

Lesson Plan:

Ohm's Law

NATIONAL
ELECTRONICS
MUSEUM



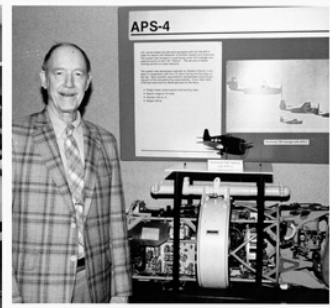
Grades 6th-8th

NGSS Standards:

MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces

Objectives:

- Students will understand the electrical quantities of and the relationship between current, voltage, and resistance in order to understand Ohm's Law.
- Calculate the electric current, voltage and resistance of basic electric circuits.





Lesson Introduction

Electrical circuits are everywhere in our lives, from very complex ones that control computers and smart phones, to the simpler circuits that allow you to switch a lightbulb on and off.

In order to understand how circuits work, we have to understand Ohm's law, which explains the relationships between the key concepts in a circuit.



Introduction to Ohm's Law Variables

German Scientist Georg Ohm studied the amount of current and voltage flowing through various conductors and discovered the mathematical relationship between them. His findings became known as Ohm's Law.

Ohm's law is a mathematical equation that describes the relationship between voltage, current, and resistance. This equation will help you understand how electric circuits work. To understand Ohm's law, you'll need to look further at the concepts of voltage, current, and resistance.

Voltage is the pressure from an electrical circuit's power source that pushes charged electrons (current) through a conducting loop. This enables the electrons to do work, such as illuminates a lightbulb. Voltage is measured in volts.

Electrical current is measured in amperes (A) or amps, for short, and it is the rate of flow of electrical charge past a given point in a circuit. In other words, it is the movement of electrons along a conductor.

The third concept in this equation is **resistance**, which is a measure of the opposition to current flow in a circuit. As electrons travel through a wire in a circuit, they encounter resistance. Resistance is measured in ohms, abbreviated by the Greek letter omega, Ω , named after Georg Ohm.

Ohm's Law Equation

The Ohm's law formula is $V=IR$. In this formula, V stands for voltage (in volts), I stands for current (in amperes), and R stands for resistance (in ohms).

The formula states that the voltage (V) of a circuit is equal to the current (I) multiplied by the resistance (R) of a circuit.

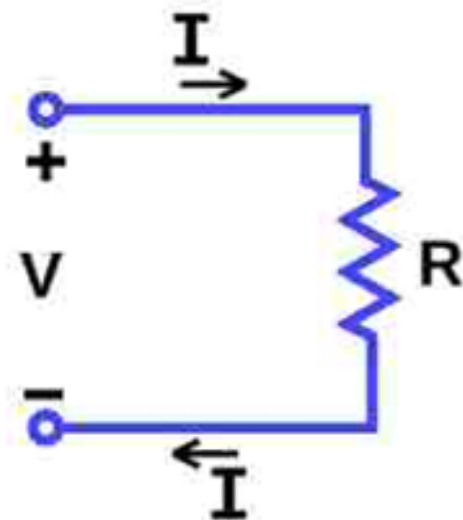
Therefore, Ohm's law states that for a given resistance, current is directly proportional to voltage.



Circuit Diagram

The diagram below is a diagram of a simple circuit, and it shows Current (I), Voltage (V) and Resistance (R). The blue line on the diagram below represents the wires of the circuit.

The battery supplies the voltage (V), the resistor and wires have resistance (R), and the current (I) flows through the circuit due to the voltage from the battery. Any one of the variables can be calculated using Ohm's law if you know the values of the other two.





An Analogy for Ohm's Law

You can use a water flow analogy to help you think about some of the key points of Ohm's Law. The voltage is the water pressure, the current is the amount of water flowing through the pipe, and the resistance is the size of the pipe. More water will flow through the pipe (current) if more pressure is applied (voltage) and the bigger the pipe is (the lower the resistance).

If resistance to water flow stays the same and pressure increases, the flow rate must also increase.

Pressure= same	Voltage=same
Flow rate= decrease	Current= decrease
Resistance= increase	Resistance=increase

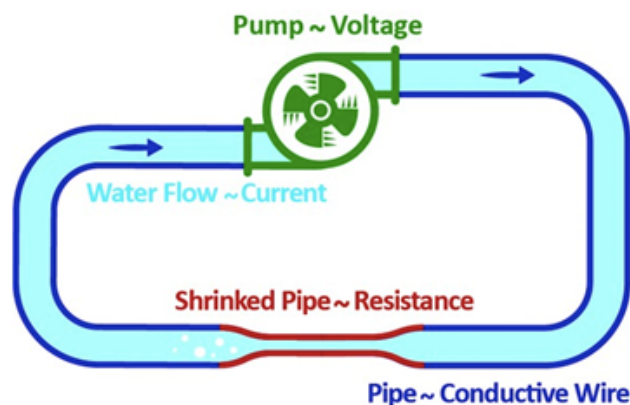


Image Source: <https://learn.thestempedia.com/courses/basics-of-electronics/lessons/introduction-to-the-world-of-electronics/topic/ohms-law/>

But if the pressure stays the same and resistance increases (making it more difficult for water to flow) the flow rate will decrease.

Pressure= same	Voltage=same
Flow rate= decrease	Current=decrease
Resistance= increase	Resistance=increase



An Analogy for Ohm's Law, continued

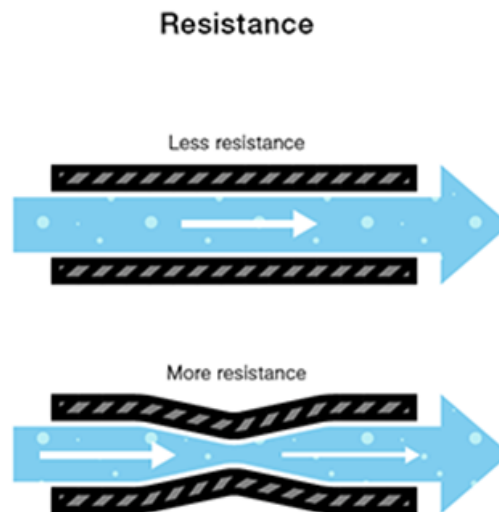


Image source: <https://learn.sparkfun.com/tutorials/voltage-current-resistance-and-ohms-law/resistance>

If the resistance increases, such as this example above, this means that less water will be able to flow through the pipes.

If we apply this to an electric circuit, we would say that if circuit with the higher resistance will allow less charge to flow, which means that circuit with the higher resistance has less electric current flowing through it.



Ohm's Law Triangle

If you know two of the three quantities, you can find out the third. The Ohm's Triangle is a visual representation of Ohm's Law.

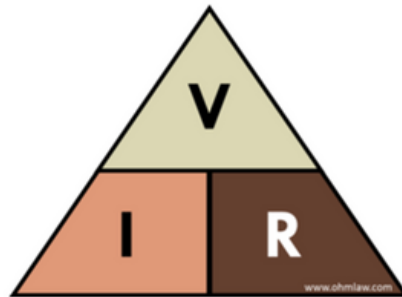


Image Source: <https://ohmlaw.com/ohms-law-triangle/>

From the above triangle you can obtain the following equations based on what you are trying to solve for:

Voltage = Current X Resistance

Current = Voltage/ Resistance

Resistance = Voltage/Current

Depending on which variable you are trying to solve for, you can manipulate the equation. Below is another visual of the equations depending what you are trying to solve for.

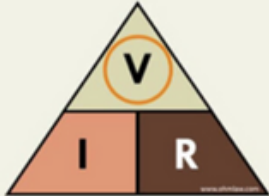
To Find Voltage	To find current	To find voltage
		
$V = IR$	$I = \frac{V}{R}$	$R = \frac{V}{I}$

Image Source: <https://ohmlaw.com/ohms-law-triangle/>



Ohm's Law Calculations

Use this method when you are trying to solve for one of the variables.

1. Write down the values.
2. Select the equation you need. Use the VIR triangle for help.
3. Plug the numbers into the equation to calculate the answer.

Example

If 3V is applied across a 6Ω resistor, what is the current?

- Values: $V=3V$, $I = ?$, $R= 6\Omega$
- Equation $I = V/R$
- Numbers: Current (I) = $3/6 = 0.5A$
 - The final answer is that $I= 0.5 A$



Quiz

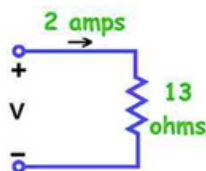
1. Which is the correct statement of Ohm's Law?

- a. $V=R/I$
- b. $I=R/V$
- c. $V=IR$
- d. $R=IV$

2. If the resistance of an electrical circuit is increased, what will happen to the current assuming the voltage remains the same?

- a. The current will not change
- b. The current will increase
- c. The voltage will increase
- d. The current will decrease

3. What is the voltage (V) in the circuit below?



4. A circuit has resistor with a resistance of $R=2\ \Omega$ and the voltage across the resistor is 6V, what is the current? Use the example above for help.

4) $I = 6/2 = 3A$

3) $V = I \times R = 2 \times 13 = 26\text{ volts}$

2) D.

1) C.

Answer Key:

Ohm's Law



[Click here](#) to watch our Voltage and Current demo video

Directions:

1. When the knob is turned clockwise, more voltage is applied to the circuit. What happens to the amount of current in the circuit?
2. Why does the lightbulb shine brighter as the knob is turned clockwise?
3. What would happen to voltage and current if a greater resistance was applied to this circuit?

Answer Key:
1) There is more current in the circuit
2) More current is flowing through the circuit, lighting the bulb
3) Current will decrease and voltage will stay the same)



Glossary

Circuit: The complete path through which electric current can flow.

Current (I): The movement of electrons along a conductor. Current is measured in amperes.

Ohm's law: Defined as the equation, $V=IR$, where V is voltage in volts, I is current in amperes, and R is resistance in ohms.

Resistance: The property of a conductor to oppose the flow of an electric current. Measured in ohms (W).

Resistor: The part of an electrical circuit that resists or limits the power of an electrical current in a circuit.

Voltage: The pressure from an electrical circuit's power source that pushes charged electrons (current) through a conducting loop.