Robotic Arts Introduction

Week 2: looking closer [basic components]

Electricity - it’s everywhere!

Electricity is the flow of electrons through a conductor.

Lightning in the sky and LED light is the same effect just a different **quantity**

We can not “see” electricity, we can see the **EFFECT**

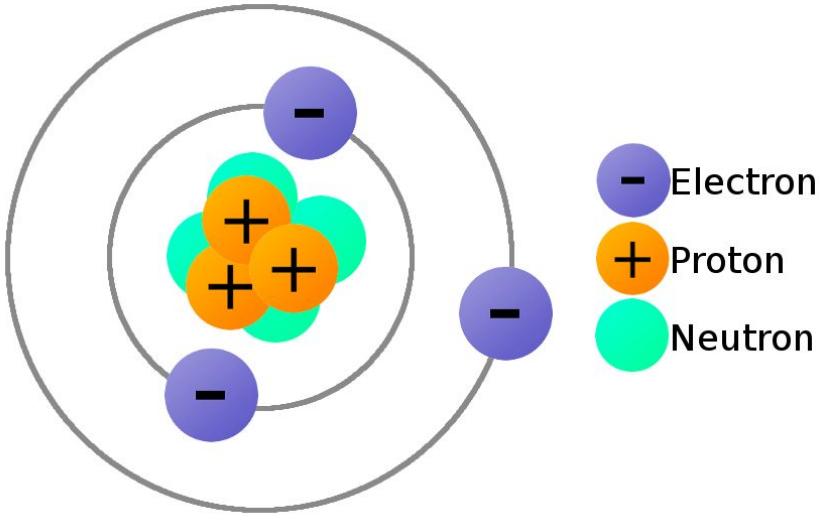
Lights, Computers, Phones, Brains

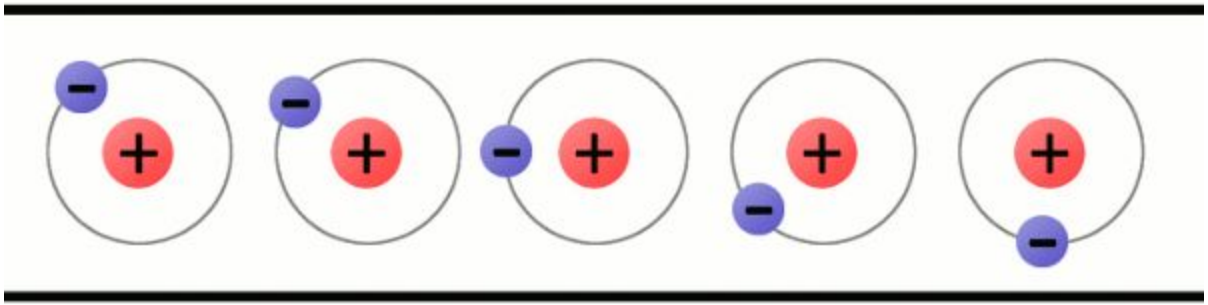
Let’s think very small

Building blocks of Atoms

Electrons have a negative charge (-)

Protons have a positive charge (+)





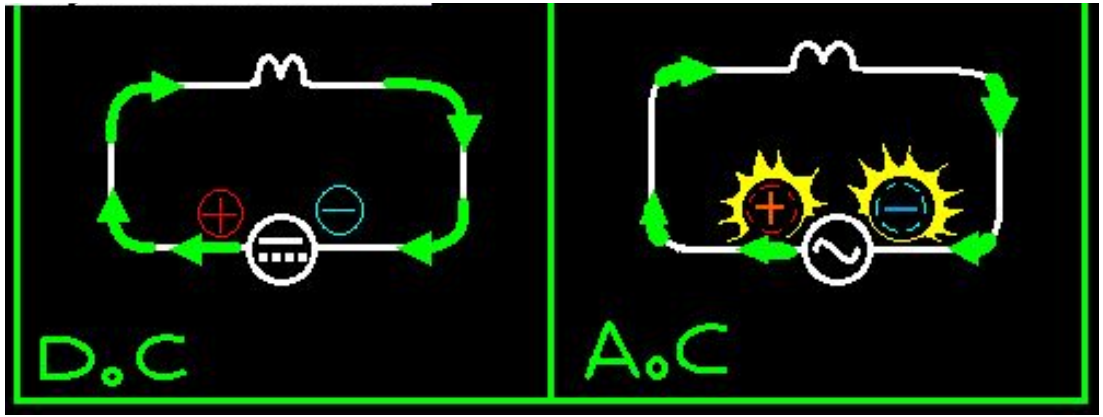
AC vs DC

DC Direct Current

- Electricity flows in one direction
- Good for low voltages used by common electronic devices
- Can come from batteries or wall adapters
- Typically much safer than AC

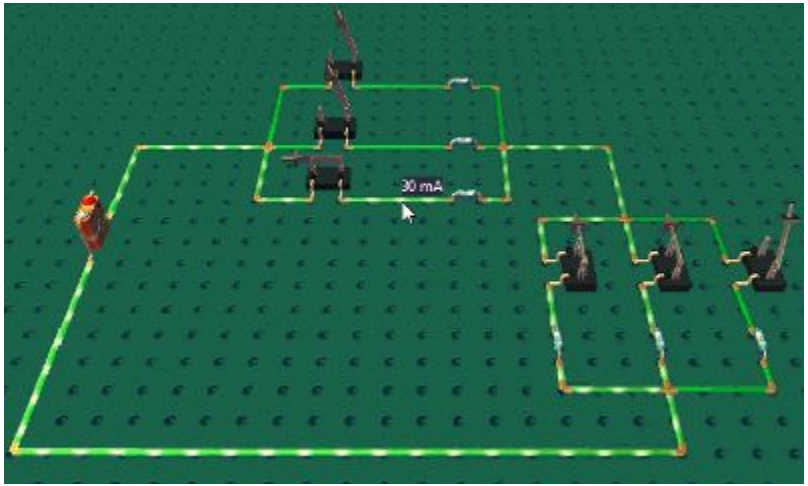
AC Alternative Current

- Electricity flows in waves (cycles)
- Flow can reverse
- Good for high voltages & long distances
- Comes directly from power outlets
- Very dangerous! Can kill you



Electronics

The control of the flow of electricity



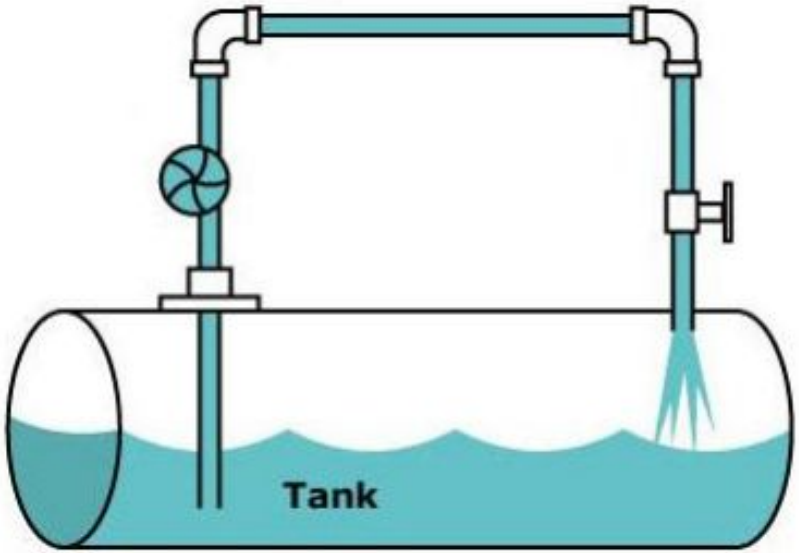
Basic properties of electronics

- **Voltage**
- **Resistance**
- **Current**

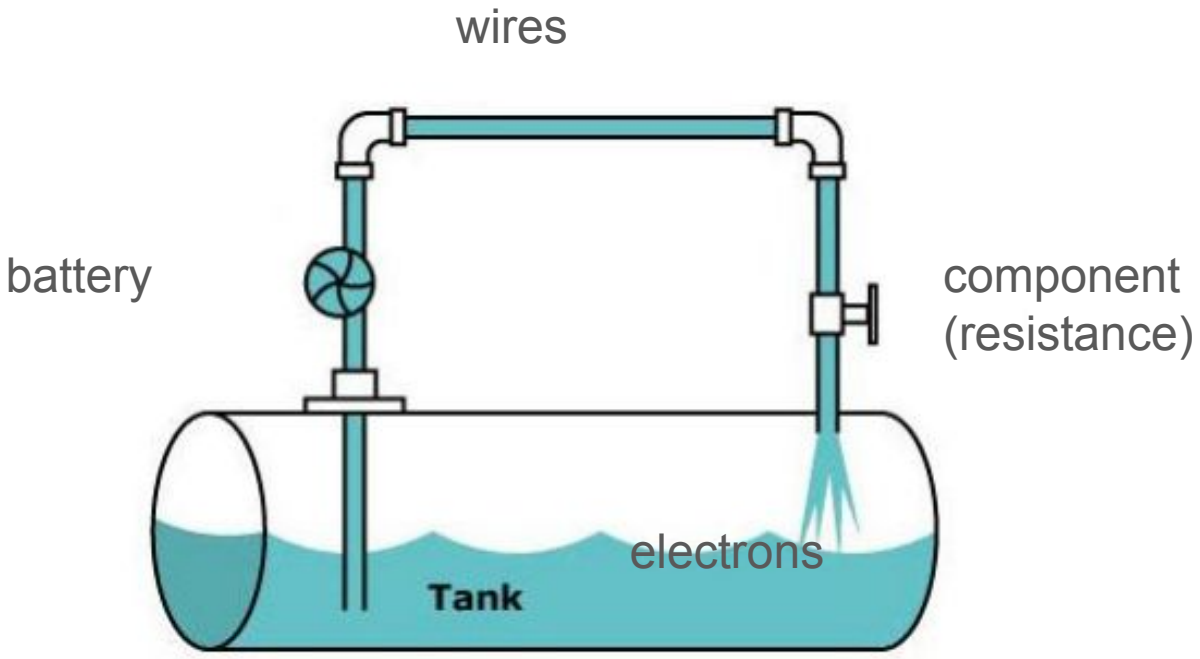
All of these properties have mutual influence over one another in a circuit.

Water analogy

We can use a simple analogy to think about each of these properties within a circuit



Water analogy



Voltage

The amount of pressure produced by the pump which drives water through the pipes.

Voltage is measured in volts (V).

Current

The amount of water flowing through a given point in a pipe.

Current is measured in amps (A).

Since we'll often be dealing with very low currents, the range will typically be measured in milliamps (mA). .001A = 1mA or 1A = 1000mA

Resistance

This is the faucet. When we tighten the faucet it reduces the water pressure flowing through.

Resistance is measured in Ohms (Ω).

1 Ohm, 10 ohms, 100 ohms…

1 Kilo ohm (1KΩ) = 1000 ohms

1 Mega ohm (1MΩ) = 1 million ohms

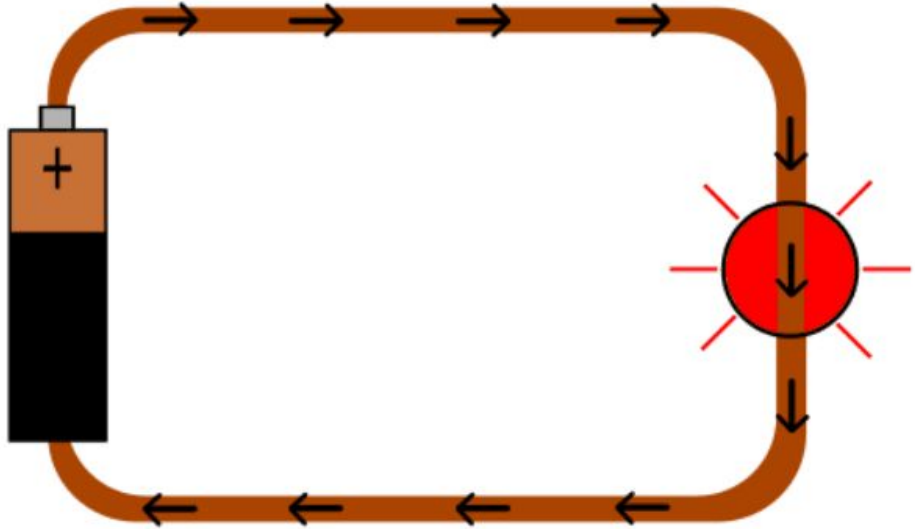
Power

This is the water being used to do something.

Power is the actual amount of work which can be done.

Electronic circuit (circle!)

- Roughly circular line, route, or movement that starts and finishes at the same place.
- Interconnected electronic components which manage the flow of electricity.

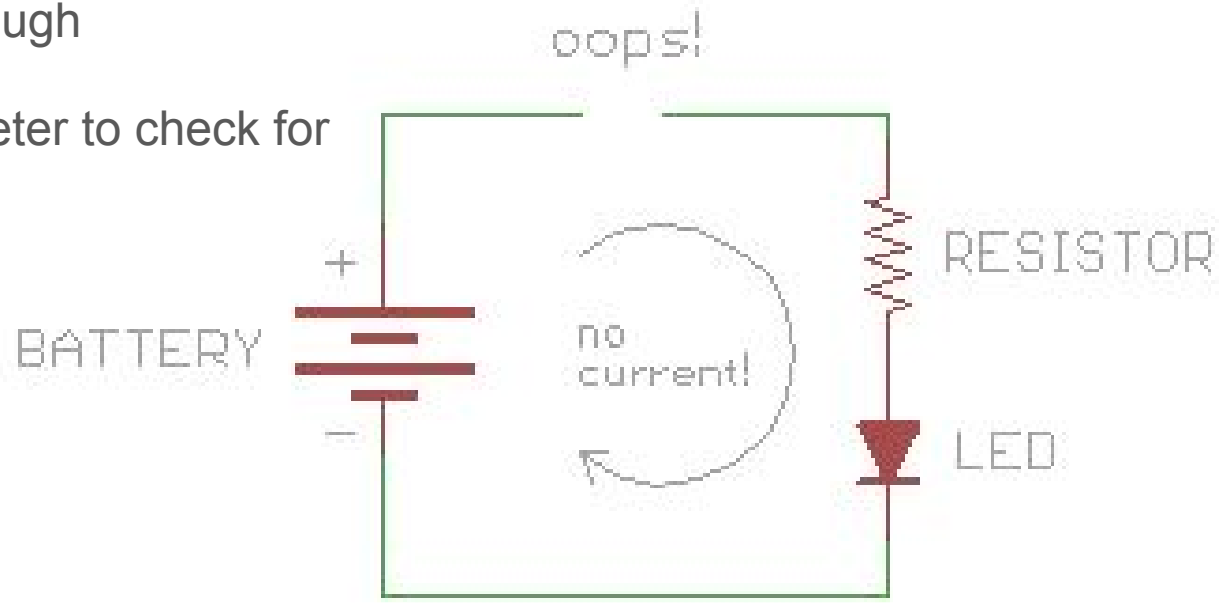


Open Circuit

Loop is not fully connected

No electricity will flow through

Troubleshoot with Multimeter to check for continuity

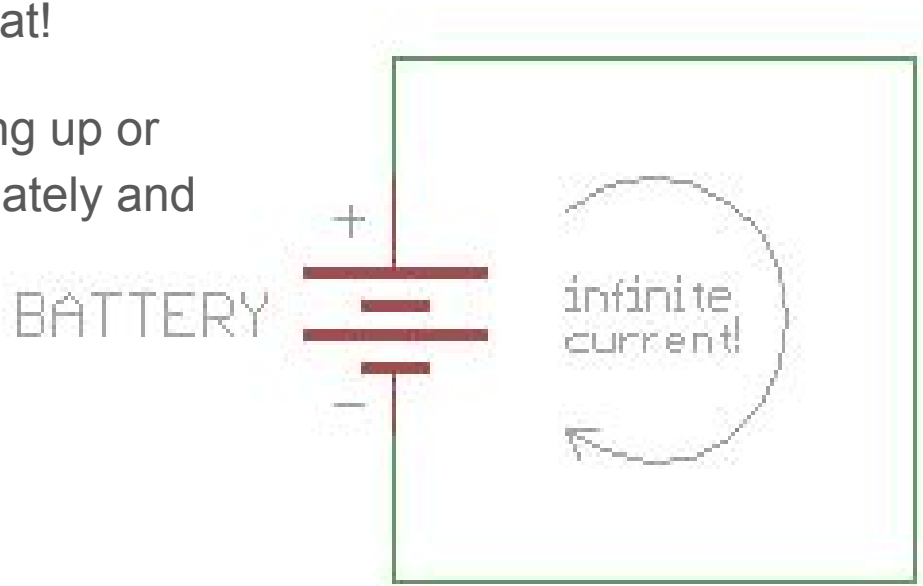


Short Circuit

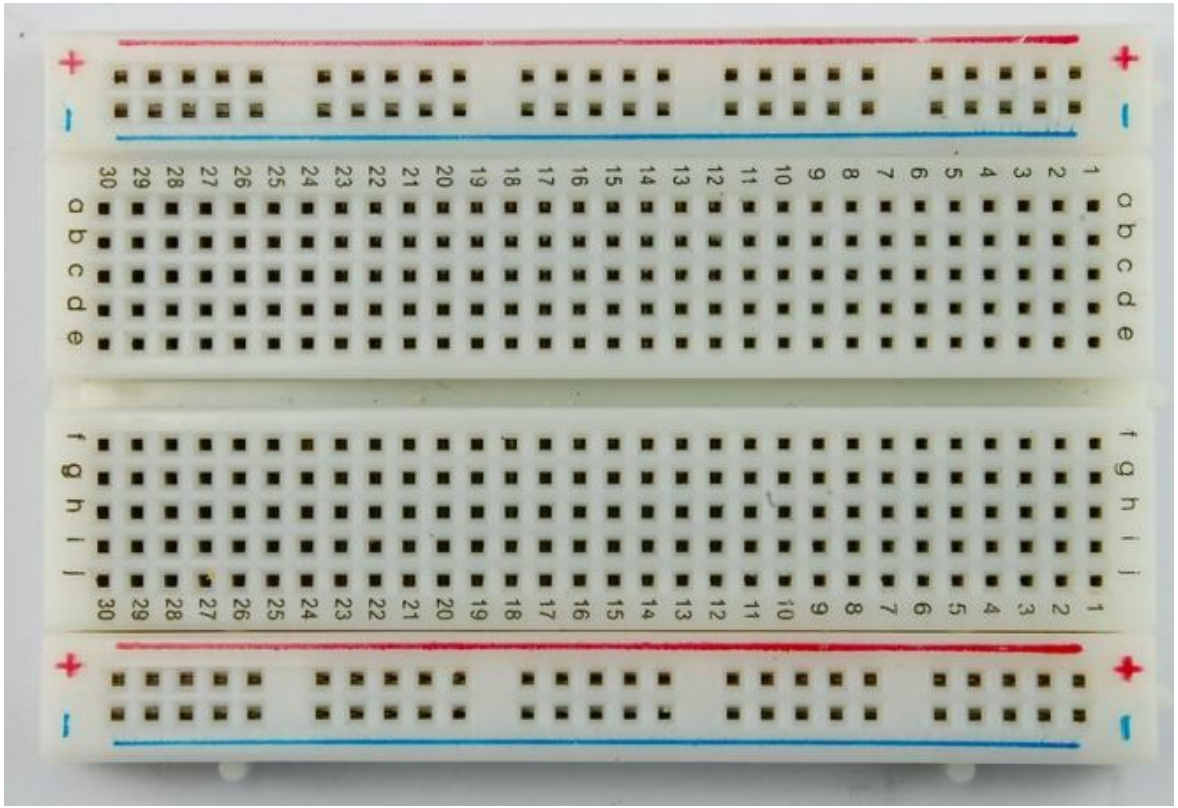
DON’T DO THIS

No load (light, LED, MOTOR, etc) to limit the circuit, results in rapid buildup of heat!

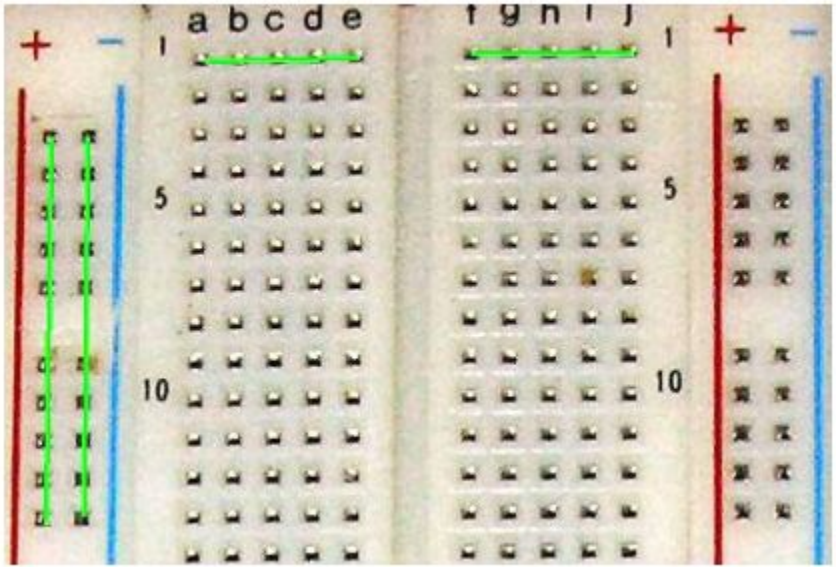
If any parts of your circuit are heating up or smoking, take off the power immediately and check for a short circuit

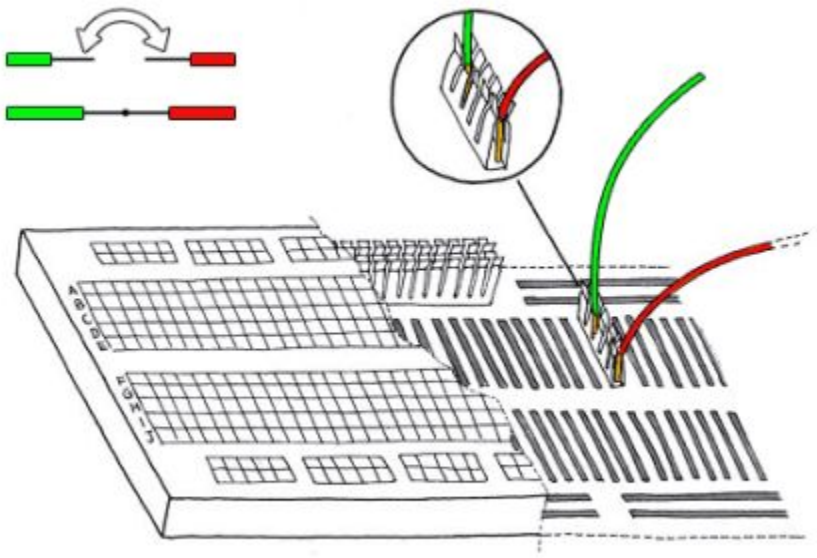


Breadboard



Breadboard connections





Wires

Wirestrippers and Wirecutters

Battery and Battery snap

Battery polarity

A battery is a polarized component.

Sometimes this is referred to as…

POSITIVE & NEGATIVE (+ & -)

POWER & GROUND (9V & GND)

By convention, the color RED is associated with POWER, and BLACK/BLUE with GROUND.

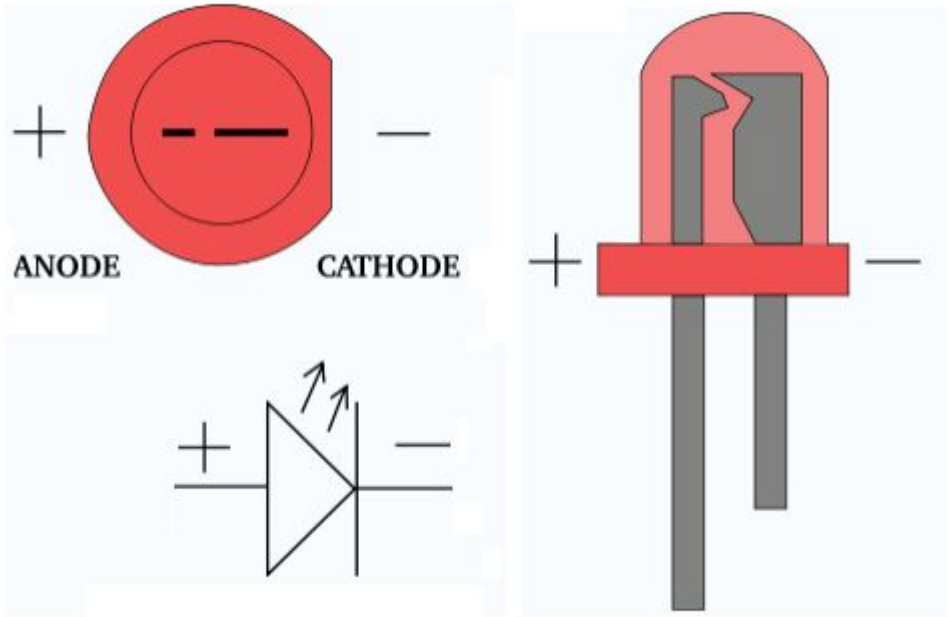
Multimeter

An instrument which can be used to test properties of an electronic circuit. Multimeters are also useful for testing connections (continuity) within a circuit.

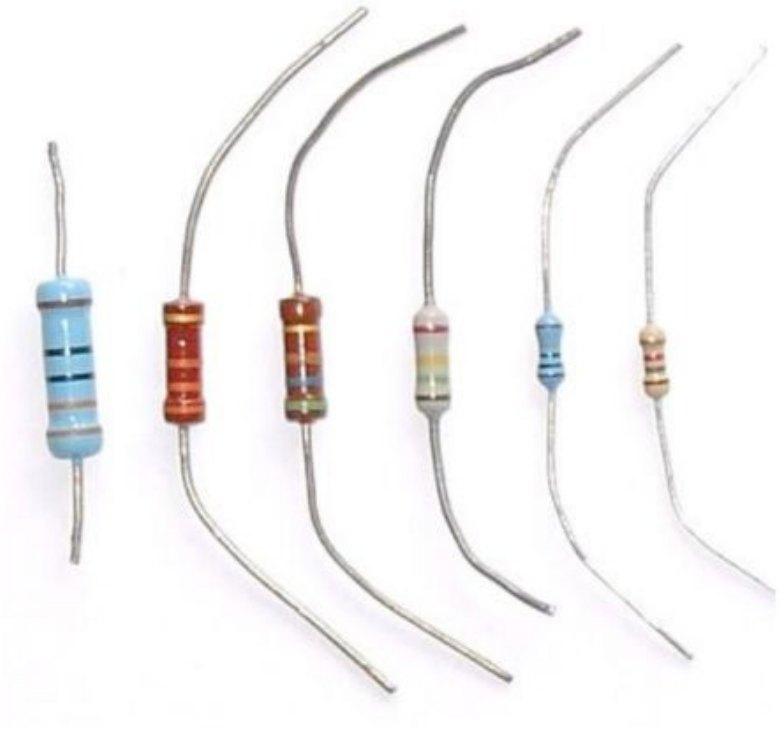
1. Check the voltage of the battery
2. Connect battery to Battery snap
3. Connect wires to + and - busses of breadboard
4. Use multimeter to check voltage

Light **E**mitting **D**iode

LED polarity



Resistors



Resistors

A resistor is the current limiting valve

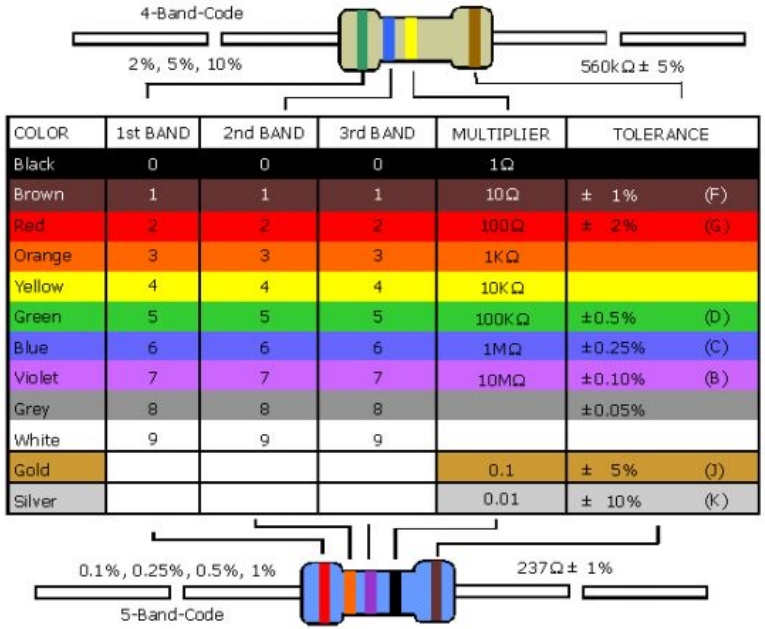
The bigger the value, the stronger the resistance

The bigger the value, the smaller the opening of the valve

Use the multimeter to check the value of the resistor

Resistor value is expressed with **Ω** ohm

Reading resistor values

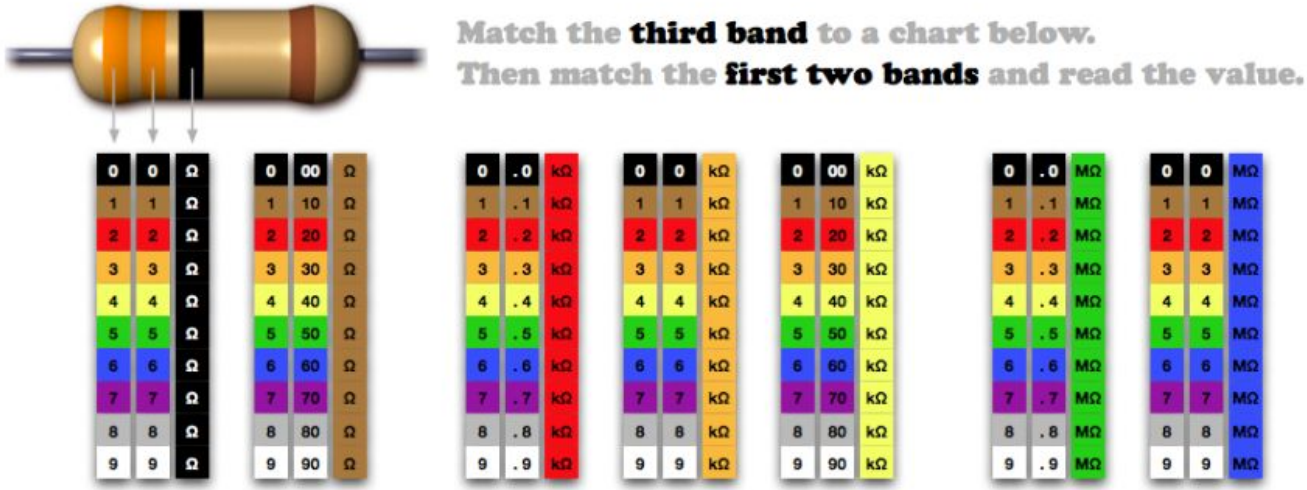


COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE	
Black	0	0	0	1Ω		
Brown	1	1	1	10Ω	± 1%	(F)
Red	2	2	2	100Ω	± 2%	(G)
Orange	3	3	3	1KΩ		
Yellow	4	4	4	10KΩ		
Green	5	5	5	100KΩ	±0.5%	(D)
Blue	6	6	6	1MΩ	±0.25%	(C)
Violet	7	7	7	10MΩ	±0.10%	(B)
Grey	8	8	8		±0.05%	
White	9	9	9			
Gold				0.1	± 5%	(J)
Silver				0.01	± 10%	(K)

Electronix Express / RSR
http://www.elexp.com

1-800-972-2225
In NJ 732-381-8020

Visual alternative



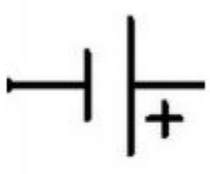
No multiplication necessary! PDF available from Bret Victor (http://worrydream.com/ResistorDecoder/)

Schematic

A schematic is an abstract diagram of a circuit which shows how components are connected. Schematics use symbols to represent parts:

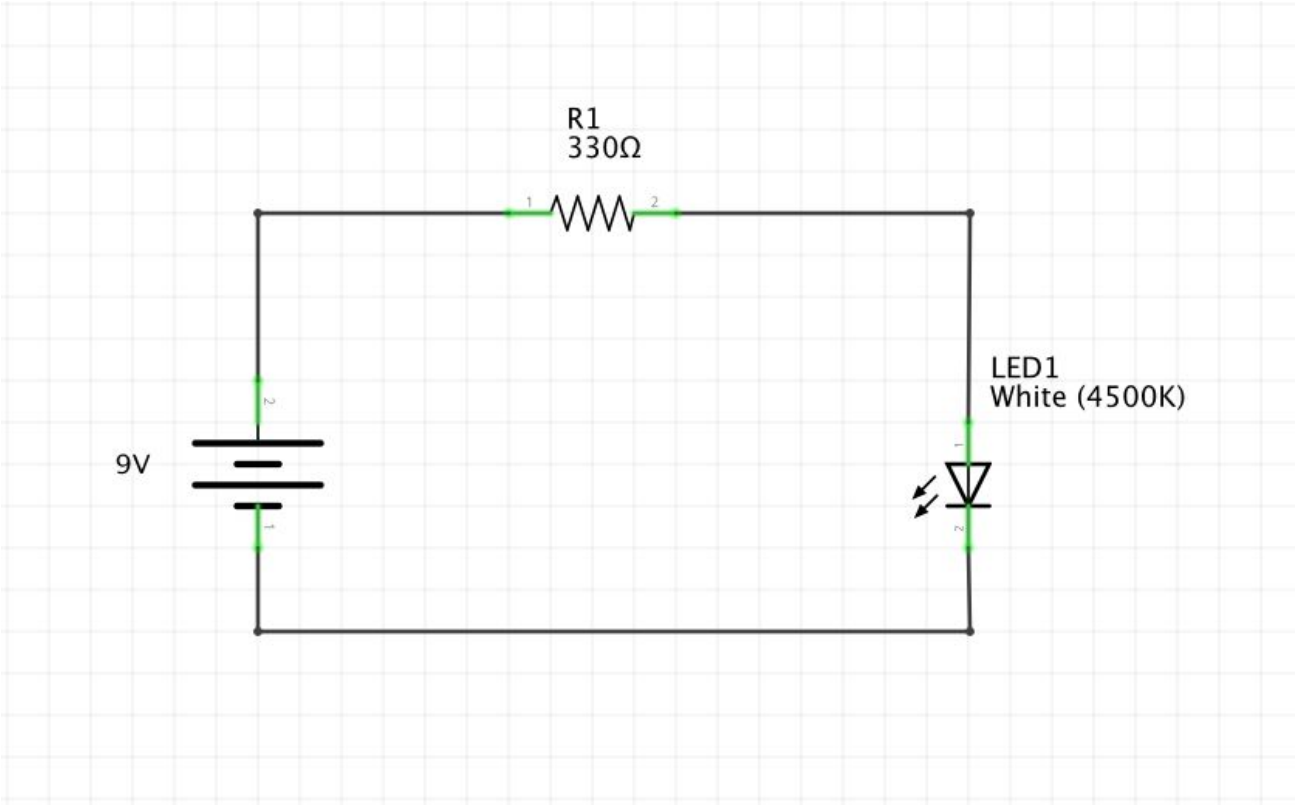
Resistor

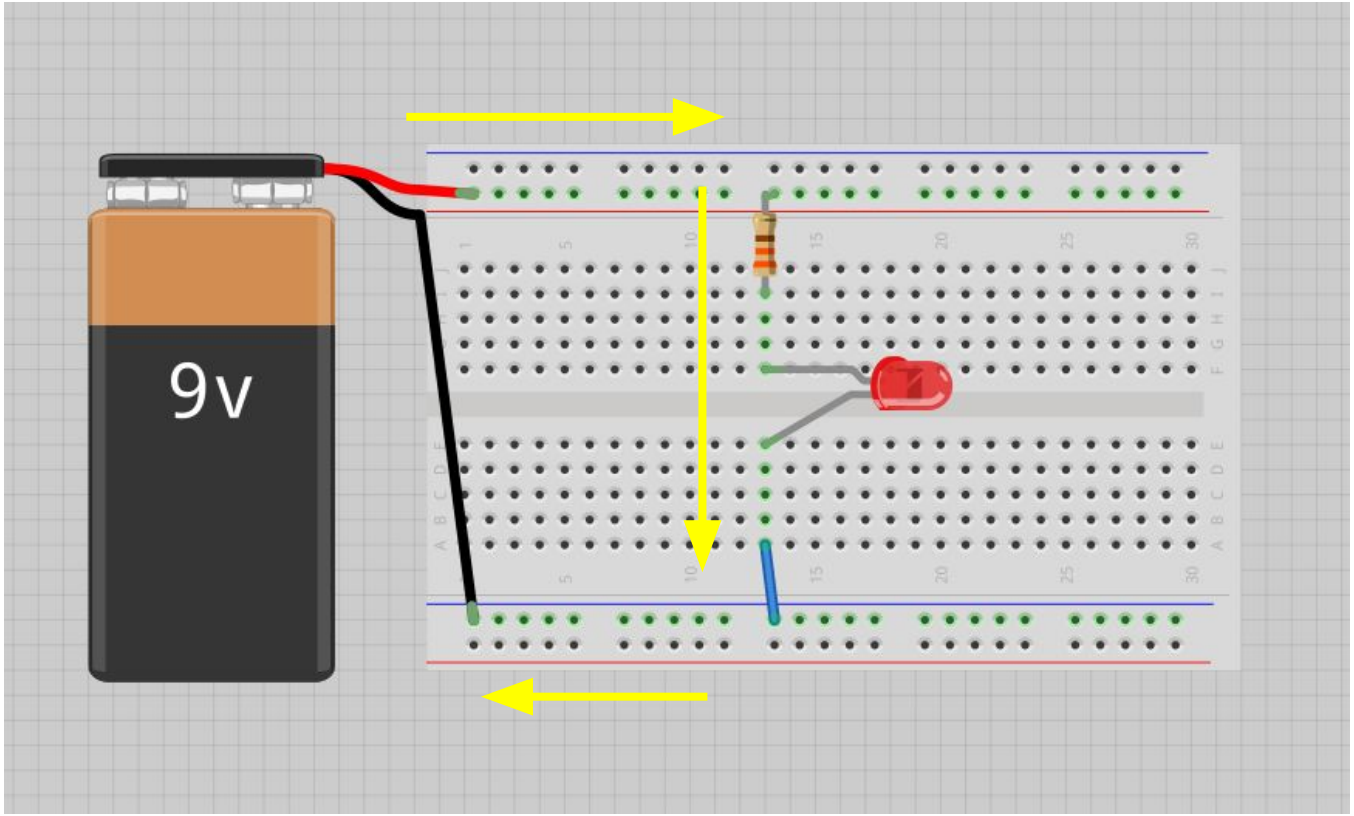
LED



Battery

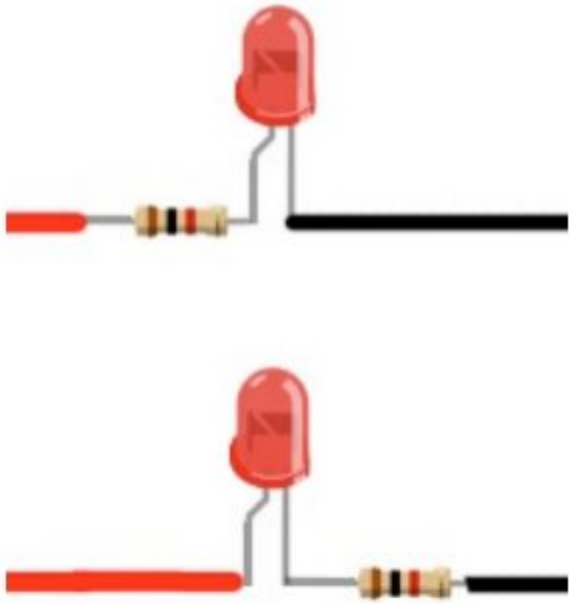
LED circuit 1




9v

Value of Resistor

- LED only need small amounts of current to work
- Resistors limit the current going into LED
- The amount of resistance is determined by the needs of LED and the amount of voltage your power supply provides
- LED will overheat and burn if there is no resistor in this circuit
- You can use a bigger resistor



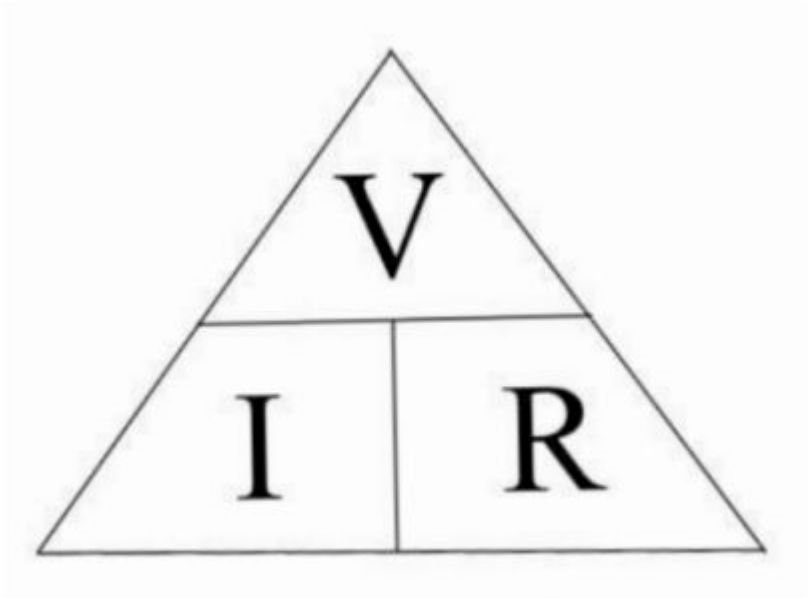
The resistor can go on either side of the LED in the circuit

How to guess what resistor to use:

A basic LED needs…

- Voltage : roughly 2V
- Current: 20 - 30 mA
- Resistance: ? determined by voltage of battery

Ohm’s Law



Resistance (R) = Voltage (V) / Current(A)

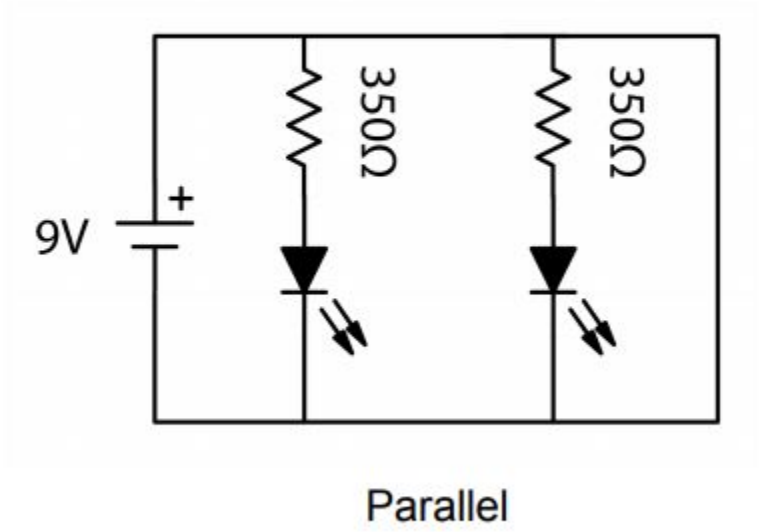
Ohm’s Law

Resistance = (Supply Voltage - Sum of LED Voltages) / LED Current

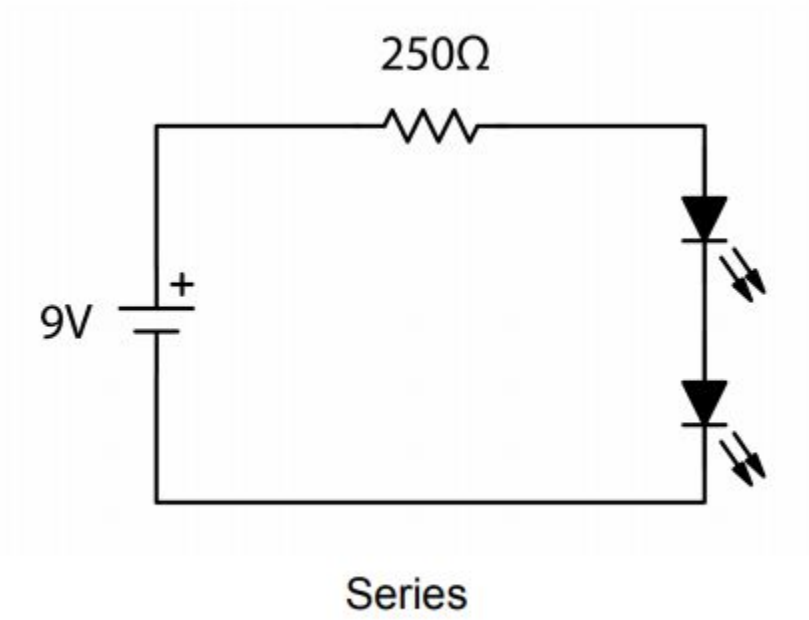
350 ohms = (9V - 2V) / 20mA*

*20 mA is 0.02A

Parallel and Series Circuits

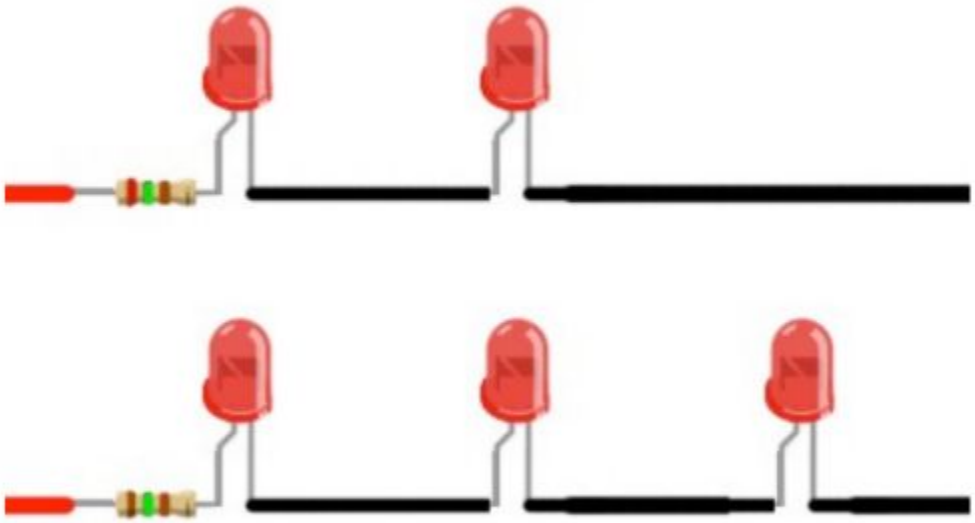


Parallel



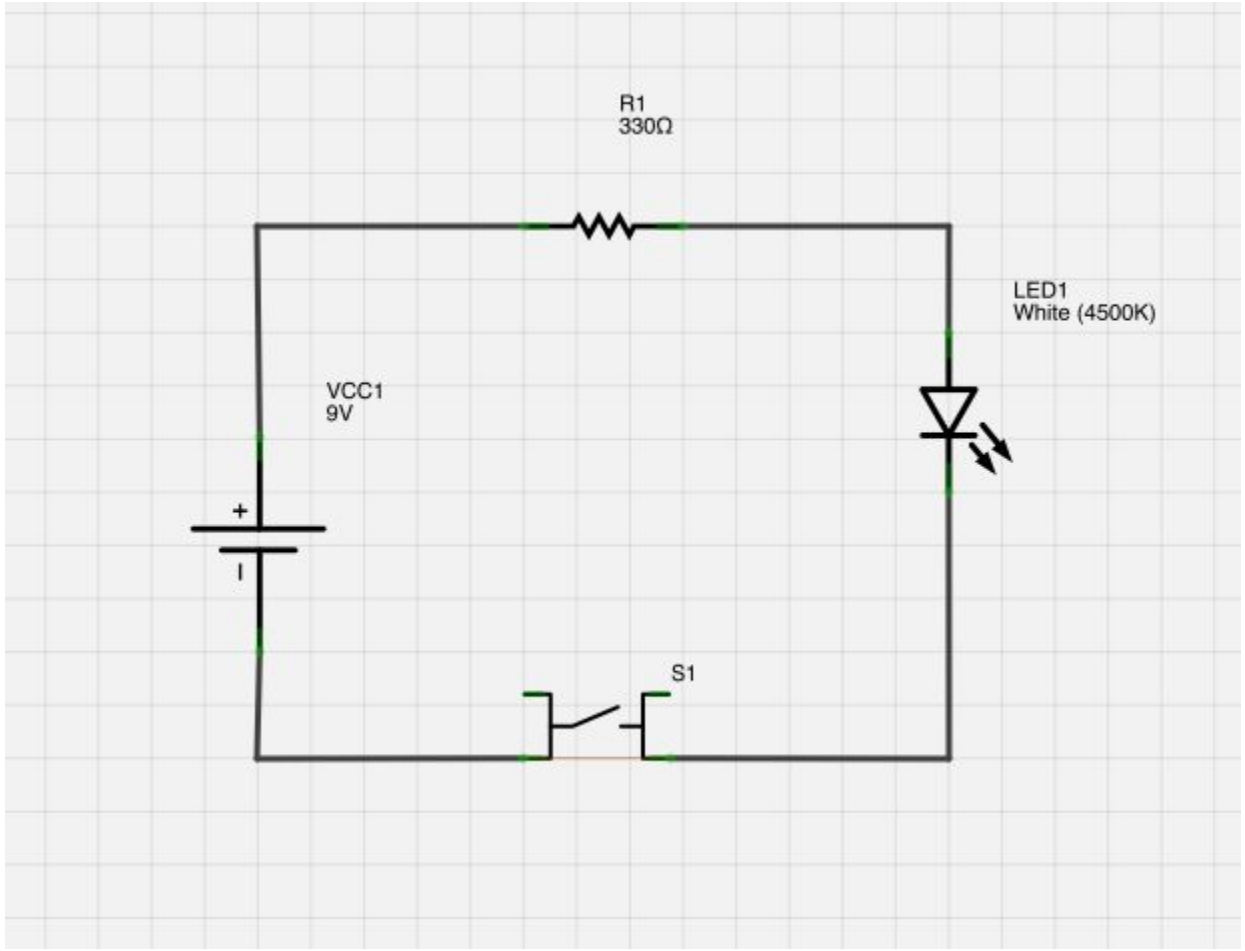
Series

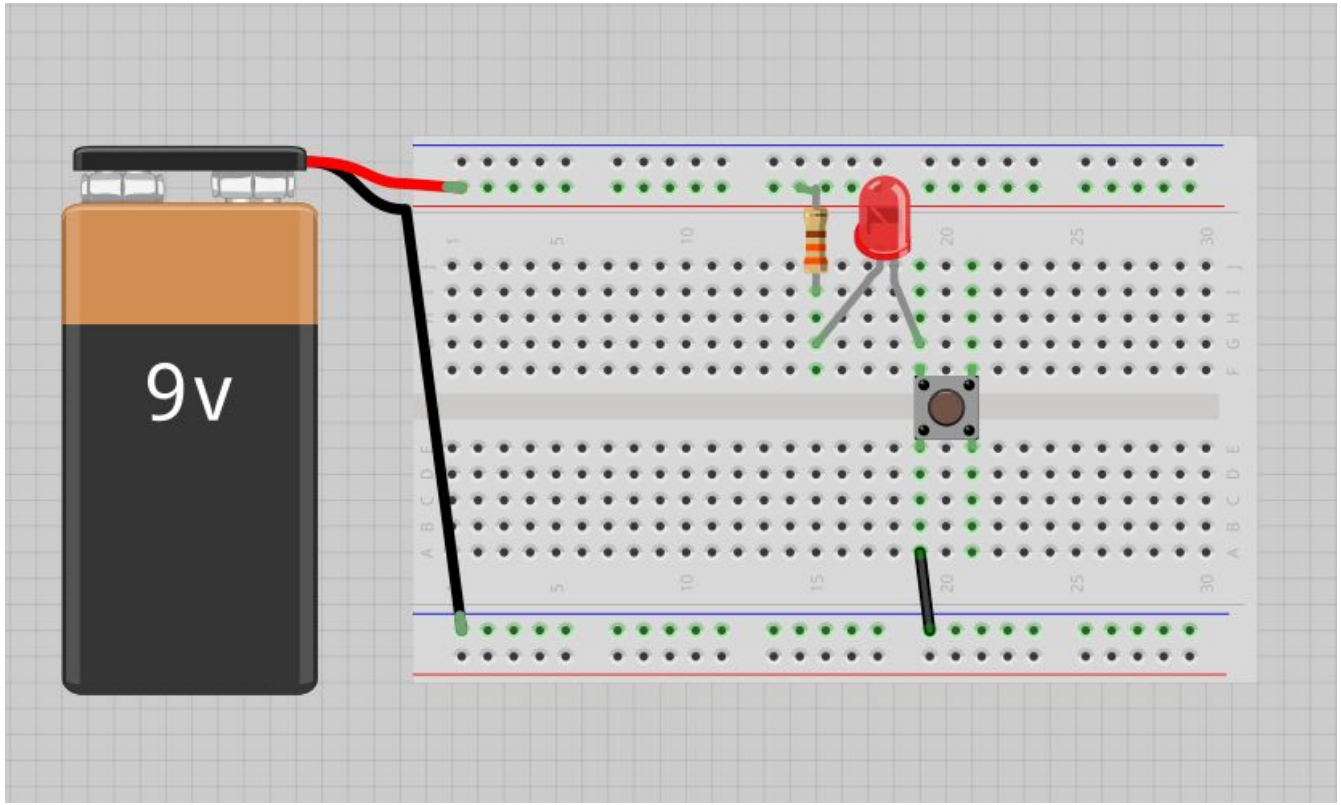
250 ohms = (9V-(2V+2V))/20mA

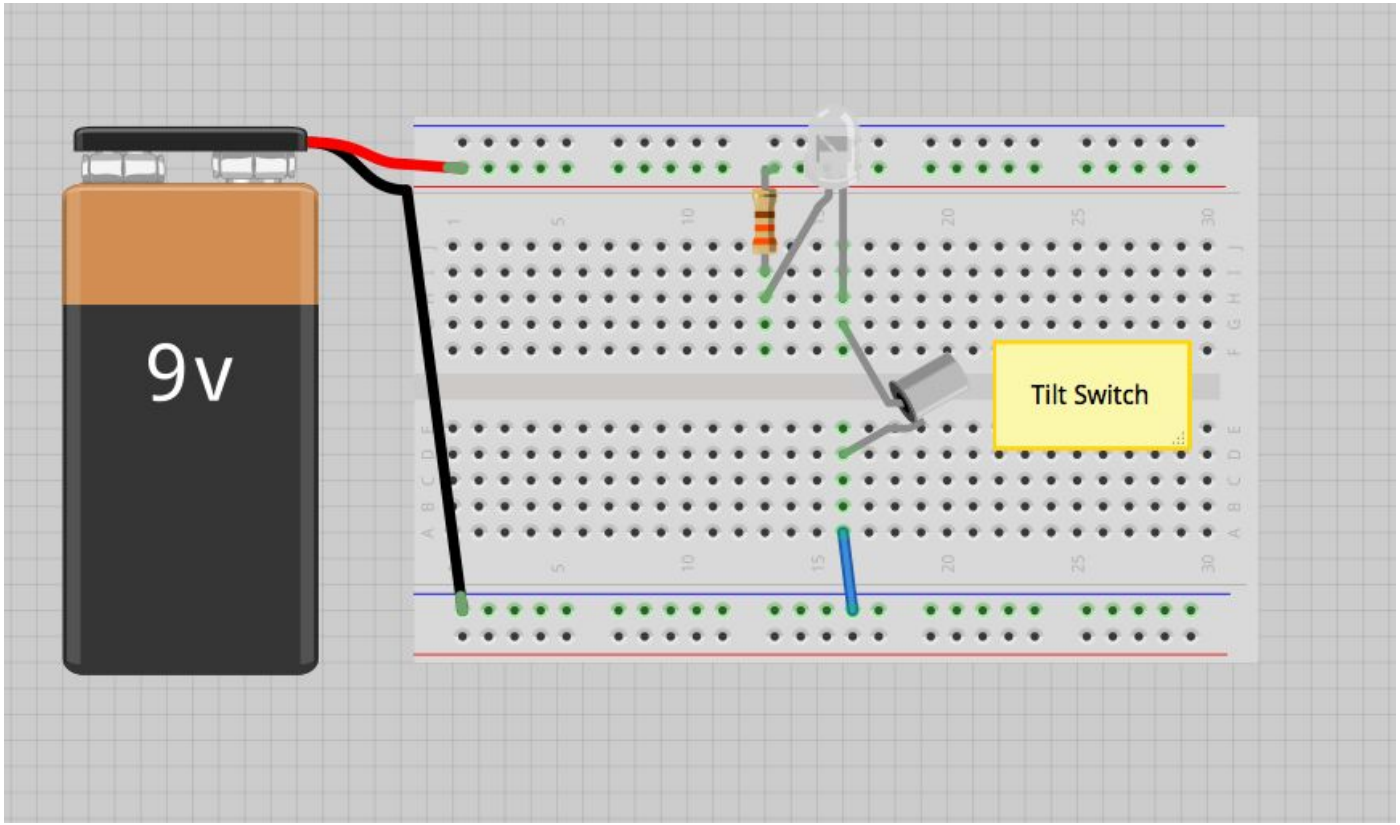


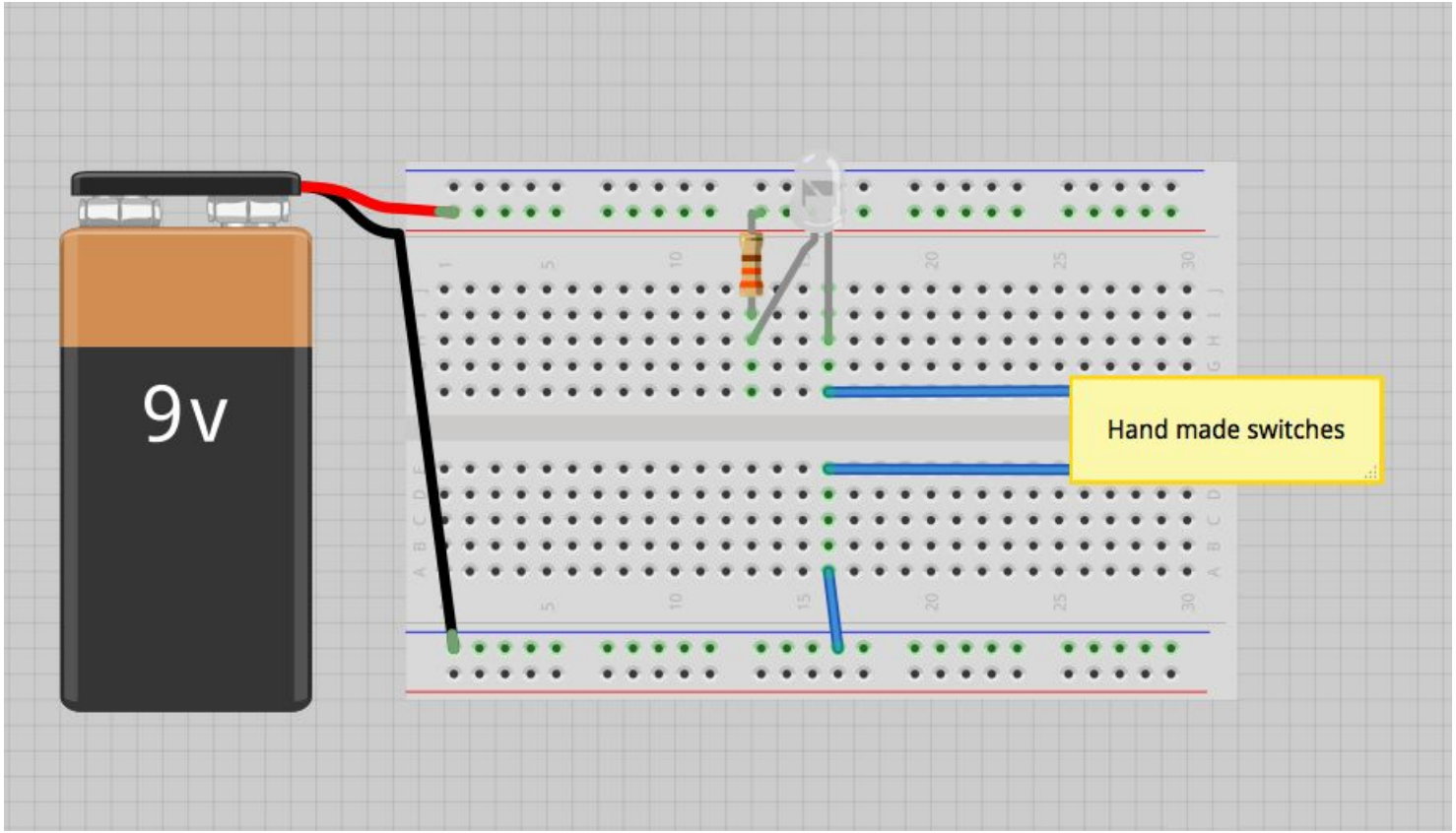
150 ohms = (9V-(2V+2V+2V))/20mA

Add a switch to the circuit


R1
330Ω
LED1
White (4500K)
VCC1
9V
+
S1

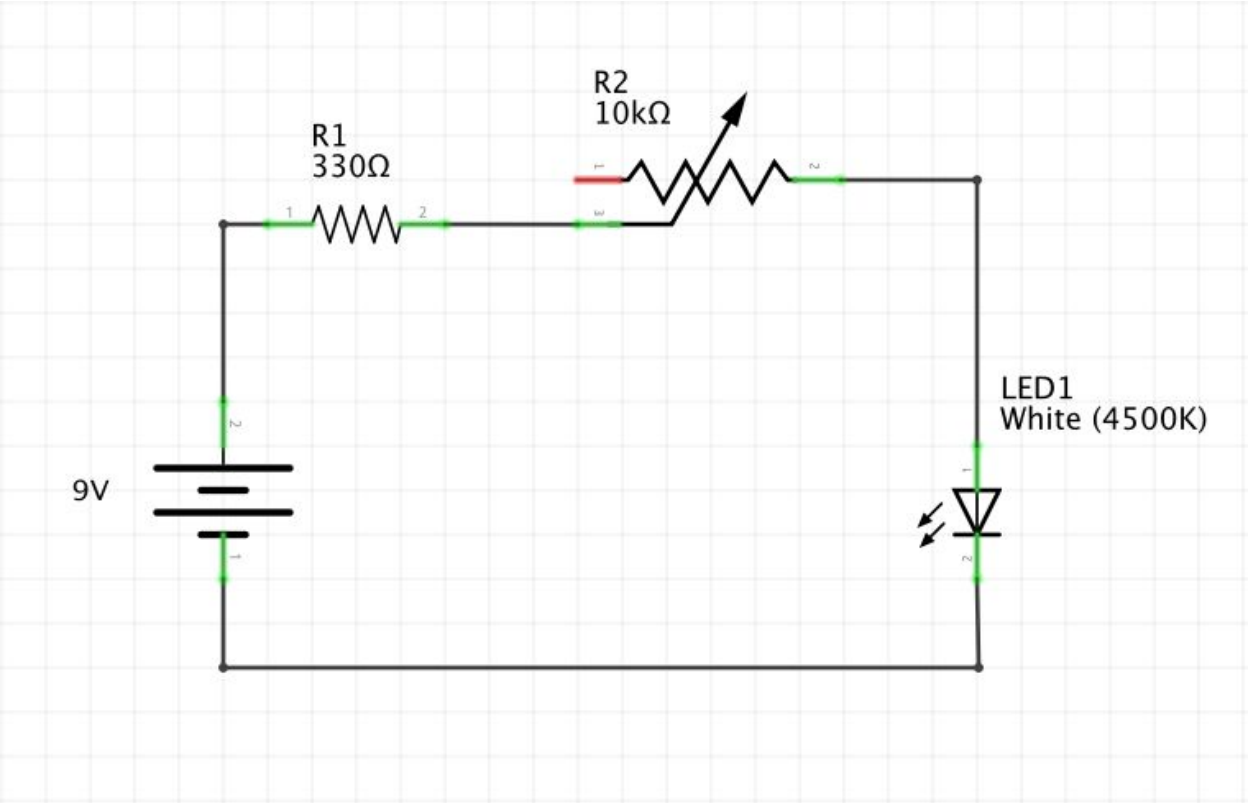

9v

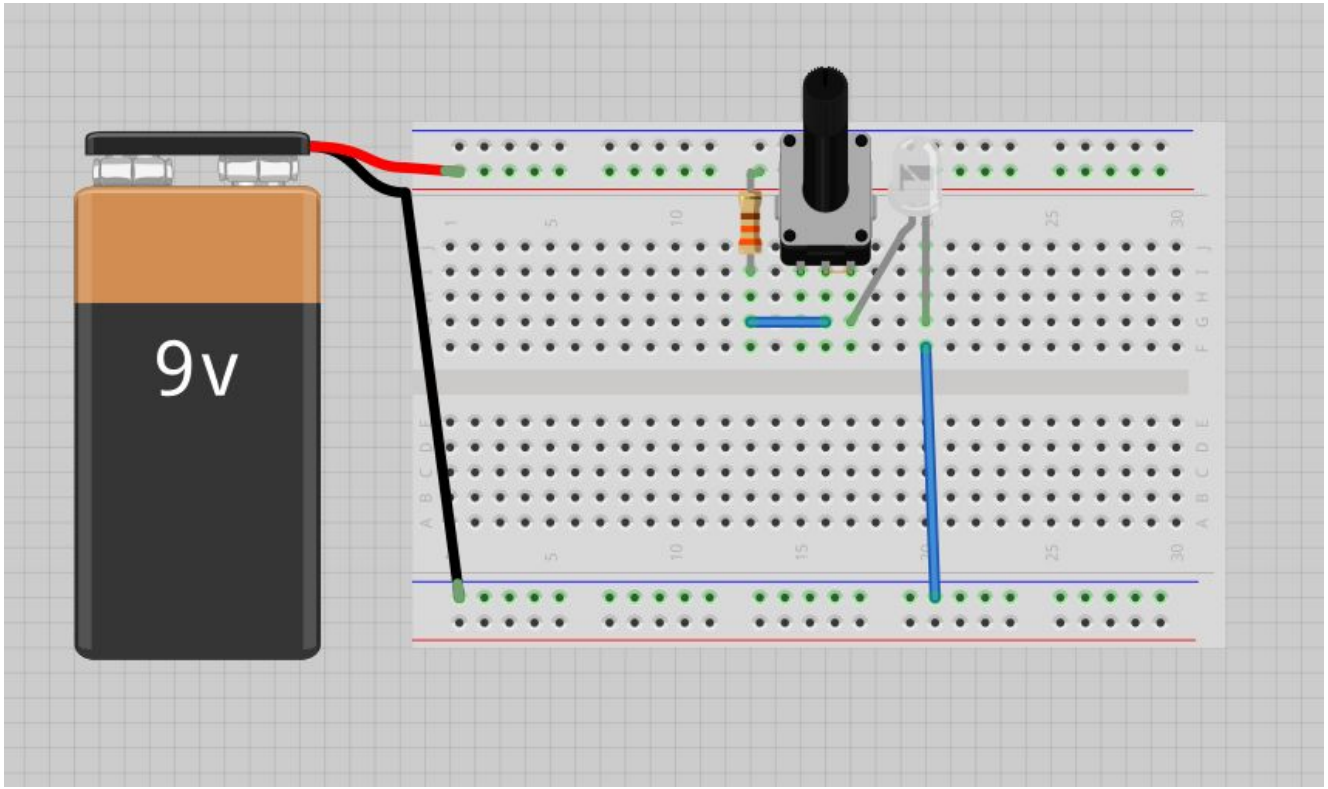

9v
Tilt Switch


9v
Hand made switches

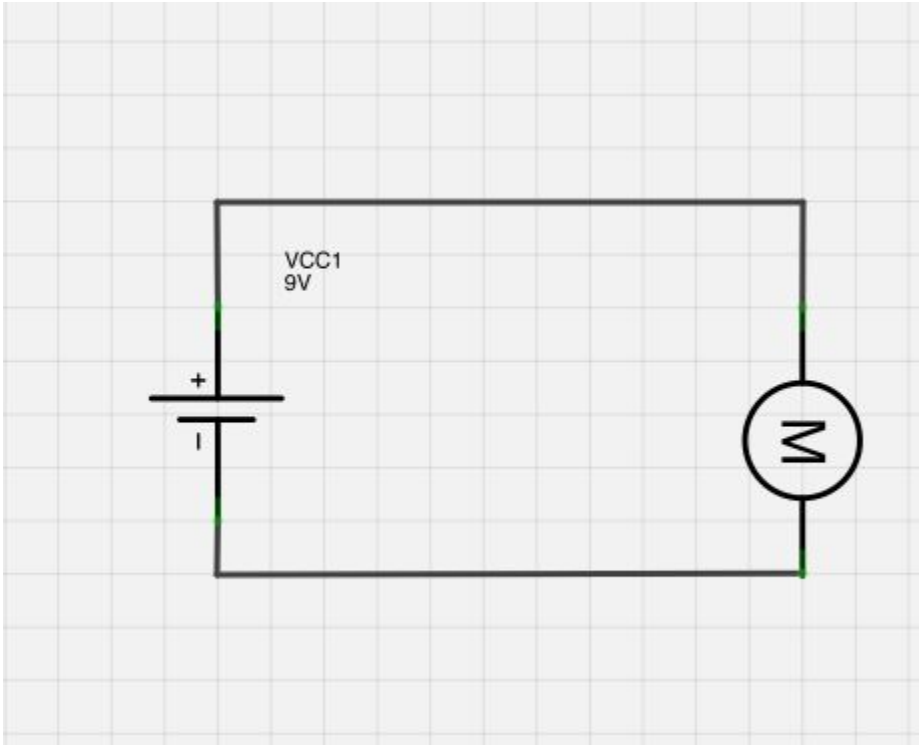
Variable resistors

Add a variable resistor to circuit




9v

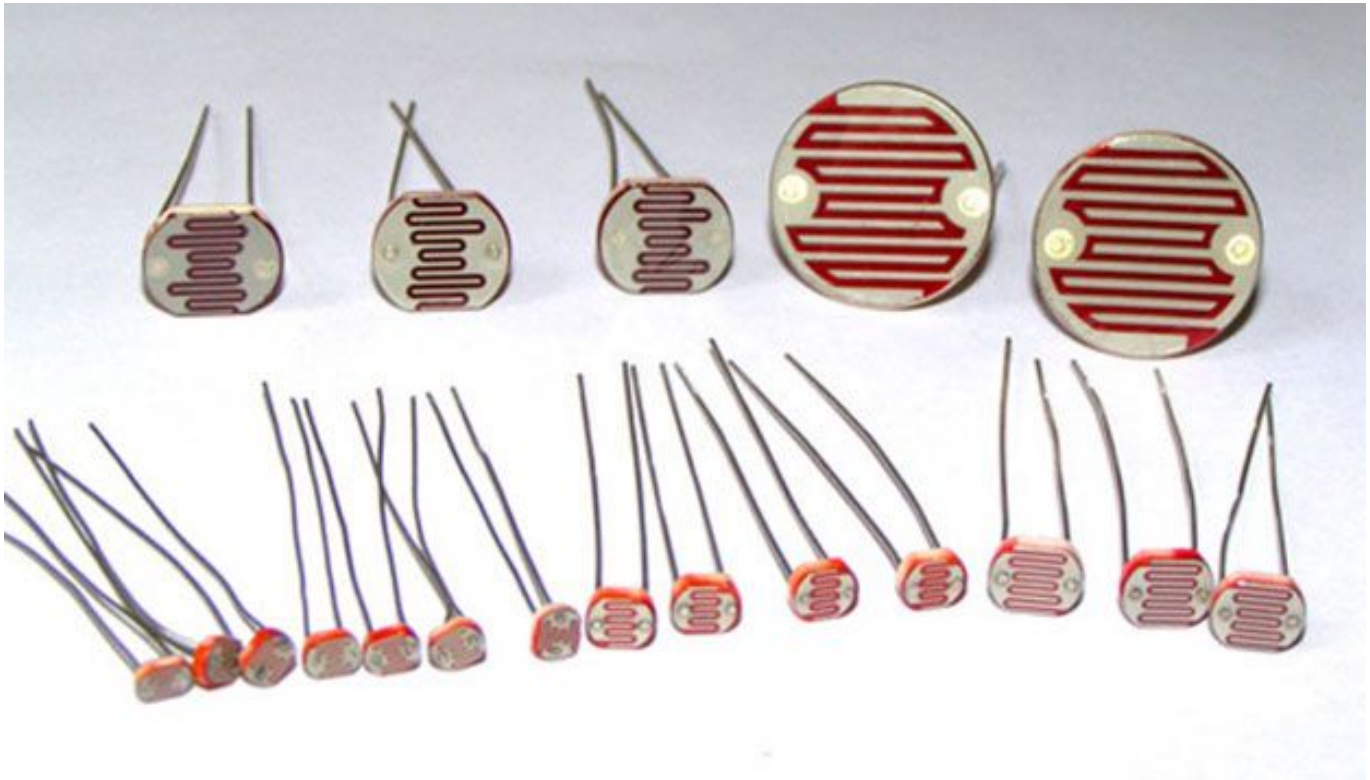
DC Motor

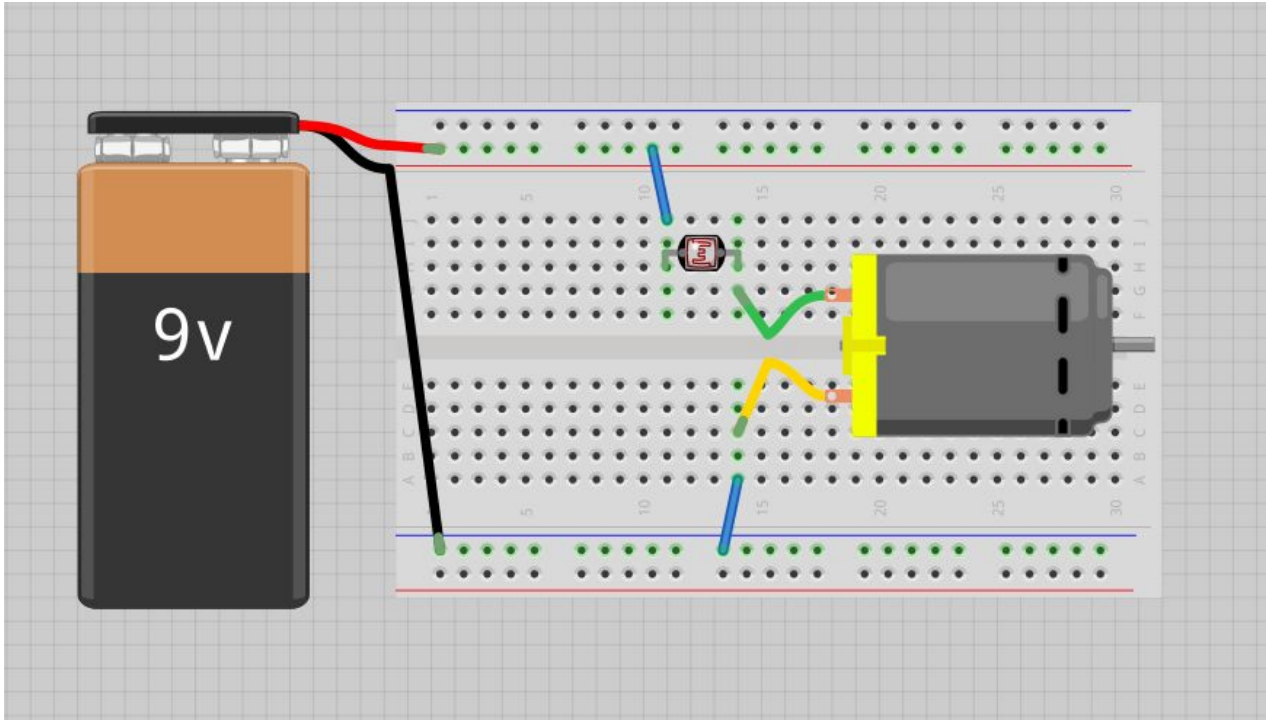


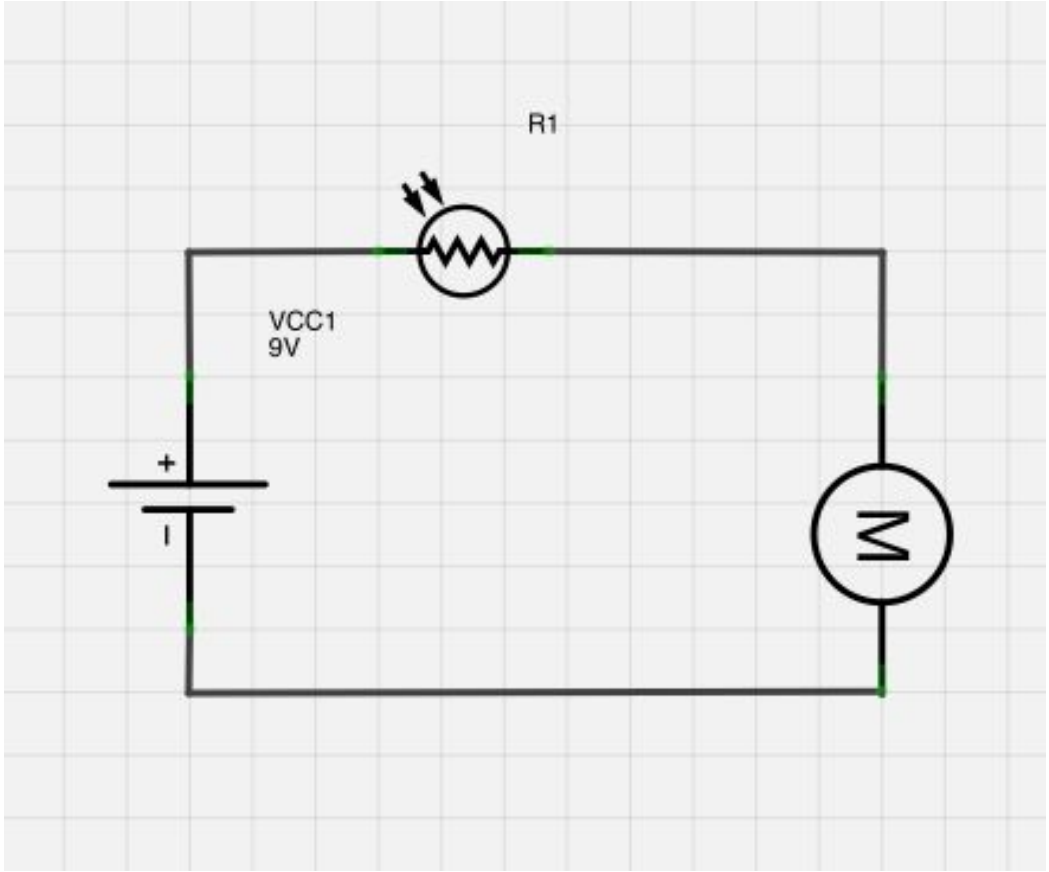
Try….

1. Add a switch
2. Try to change the speed with a variable resistor

Light **D**ependant **R**esistor (Photoresistor)




9v


R1
VCC1
9V
+
M

JIMBO. “What Is Electricity?” *Sparkfun*, Sparkfun, learn.sparkfun.com/tutorials/what-is-electricity.