ROBOTICS FROM SCRATCH

SI Prefixes

- These prefixes are used to represent a specific power of 10
  - milli (m): 1/1000th or 10^{-3}
  - micro (μ): 1/1,000,000th or 10^{-6}
  - nano (n): 1/1,000,000,000 or 10^{-9}
  - kilo (k): 1,000 or 10^{3}
  - mega (M): 1,000,000 or 10^{6}
  - giga (G): 1,000,000,000 or 10^{9}

SI Prefixes

- For example:
  - 0.025 L = 25m L
  - 20,000 m = 20 Km
  - 0.000005 s = 5 µs
  - 1,500,000g = 1.5 Mg

Electricity Basics

- Electricity is the movement of electrons in a conductor
- A conductor is a material which allows electricity to flow. An insulator is a material which does NOT allow it to flow.
- A circuit is a closed loop that allows electricity to flow
- If there is a break in the loop, electricity doesn’t flow. This is how a switch works.

Voltage (V)

- Voltage is the “force” behind the flow of electricity
- The higher the voltage, the higher the force
- Think of it like a pressure or height difference. It flows from higher to lower.
- Wall Outlets: 120VAC
- Car Battery: 12VDC
- AA Battery: 1.5VDC

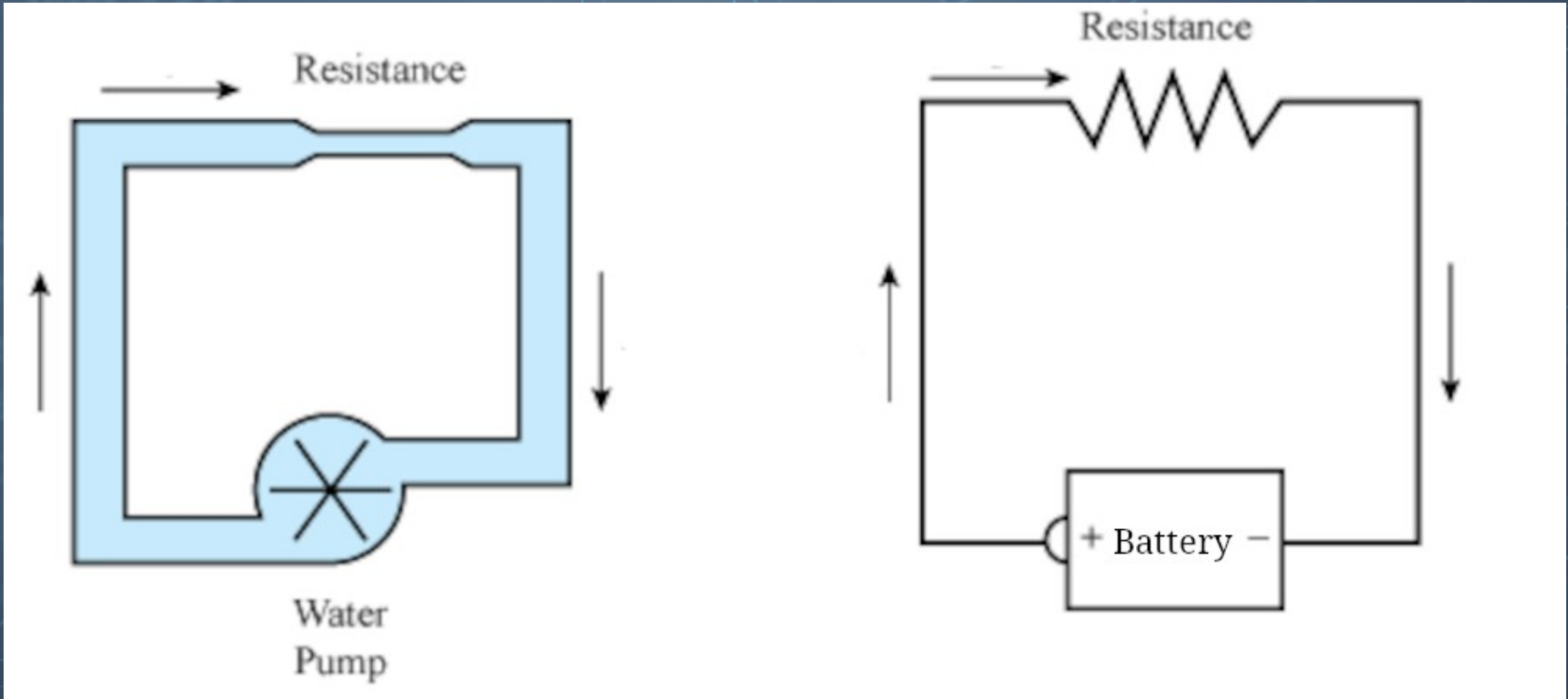
Current (I)

- Current is the amount of charge flowing through the wire
- Measured in Amperes or Amps for short
- Referred to as I in schematics

Resistance (Ω)

- A resistor is something in the circuit which resists the flow of current
- Resistance is measured in Ohms
- It is represented by the capital Greek letter Omega (Ω)
- Everything has some level of resistance, even plain wire

Water Flow Analogy



AC vs DC

- Alternating Current changes the direction of current flow, dependent on its frequency
- 120VAC from wall outlets has a frequency of 60Hz (Hertz), which means it changes direction 60 times per second

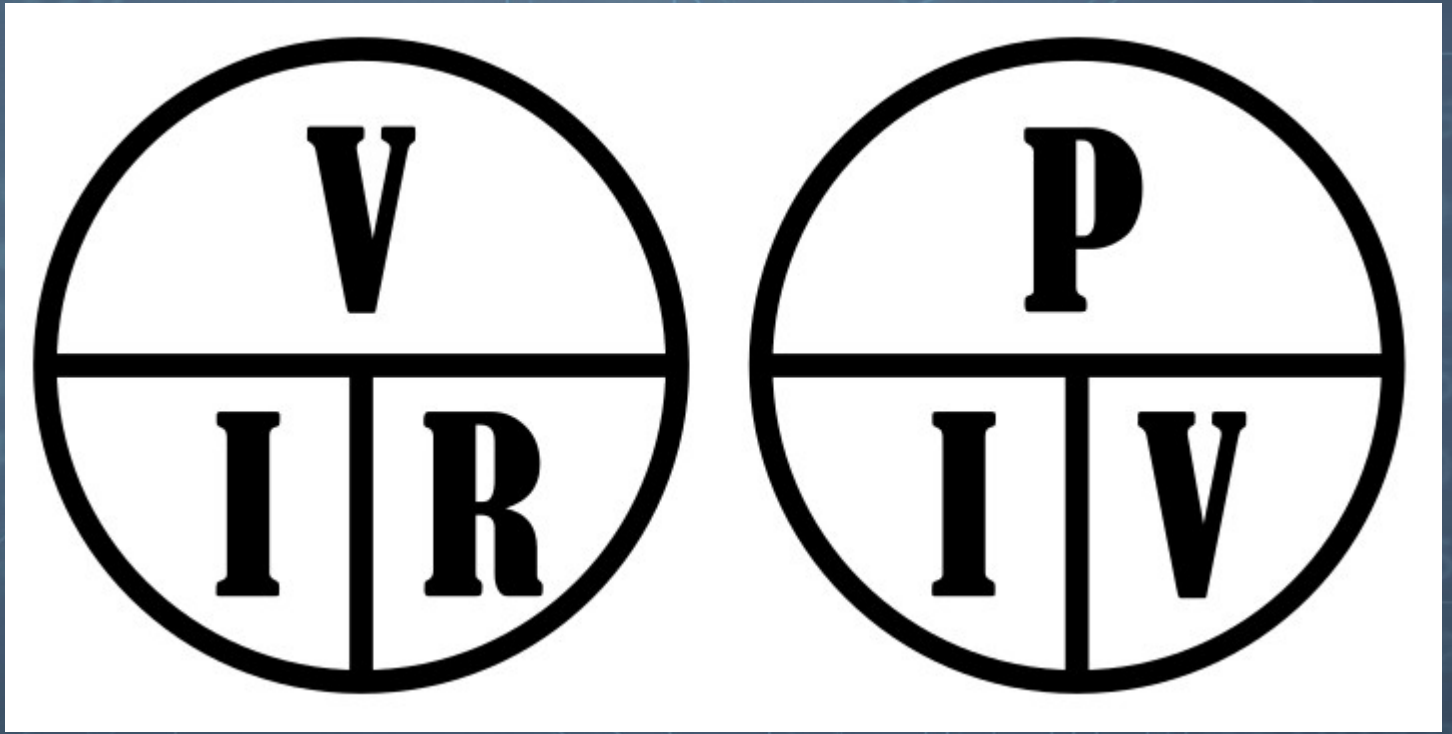
AC vs DC

- DC or Direct Current does not change direction
- This is what we will be using for the class
- In fact, almost all electronics take the AC from the wall and convert it to DC before use

Key Formulas

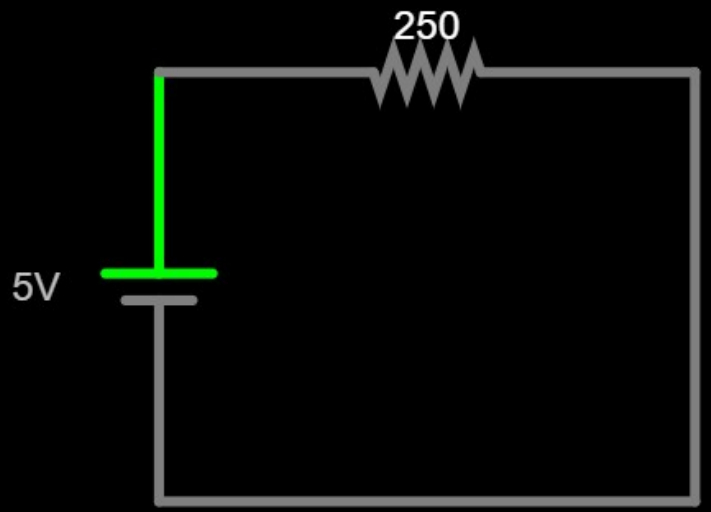
- Ohm's Law $V = I \cdot R$
  - Voltage (V) = Current (I) x Resistance (R)
  - If you have any two, you can find the third
- Watt's Law $P = I \cdot V$
  - Power (P) = Current (I) x Voltage (V)
  - Power is measured in watts

Key Formulas



Worked Example #1

V = 5V
R = 250Ω
I = ?A



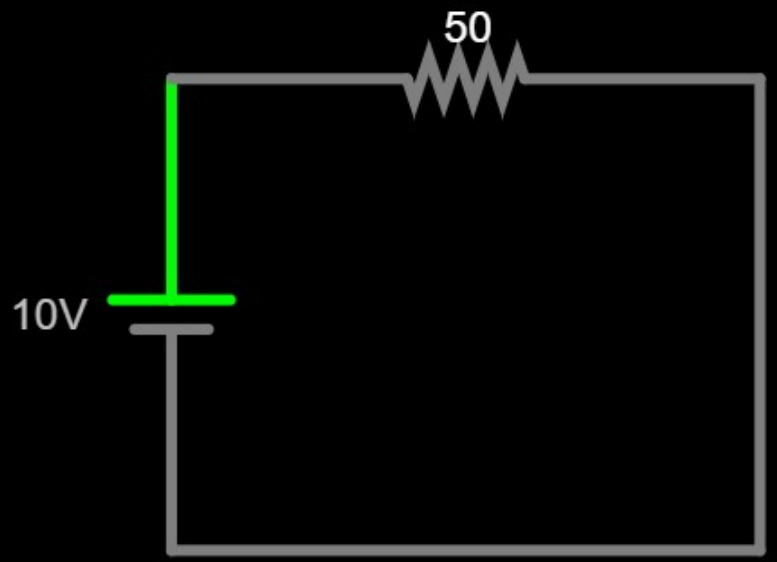
Worked Example #2

Worked Example #3

V = 10V P = ?W

R = 50Ω

I = ?A

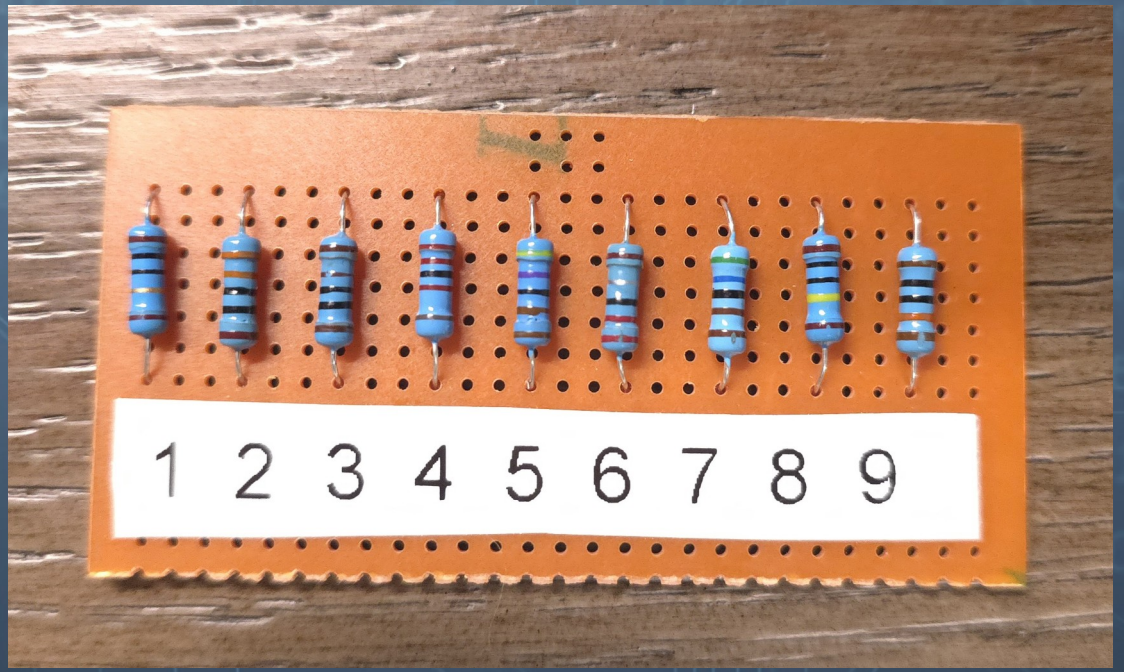


Taking Measurements

- We will often need to measure or confirm voltage, current, resistance, etc
- Most often we will use a multimeter

Multimeter Practice

- Pass the board around and use the multimeter to determine the resistance of each resistor



Multimeter Practice

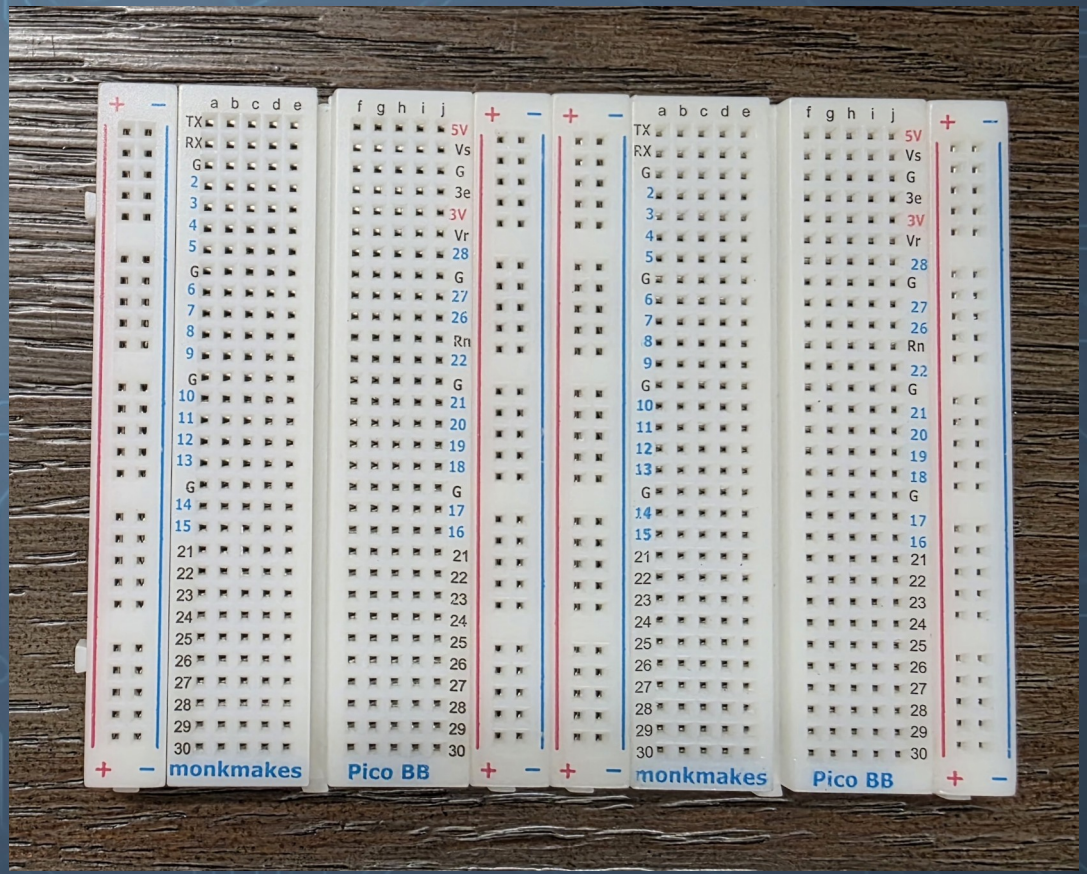
- Pass the board around and use the multimeter to determine the resistance of each resistor

1. 10
2. 330
3. 1K (1000)
4. 22K (22,000)
5. 4.7K (4,700)
6. 2.2
7. 5.6K (5,600)
8. 1M (1,000,000)
9. 100K (100,000)

Breadboards

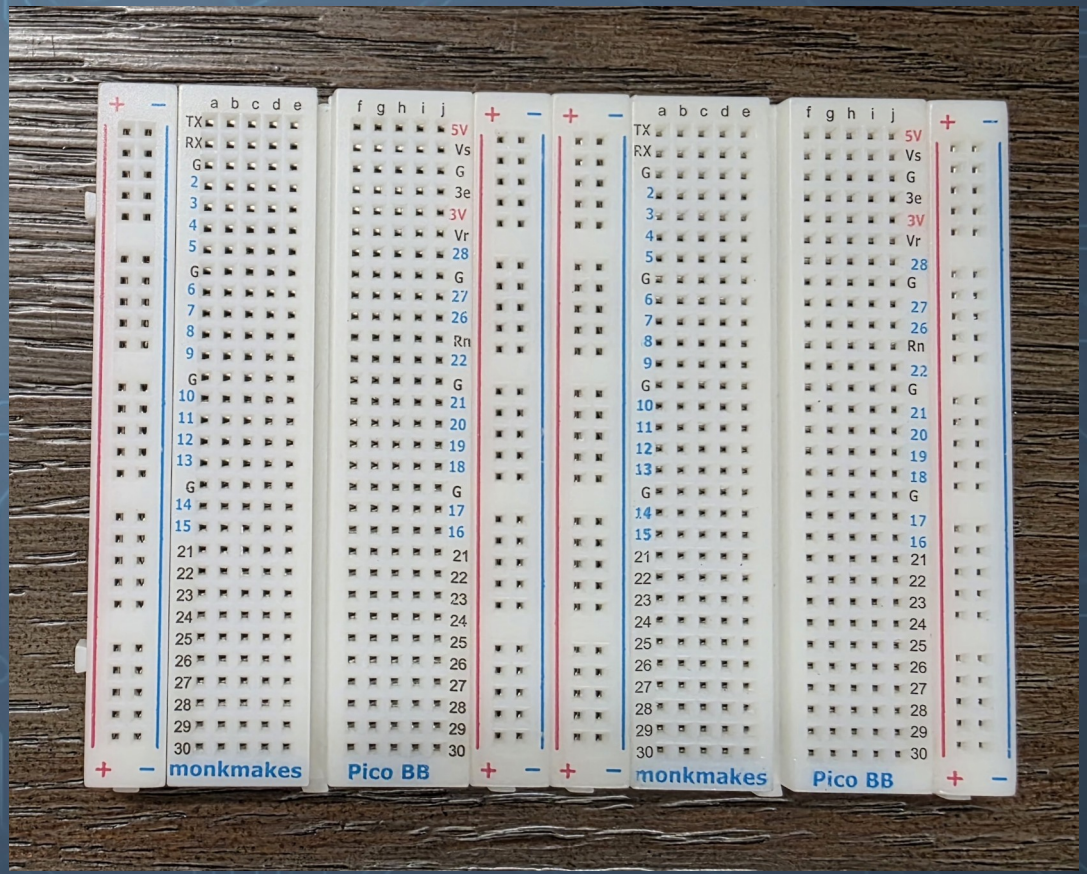
Breadboards are used for prototyping and testing.

They have holes on top for plugging in components and wires.



Breadboards

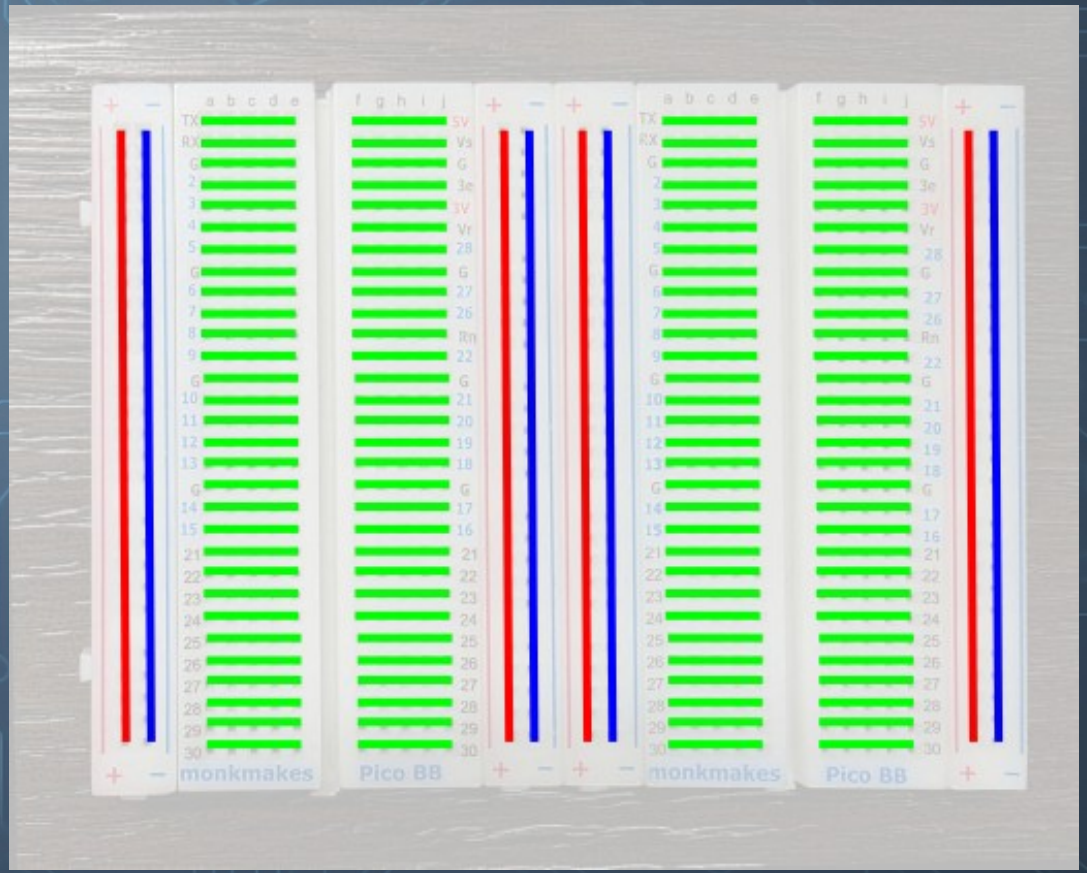
Each colored line on top represents holes which are connected together.



Breadboards

The red and blue lines are generally used for power (+) and ground (-).

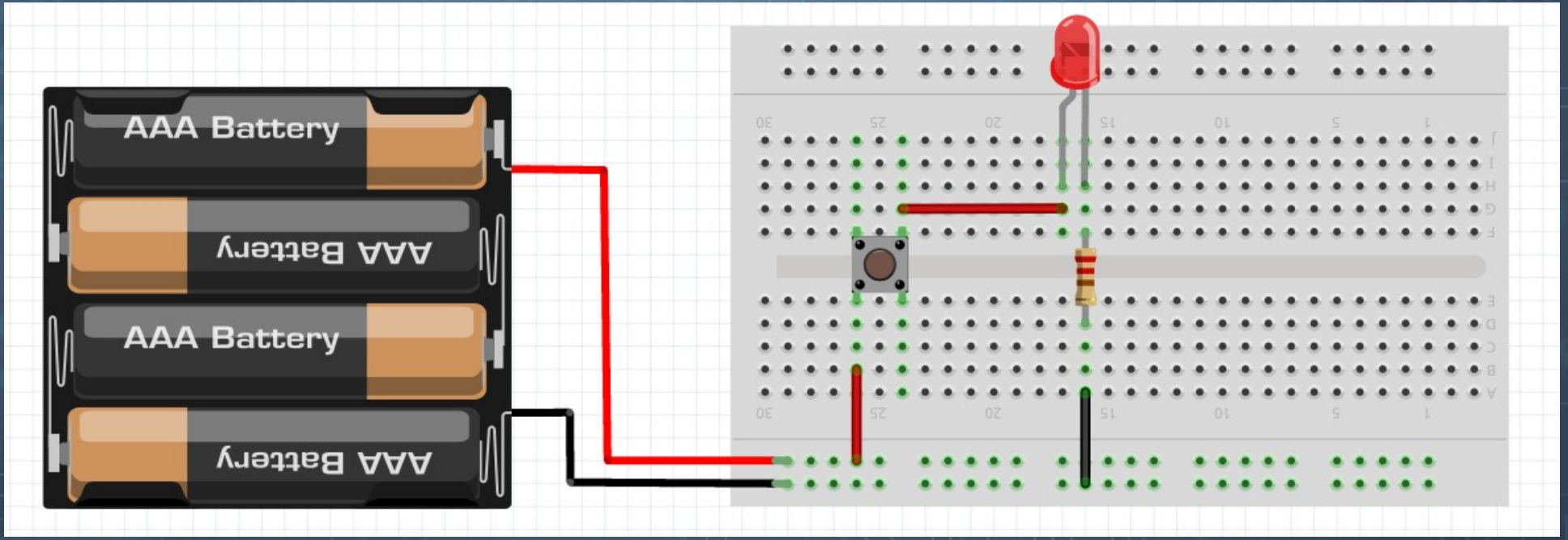
The green lines are general purpose lines for your use.



Breadboard Example

- You need:
- 1 breadboard
- 1 battery pack
- 1 resistor
- 1 LED
- 1 Switch

Breadboard Example



Schematic Example

- A schematic is a drawing that shows the electrical connections between components.
- It does not show the physical layout of the parts.

Schematic Example