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# Resistance and Ohm's Law

## Resistance

**Resistance** is a measure of the resistance to the flow of electrons in a completed circuit. In many cases, resistance is accompanied by energy being converted into a different type of energy, often giving off heat, light, or sound.

Examples of common resistors are light bulbs and other appliances, as well as devices actually called resistors, meant to oppose an electron flow for a purpose.

The **resistor devices** resist electron flow in three ways:

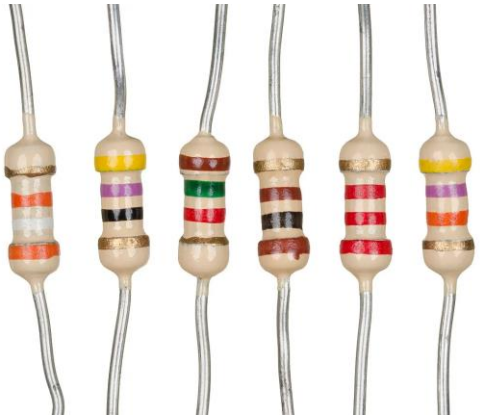
- by using a less conductive material (like glass or wood)
- by making the conductive material thinner
- by making the conductive material longer.

Resistor devices are colour coded with specific, known resistant amounts.

In the case of a lightbulbs which act like resistors, the filament in the light bulb is usually less conductive than the metal wiring that hooks it up. The light bulb's resistance is usually more varied, and less specific.

For instance, the resistance of the tungsten filament in a light bulb is more than 400 times greater than the resistance of copper connecting wires. When current moves through the high-resistance tungsten filament of the light bulb, the filament converts much of the energy carried by the current into light and heat. When the same current moves through the copper wire, the amount of energy converted into heat is much smaller.

**Light bulbs act as resistors**



**Resistor devices**

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The unit used for measuring resistance is the **ohm (Ω)**. An **ohmmeter** (or multimeter) can be used to measure resistance and is not required to be a part of the core circuit to function.

Resistor devices have the following symbol: 

## How is resistance related to voltage and current?

Voltage, current, and resistance are closely related.

- **Current** is the movement of electrons (charges) through a conductor.
- **Voltage** is what makes the electrons move through the conductor.
- **Resistance** works against and slows down the motion of the electrons.

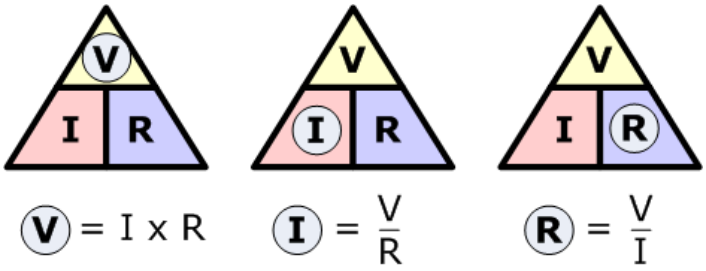
Good conductors have low resistance, which means that electrons flow through them easily. Poor conductors have high resistance, which means electrons are slowed down.

## Math Time! How does Ohm's law relate voltage, current, and resistance?

**Ohm's law** is the mathematical equation that relates voltage, current, and resistance.

$$\text{resistance} = \frac{\text{voltage}}{\text{current}} \text{ or } R = \frac{V}{I}$$

Once two pieces of information are known, you can find the third mathematically. You can use a triangle to find an equation for each unknown piece of information.




**Example 1:** If we know the voltage is 9 V, and the current is 3 A, we can find Resistance with R = 9V -÷ 3A = 3Ω.

**Example 2:** If we know the Resistance is 4Ω, and the current is 3 A, we can find Voltage with V = 4Ω -X 3A = 12V.