

# Ohm's Law

Automotive Service Technician, Electrician, HVAC Technician

## Grades

- Grade 9

## Learning objective

Apply Ohm's Law to calculate voltage, current, and resistance in electrical circuits using multimeters

## Concepts

- Ohm's Law
- Calculating voltage, current, and resistance
- Difference between calculated and actual readings
- Practical application using digital clamp meters or multimeters

## Description and Trades Connection

In this lesson, students will learn and apply Ohm's Law to calculate voltage, current, and resistance in electrical circuits. They will use digital clamp meters or multimeters to measure these quantities and practice solving for the third variable using the observed values. Through hands-on activities and discussions, students will understand the differences between calculated and actual readings and the factors that can cause discrepancies.

Understanding and applying Ohm's Law is essential for trades such as electricians, automotive service technicians, heating, ventilation and air conditioning (HVAC) technicians, and industrial maintenance technicians. These professionals use Ohm's Law to calculate and verify voltage, current, and resistance in electrical circuits, which is crucial for diagnosing and repairing electrical issues. By mastering Ohm's Law, students gain practical skills that are directly applicable to real-world tasks, such as troubleshooting faulty components and ensuring the safe and efficient operation of electrical systems.

## Contributors:

**Eric Mitchell, Warren Anderson, Joel Stretch, Dave Cole**



Scan to access video demonstrations, activities, classroom resources and more at [learninginnovation.ca/k-12STEM](https://learninginnovation.ca/k-12STEM)

## QUESTIONS?

403.320.3202 • [STEM@lethpolytech.ca](mailto:STEM@lethpolytech.ca)  
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## Curriculum connections

### Science 9, Unit D: Electrical Principles and Technologies

Outcome 2: Describe technologies for transfer and control of electrical energy

- use switches and resistors to control electrical flow, and predict the effects of these and other devices in given applications
- describe, using models, the nature of electrical current; and explain the relationship among current, resistance and voltage
- measure voltages and amperages in circuits – apply Ohm's law to calculate resistance, voltage and current in simple circuits
- investigate toys, models and household appliances; and draw circuit diagrams to show the flow of electricity through them

### Math 9, Patterns and Relations

Outcome 3: Model and solve problems, using linear equations of the form  $ax = b$ .

# Ohm's Law

## Procedure

### Preparation

Review Ohm's Law as needed. Helpful video:

- [Ohm's Law](#) (SparkFun Electronics, 2016)

Review how to use the automotive window motor box, the digital clamp meter or multimeter, as well as concepts of current, voltage, and resistance as needed.

Helpful videos:

- [Window motor box overview](#) [4:10] (Lethbridge Polytechnic, 2023)
- [How to use a digital clamp meter or multimeter \(video\)](#) [12:29] (Lethbridge Polytechnic, 2025)

Feel free to show these videos to students as well (and revisit as needed).

### Time

30 minutes

### Materials

- Calculators
- Digital clamp meter (*included in kit*) or multimeter
- Automotive window motor box (*included in kit*)
- 120v Power Cord (*included in kit*)
- A fused 12v battery pack (*included in kit*)

### Lesson Activities (30 minutes total)

#### Introduction (5 minutes):

- Begin by asking students if they remember the key terms: current (amperage), voltage and resistance.
- Introduce today's focus: understanding and applying Ohm's Law to calculate these quantities in electrical circuits.
- Discuss this lesson's trades connection (included in the preamble to this lesson guide).

#### Explanation of Ohm's Law (5 minutes):

- Explain Ohm's Law: ( $R = V / I$ ) (Resistance = Voltage / Current). Ohm's Law states that the current (I) through a conductor between two points is directly proportional to the voltage (V) across the two points and inversely proportional to the resistance, expressed ( $R = V / I$ ). Show this video:
  - [Ohm's Law - YouTube](#)
- Discuss how this fundamental law relates voltage, current, and resistance in a circuit.
- Provide examples of how knowing any two of these quantities allows you to calculate the third.

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## Procedure

### Lesson Activities (continued)

#### Demonstration of Ohm's Law (5 minutes):

- Use the automotive window motor box to demonstrate Ohm's Law in action.
- Measure the voltage across the motor and the current flowing through the circuit using a digital clamp meter or multimeter.
- Calculate the resistance of the motor using the measured values and Ohm's Law.
- Highlight the difference between calculated resistance and actual resistance, discussing factors that might cause discrepancies (e.g., temperature, material properties).

#### Student Practice with Multimeters (10 minutes):

- Have students take turns using a multimeter to measure current, Voltage and resistance on the automotive window motor box.
- Provide guided practice in calculating the third variable using Ohm's Law; students who are not measuring should copy down two of the measurements taken by whoever's turn it is and try to solve for the third variable.
- Encourage students to record their measurements and calculations, comparing their results with theoretical values.

#### Discussion on Calculated vs. Actual Readings (3 minutes):

- Discuss why actual readings might differ from calculated values: imperfections in manufacturing, internal resistance, the window box is not 100% efficient.
- Encourage students to think about real-world factors that could affect their measurements, such as connection quality, energy source (battery vs 120V power cord), worn or damaged circuit components.

#### Conclusion (2 minutes):

- Recap the key points of the lesson, emphasizing the importance of understanding and applying Ohm's Law in electrical circuits.
- Ask students to share their experiences and any challenges they faced during the practice.
- Possible discussion questions:
  - How did your actual measurements compare to your calculated values?
  - What factors might cause differences between calculated and actual resistance?
  - How can understanding Ohm's Law help tradespeople in troubleshooting electrical problems? (ex: auto tech: measuring resistance on a sensor in a vehicle, electrician: ensuring that the components used can handle this current without overheating or causing any safety issues).

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Assessment and online resources

## Assessment suggestions

- Have students rate their understanding of Ohm's Law and its application.
- Use an exit slip asking students to solve a simple Ohm's Law problem.
- Collect and review students' measurements and calculations to assess their grasp of the concepts and proper usage of the multimeter.

## Online resources

- [Automotive Window Kit - Lethbridge Polytechnic STEM Website](#) (Lethbridge Polytechnic, 2023)
- [Window motor box overview](#) (Lethbridge Polytechnic, 2023)
- [How to use a digital clamp meter or multimeter](#) (Lethbridge Polytechnic, 2025)
- [Ohm's Law](#) (SparkFun Electronics, 2016)