ROBO DYNAMICS

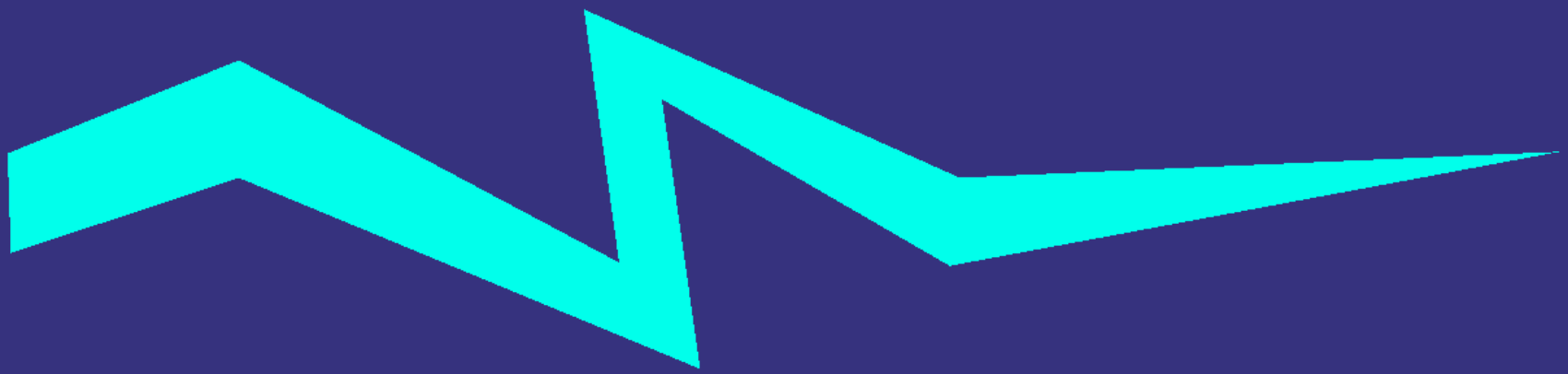
Build Your Own Robot

Day 3 : Basics of Electricity

Session Objective

- In this session, we are going to focus on Basics of Electricity

Electricity



Electricity

- Electricity is the flow of tiny particles called electrons through a material, like a wire
- Think of electrons like tiny little cars that can drive through a road made of wire.
- The flow of electrons is what we call an electric current.

Electricity

Here are some analogies to help you understand the basics of electricity:

Water flowing through a pipe

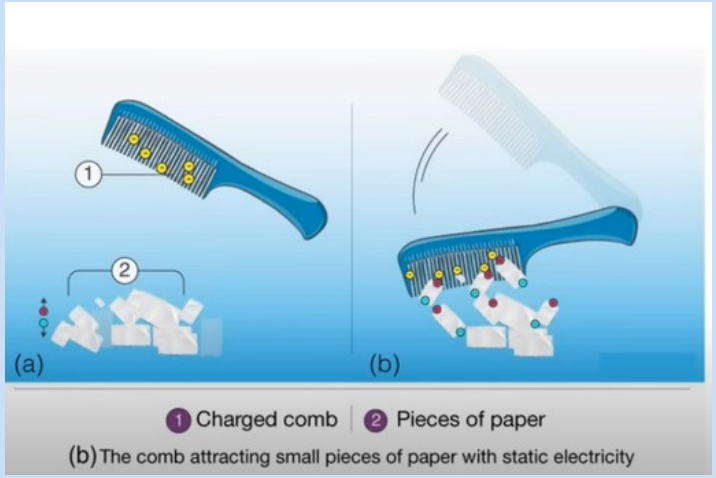
A River

Types of Electricity

- **Static Electricity :**
  - **When electricity gathers at one place, it is known as Static Electricity**
- **Current Electricity**
  - **Electricity which moves from one place to another, it is known as Current Electricity**

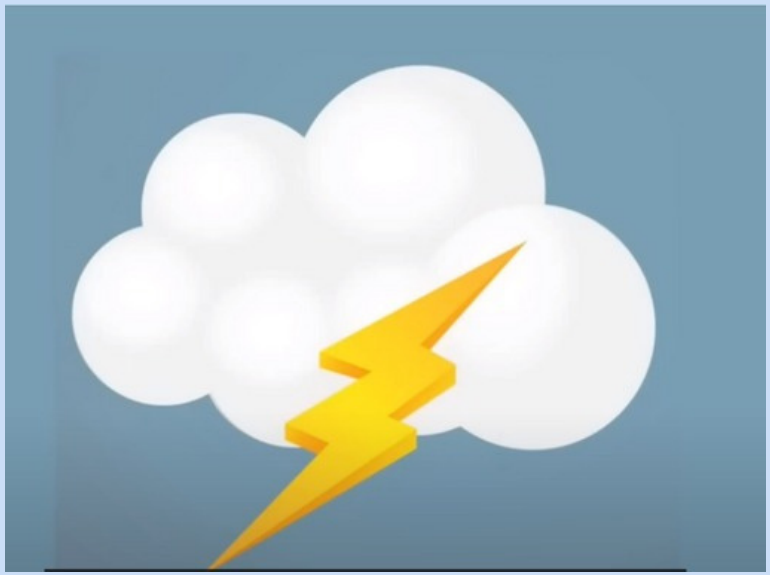
Static Electricity

- Have you felt a sudden painful jolt when you brush someone's arm
- Or crackling sound, when you take of your sweater
- have you tried to attract paper bits, while combing your hair



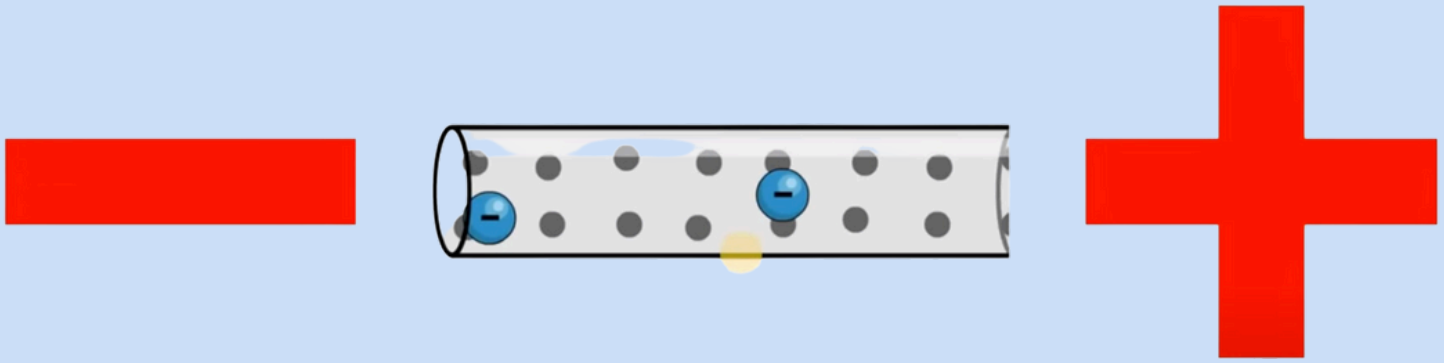
Static Electricity

- All this happens due to Static Electricity
- Even, the lightning happens due to static electricity



Current Electicity

- Form of electricity, which makes all our gadgets or house hold items work
- This form of electricity exists, when charges able to constantly flow
- Current electricity is dynamic, charges are always on the move



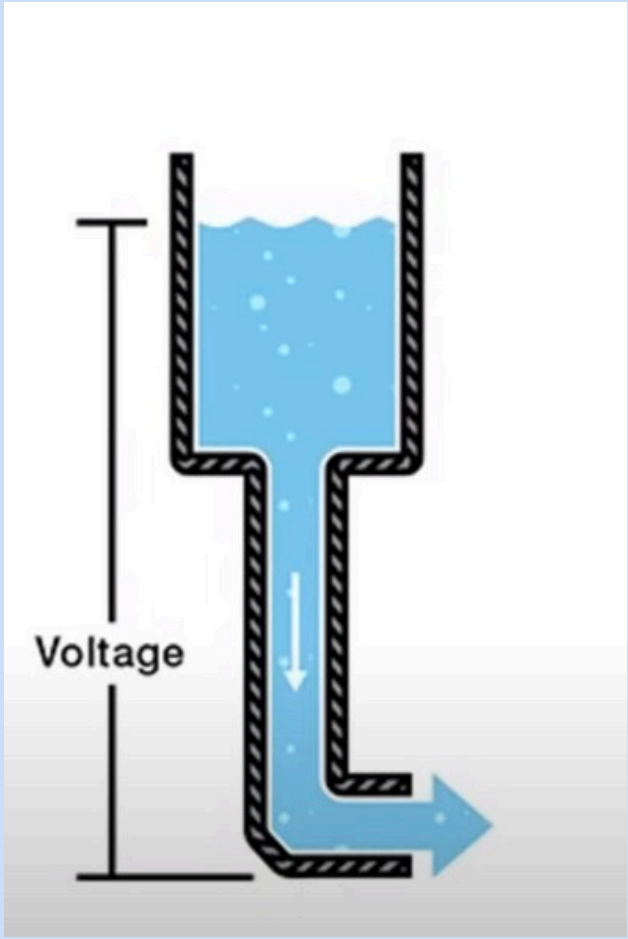
Flow of Electrons

Voltage

- A force that makes electrons move through a wire
- It is measured in volts and v is the symbol

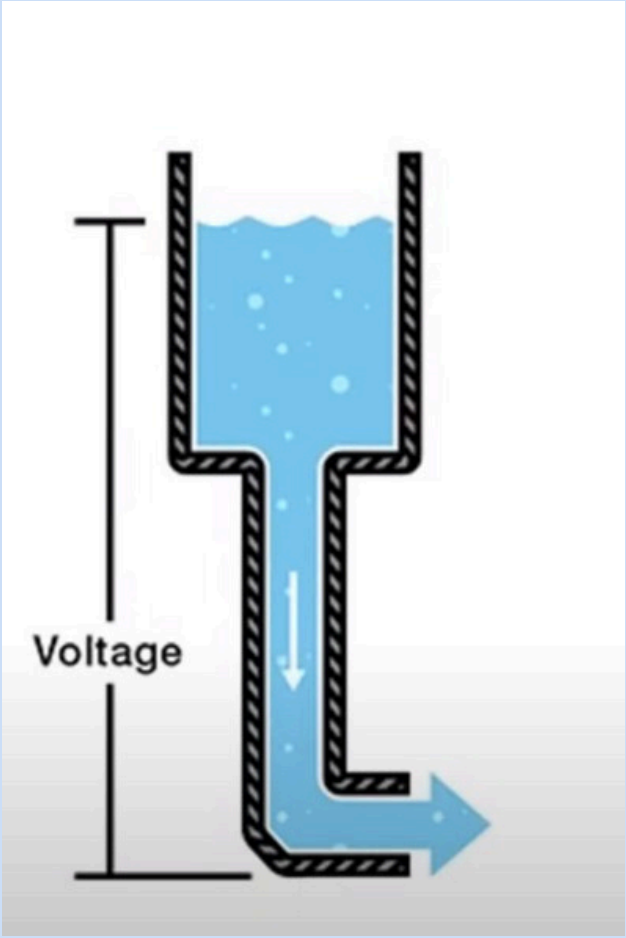
Voltage Water Analogy

- This is a water tank and the pressure at the end of the tank can be represented as a voltage
- Water in the tank represents charge
- More the water in the tank, higher is the charge and more is the pressure at the end of the hose



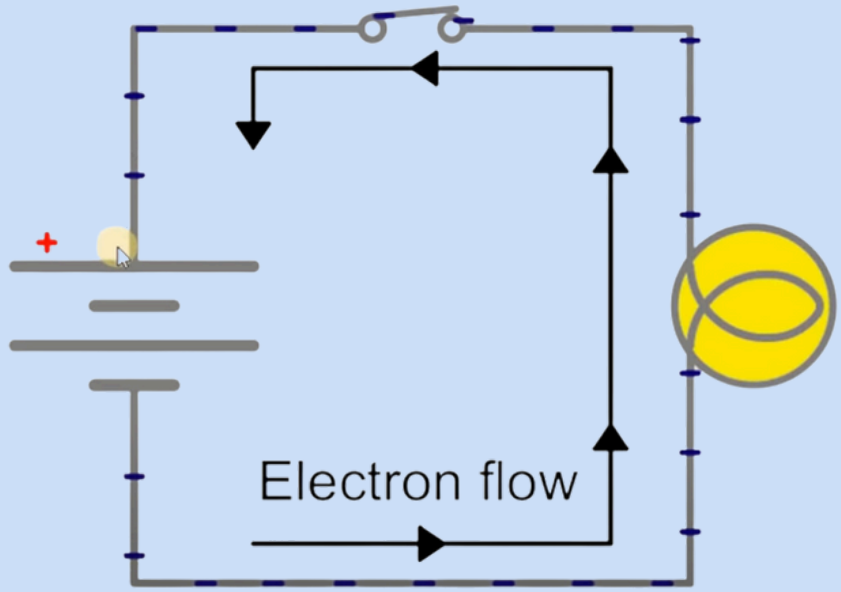
Water Analogy

- We can think the tank as the battery, where we can store certain amount of energy



Voltage

- Voltage is the difference between two points
- Let's say this battery is of 5 volts so the potential at the positive point can be of 5 points
- and at the negative point is 0 points

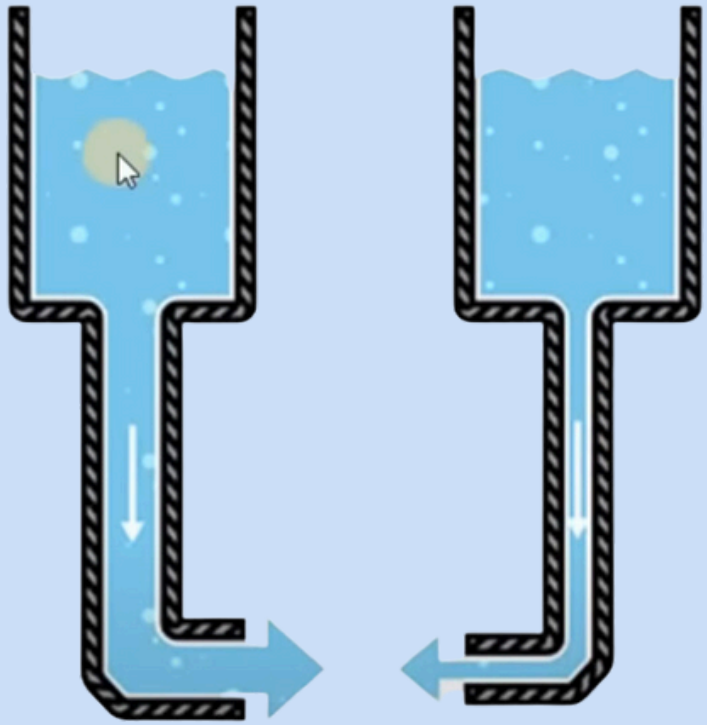


Current

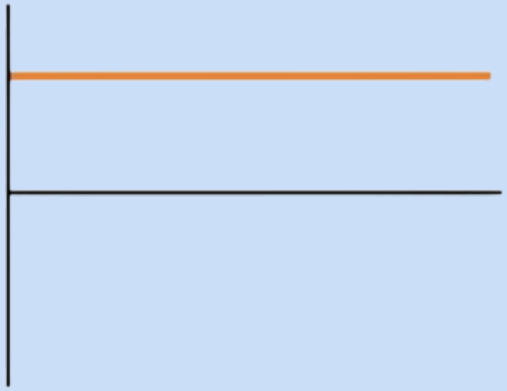
- Rate of flow of charge is known as current
- When electrons move from a negative terminal to a positive terminal of a battery, they give rise to a current
- The unit of current is Amperes (A)
- The direction in which the current is flowing is opposite to that of electrons

Current Water Analogy

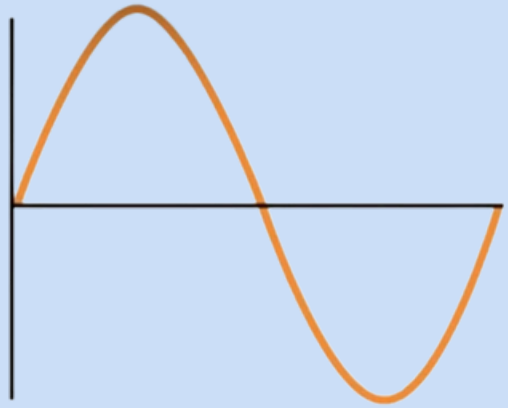
- Current Flows from higher potential to lower potential (High Pressure Area to lower pressure Area)



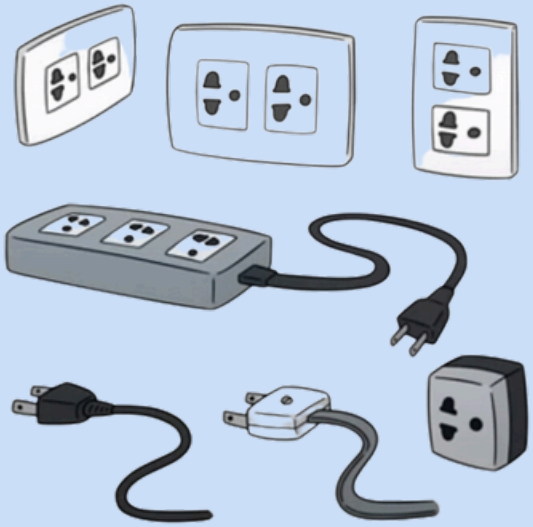
Two types of Current



Direct Current



Alternating Current

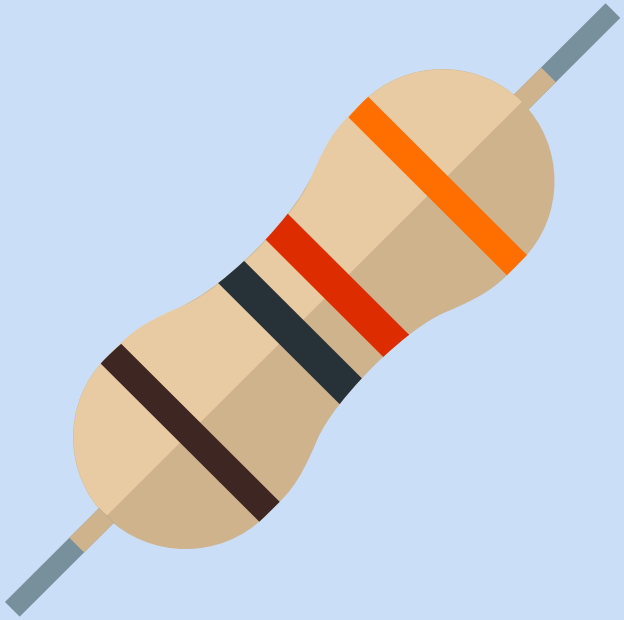


Two types of current

- The current which drives your fan , other appliances like AC, Television etc is know as AC Current
- and the current which you get from the battery, specific power supplies is DC Current
- The current which comes from the computer port of USB Port is also DC Current

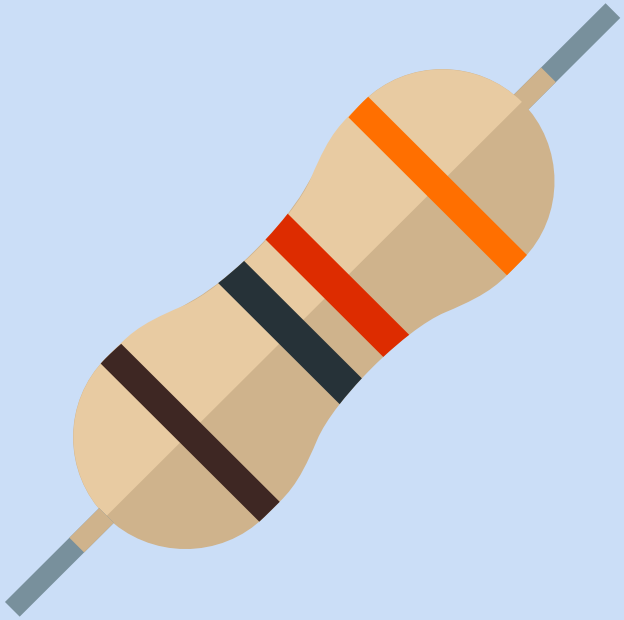
Resistance

- The electrical resistance of any component is a measure of difficulty of passing an electric current through that substrance
- With more resistance in a circuit, less electricity will flow through the circuit



Resistor

- Based on this concept, there is an electric component called as a Resistor
- A Resistor is a device, which limits the flow of current in a circuit
- We may need a resistor in a circuit, where we need to drive LEDs , that require limited amount of current, so that we can prevent it from burning



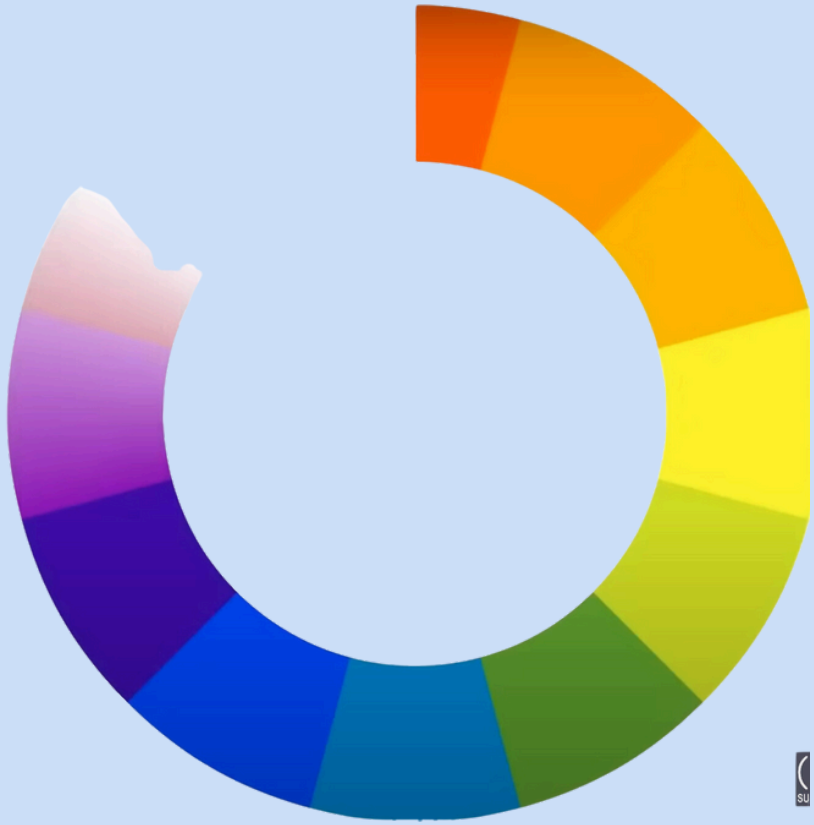
Resistor

- The resistor color code is a standardized system for indicating the resistance value of a resistor using color bands.
- The colors of the bands represent specific numbers and are read from left to right.
- The first two bands indicate the significant digits of the resistance value, while the third band indicates the multiplier (power of ten).
- The fourth band indicates the tolerance of the resistor, which is a measure of how closely the actual resistance value matches the stated value.

Resistor

Here are the colors and their corresponding numbers for the resistor color code:

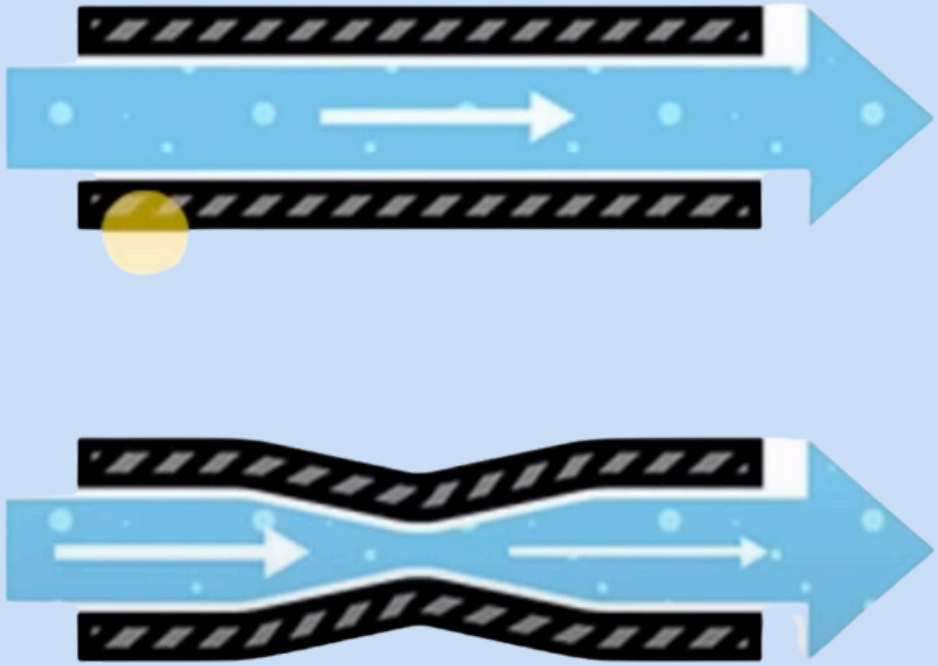
Black: 0
Brown: 1
Red: 2
Orange: 3
Yellow: 4
Green: 5
Blue: 6
Violet: 7
Gray: 8
White: 9



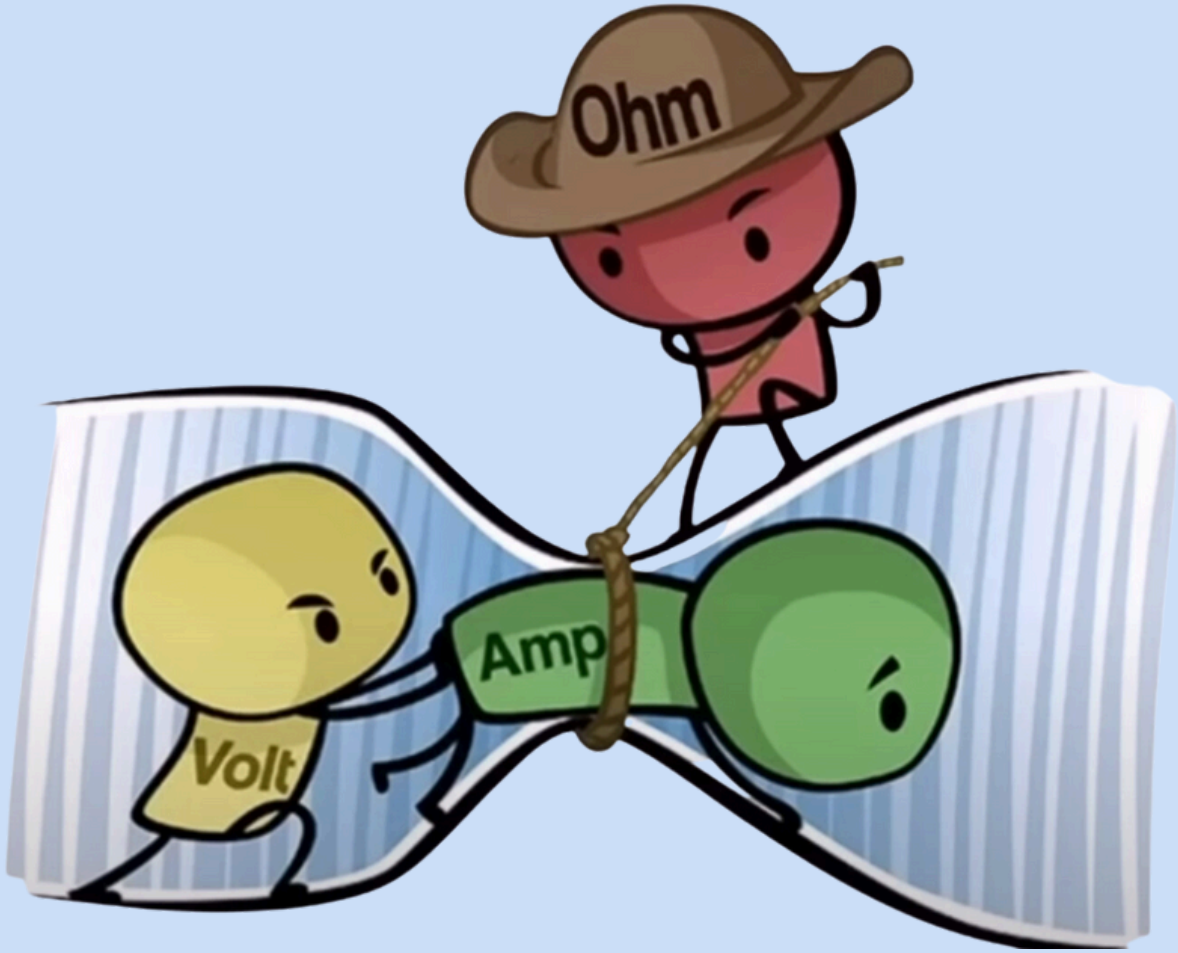
Resistor

- The color of the fourth band indicates the tolerance of the resistor, as follows:
- Gold: ±5%
- Silver: ±10%
- No band: ±20%
- For example, a resistor with brown, black, and orange bands has a resistance value of 10 x 10^3 ohms, or 10 kiloohms (10kΩ), with a tolerance of ±3%.

Resistance



Ohms Law



Ohms Law

Ohm's Law means that the current flowing through a circuit is determined by the voltage applied to it and the resistance of the circuit.
The higher the voltage, the more current will flow through the circuit, but the more resistance there is in the circuit, the less current will flow.

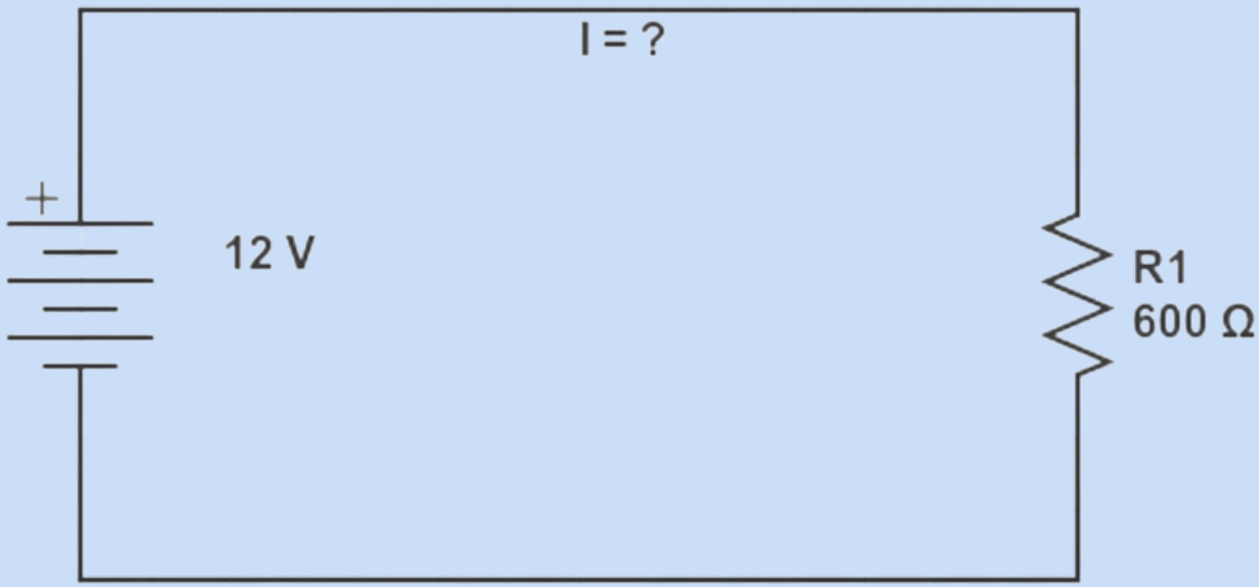
$V = I * R$

Ohms Law

Imagine a water pipe. The water flowing through the pipe is like the electrical current flowing through a circuit. The water pressure is like the voltage, and the diameter of the pipe is like the resistance. If you increase the pressure (voltage), more water will flow through the pipe (current). However, if you reduce the diameter of the pipe (increase the resistance), less water will flow through it.

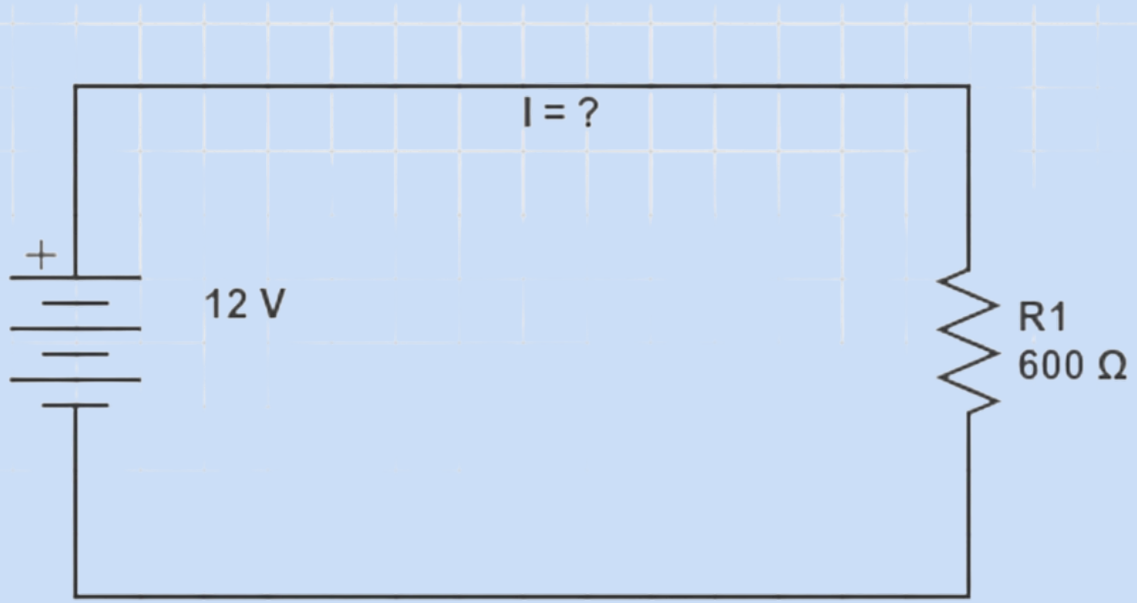
Ohms Law Example

- **How much current is flowing in the circuit?**

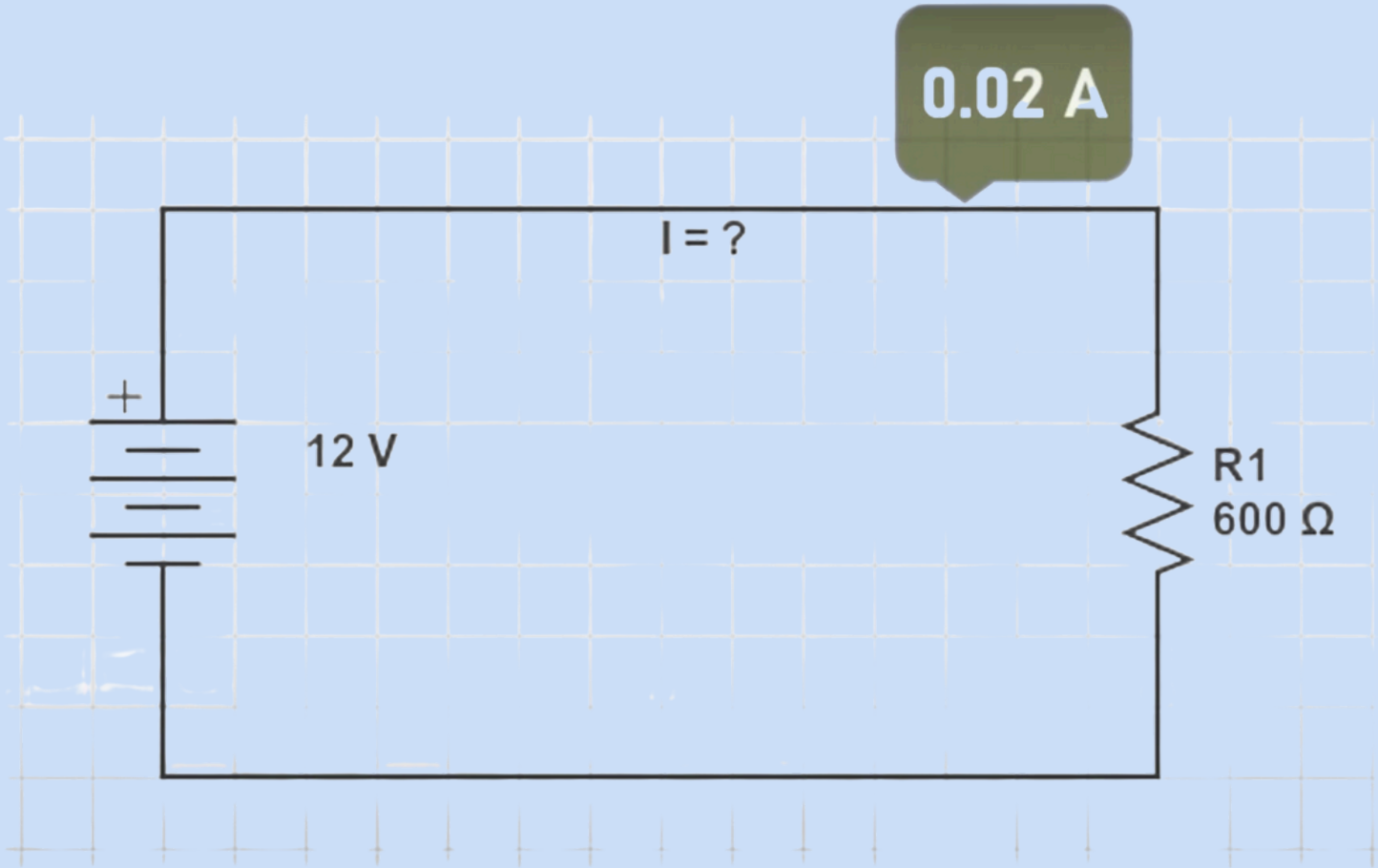


Ohms Law Example

12/600

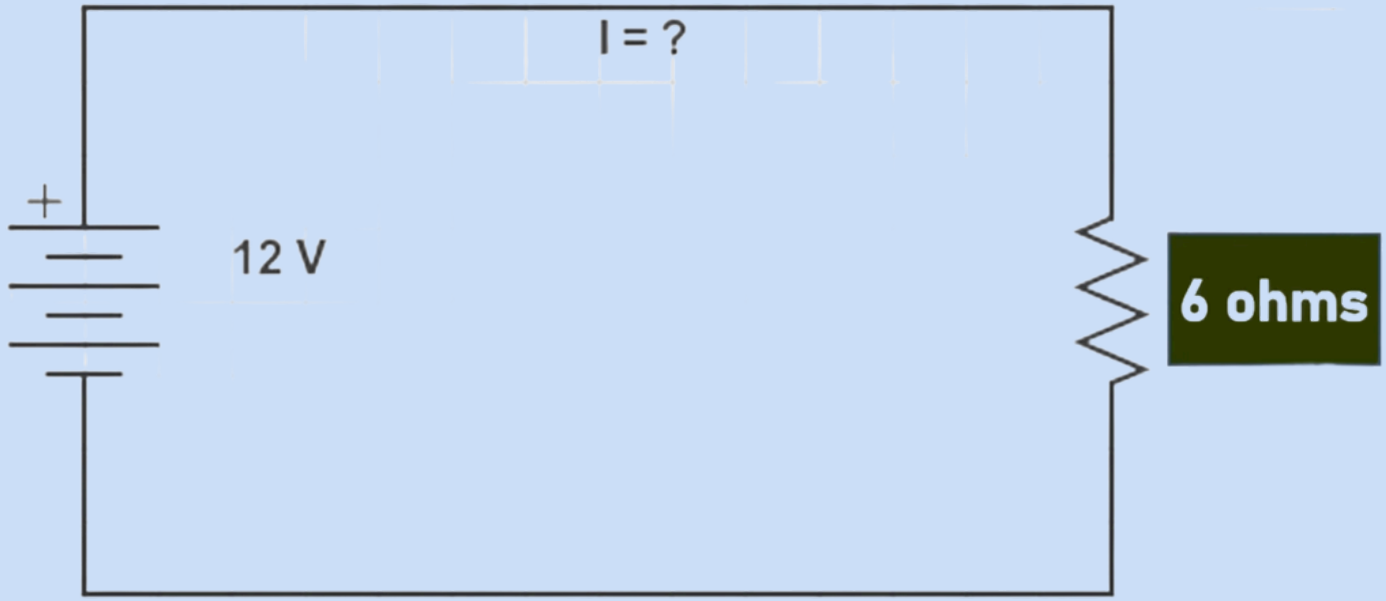


Ohms Law Example



Ohms Law Example

- If we change the value of resistance to 6 ohms, what is the current?



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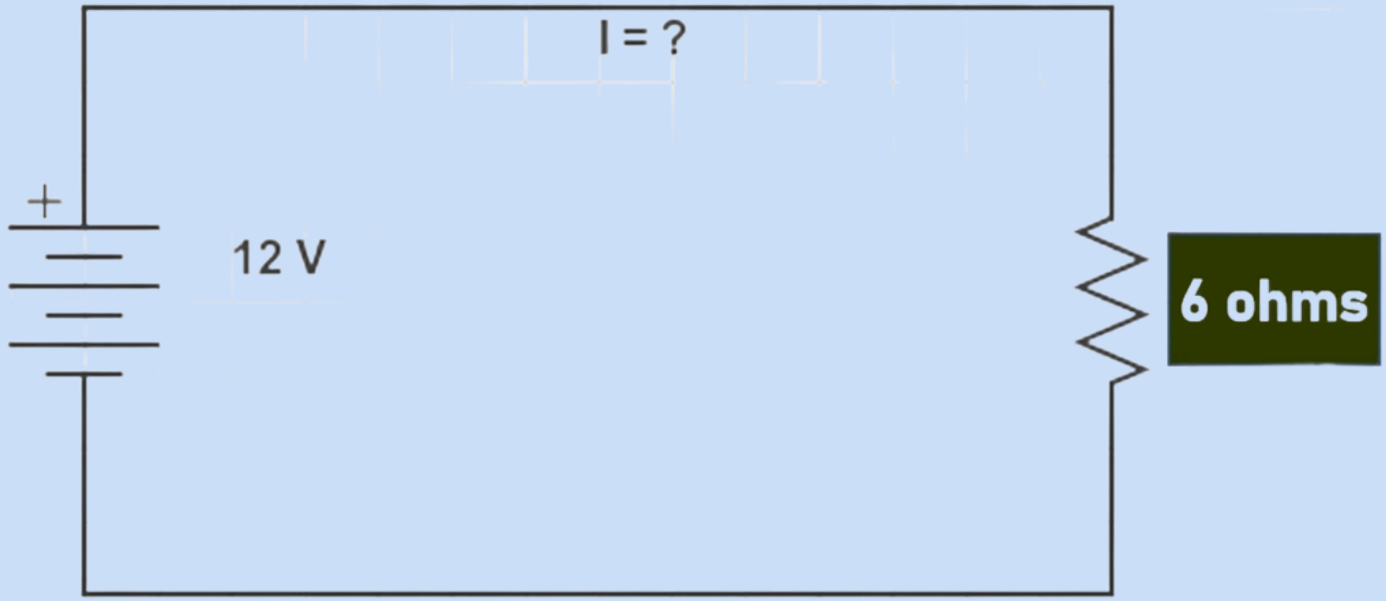
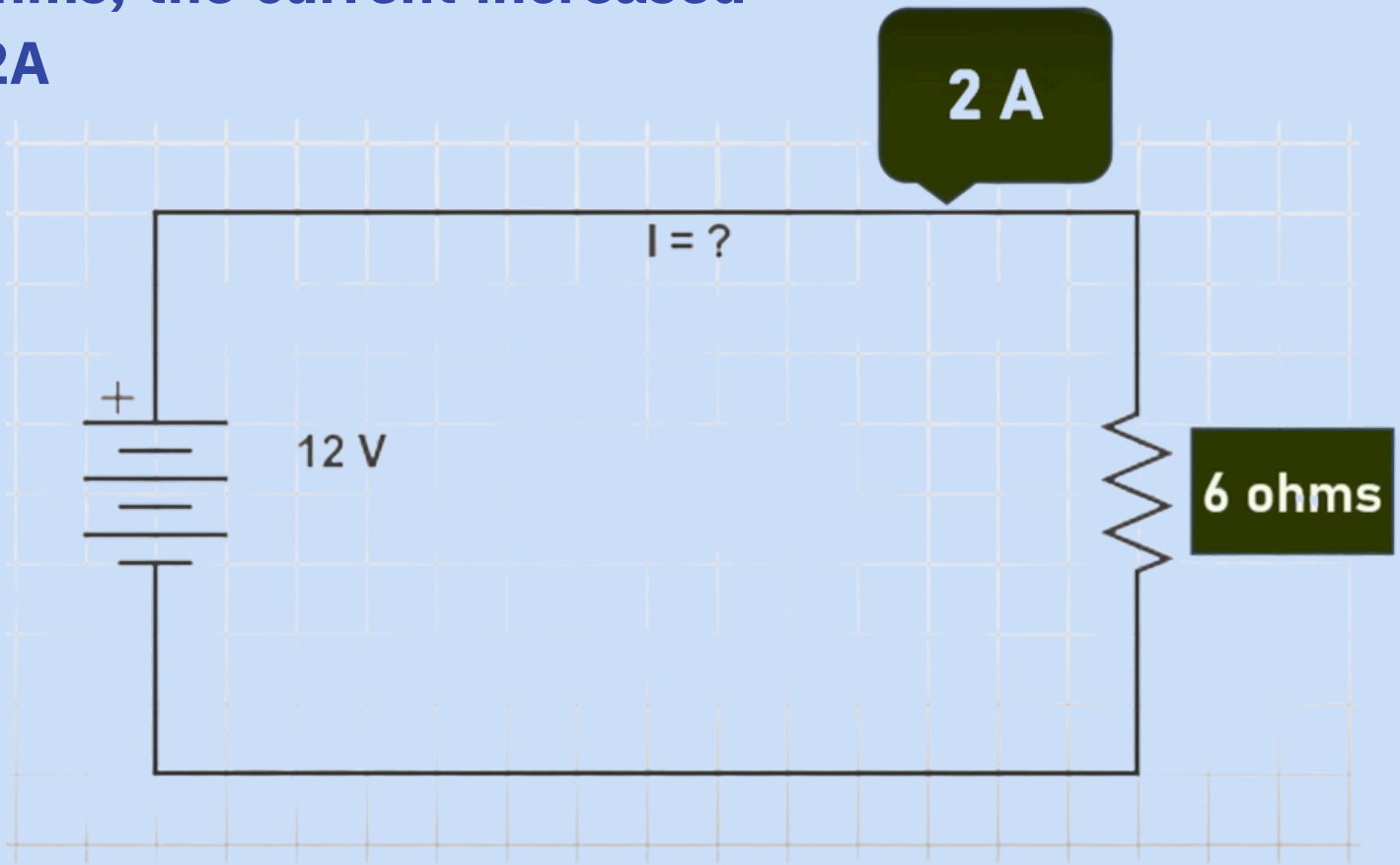


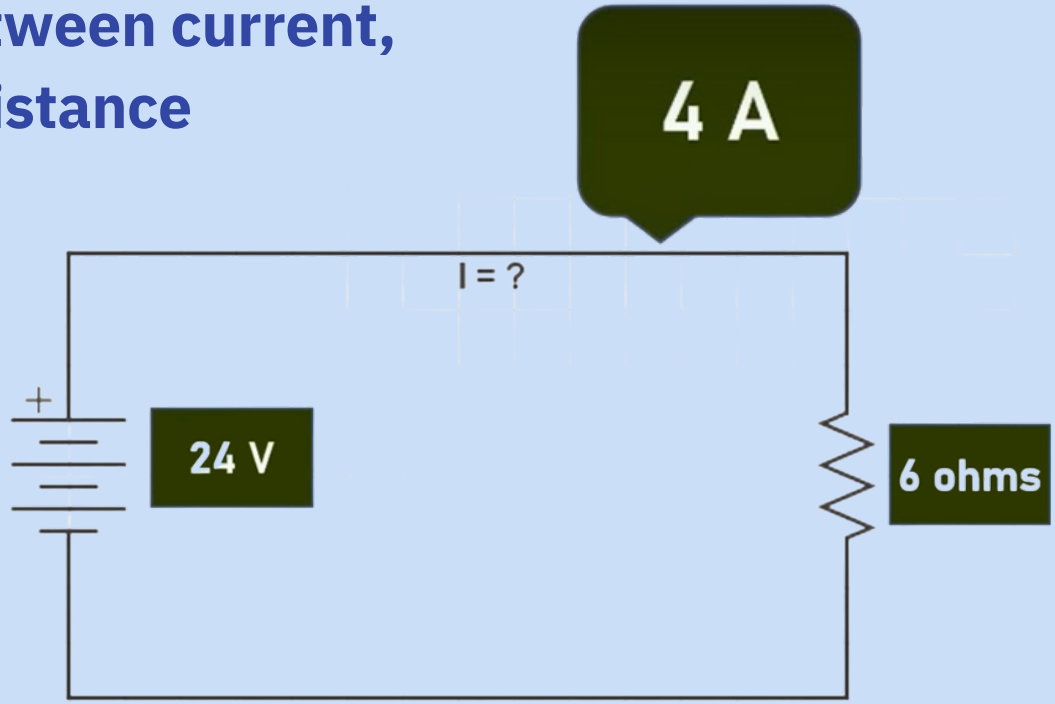
Ohms Law Example

- If we reduce the resistance to 6 ohms, the current increased to 2A



Ohms Law Example

- If we change the voltage to 24v, now the current flowing will be 4A
- Now you must be seeing the relationship between current, voltage and resistance



Ohms Law Example

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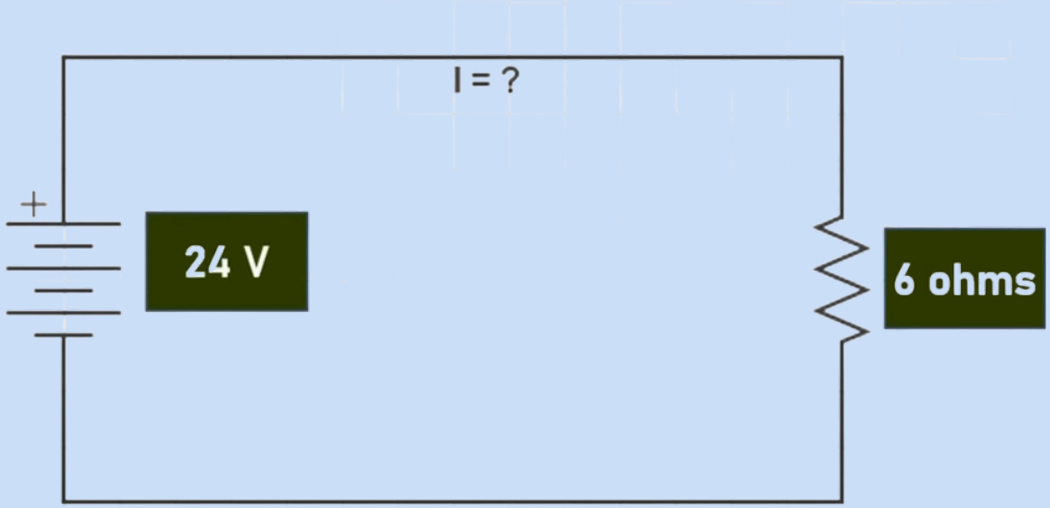
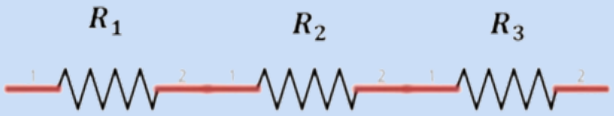


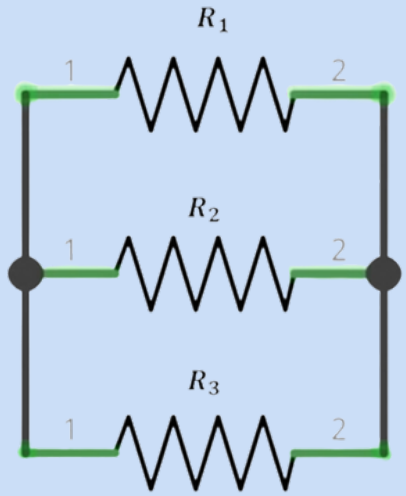
Series vs parallel circuit

- There are multiple ways we can use resistances
  - We can use them in series

and we can use them in parallel



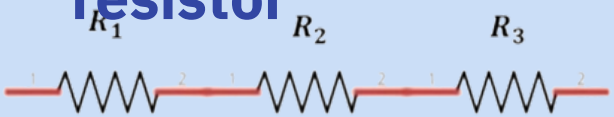
Series



Parallel

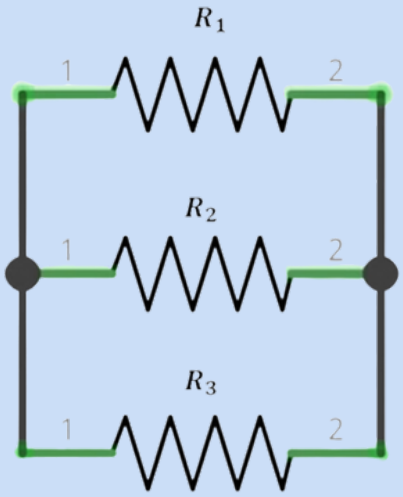
Series vs parallel circuit

- In the series circuit, the output current of the 1st resistor flows into the second resistor and the output current of 2nd resistor flows into the 3rd resistor, the current is same on each resistor



Series

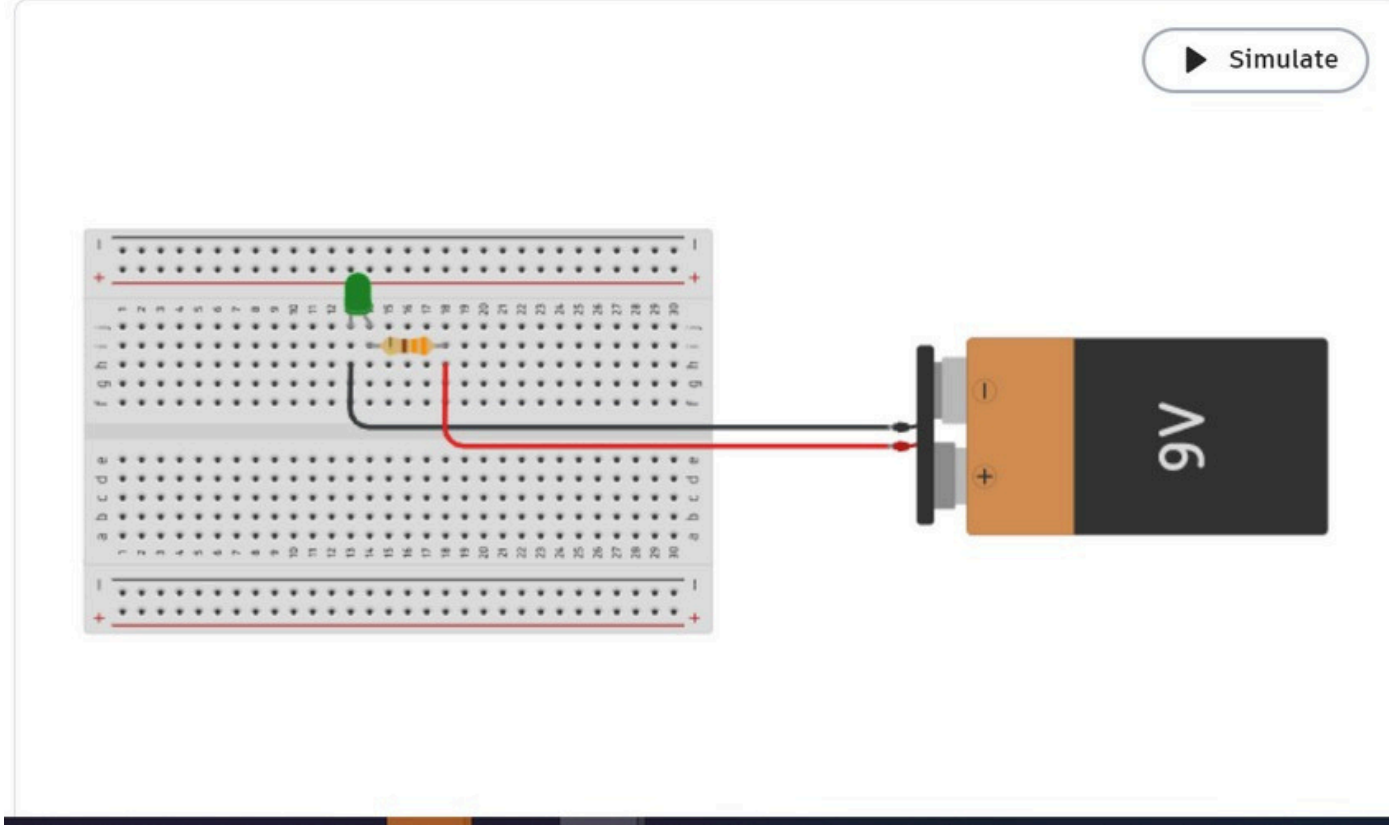
- While in parallel , all the resistors are connected to each other



Parallel

Activity 1

1. Basic LED



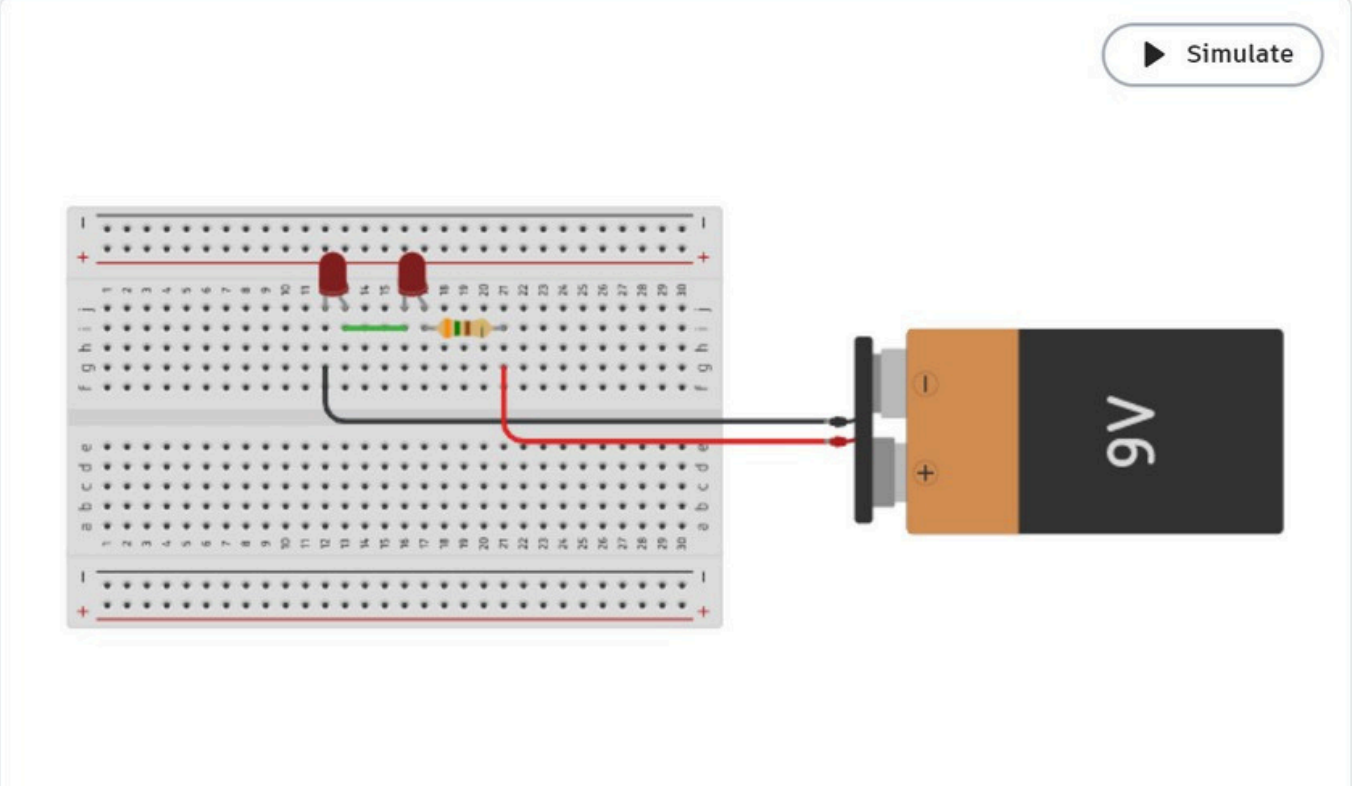
Activity 1

- **Hover over your LED, is it warning us?**
    - **The current in our circuit is clearly more than needed.**

    What do we do to reduce current?

Activity 2

LED's in Series

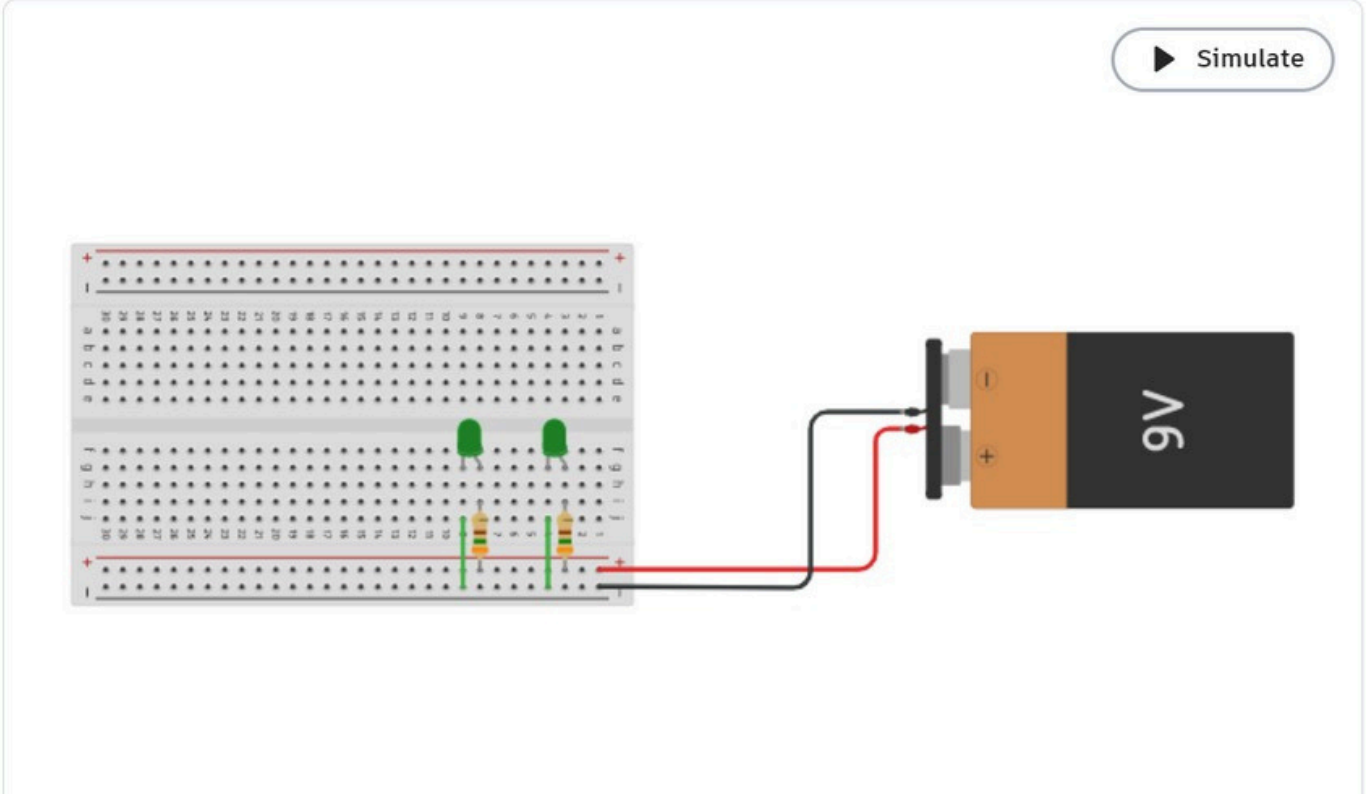


Activity 2

- Construct the same in your breadboard
  Try removing one of the led's
  What do you observe

Activity 3

Copy of LEDs in Parallel: Breadboard



Activity 3

- Construct the same in your breadboard
  Try removing one of the led's
  What do you observe?
    - How is it different from Activity 2?