

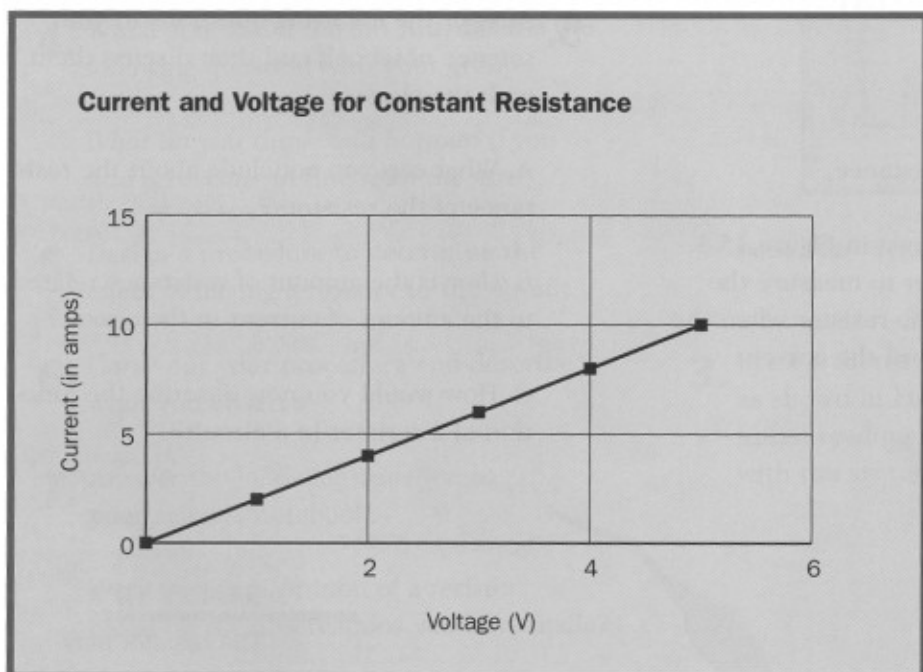
MEASURING RESISTANCE

You saw in Lesson 8 that if you increased the number of batteries in series in an electrical circuit, the current in the circuit increased. The current in the circuit was directly proportional to the number of batteries. What do you find if you measure the voltage across a device and the current through it?

In the 1820s, German scientist Georg Ohm investigated the relationship of voltage and current for conductors. To do that, he measured the voltage across a conducting material and the current through it at the same time. He found that as the voltage across the material increased, the current through it also increased. The graph below shows what Ohm found.

The graph shows a direct proportion between voltage and current. What that means is that when you increase the voltage across the circuit, the current in the circuit increases in the same way.

This relationship between voltage, current, and resistance is called Ohm's law. Ohm's law is one of the basic laws of electrical circuits. To honor Ohm's work, the unit of resistance is named the ohm. The symbol for the ohm is Ω .



What Ohm discovered about voltage and current

Ohm recognized that the relationship he observed in the graph could be described by an equation. Ohm's equation had voltage, current, and something Ohm called "resistance." Ohm was able to write his law as the following equation:

$$\text{Voltage} = \text{current} \times \text{resistance}$$

Ohm could measure voltage with a voltmeter and current with an ammeter. But he could not measure resistance directly. Ohm realized he could use his equation to calculate the resistance of conducting materials. He rearranged the equation:

$$\text{Resistance} = \frac{\text{Voltage}}{\text{Current}}$$

In other words, the resistance of a material is calculated by dividing the voltage across it by the current through it.

Like Ohm, you can measure the voltage with a voltmeter and the current with an ammeter. And, by making these two measurements, you can calculate the resistance of a material or device in an electrical circuit.

Here's an example of how to use Ohm's law to find the resistance of a lightbulb:

A lightbulb in an electrical circuit has a voltage of 3.0 volts across it and a current of 0.5 amperes through it. What is the resistance of the lightbulb?

$$\begin{aligned}\text{Resistance} &= \frac{\text{Voltage}}{\text{Current}} \\ &= \frac{3.0 \text{ V}}{0.5 \text{ A}} \\ &= 6.0 \Omega\end{aligned}$$

You can also use Ohm's law to predict the current through a device if you know the voltage across it and its resistance:

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$$

Electricians use this equation to provide just the right amount of current to electrical components in circuits.
