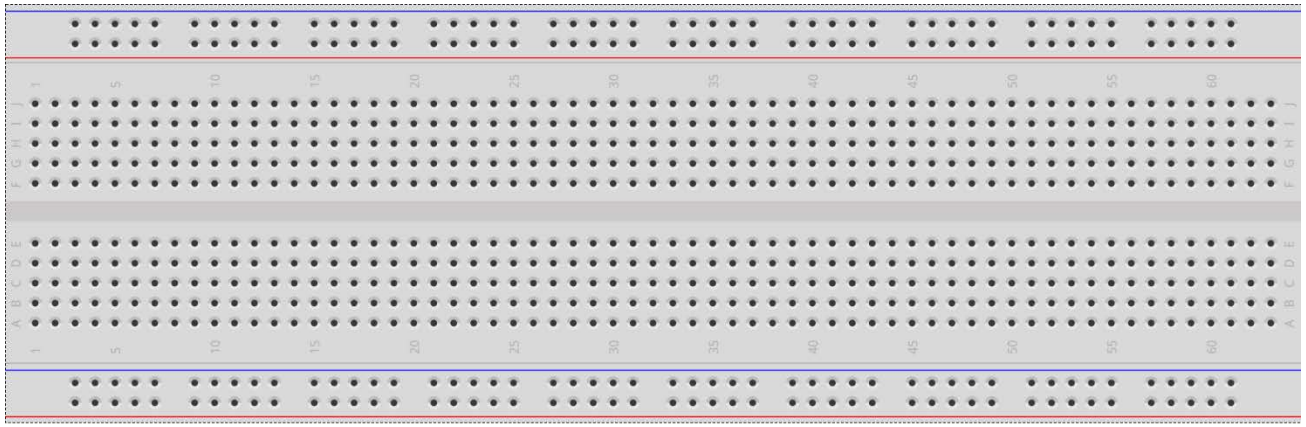
- It is a good idea to avoid connecting LEDs, resistors and other electronic components directly to the Arduino because you can easily damage the headers on the Arduino and the circuit quickly turn into an unorganized mess.

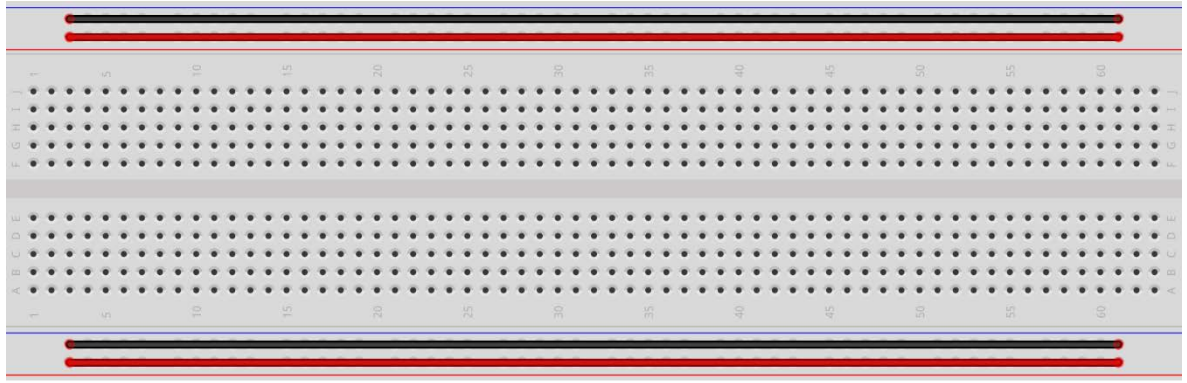
- When prototyping, it is a lot easier to connect the components together using a solderless breadboard.

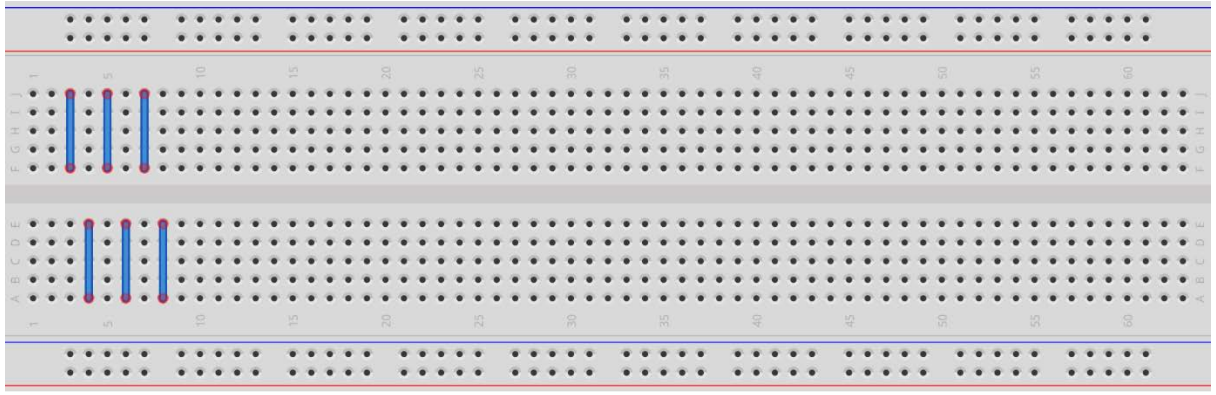
- A solderless breadboard enables us to connect electronic components together without the need to solder.

Solderless Breadboard

- Horizontal rows called power bus are connected horizontally
- Each vertical column of 5 holes are connected.







Tinkercad View of Breadboard Circuit