

## Ohm's Law

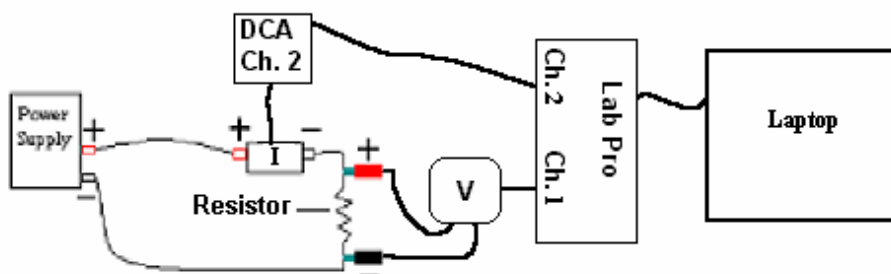
**Goals:** Construct a qualitative understanding and quantitative relationship between voltage, current and resistance in a single resistor circuit.

**Equipment:**

**On student bench:** Laptop, lab Pro interface, current sensor, differential voltage sensor, dual channel amplifier, DC power supply, wires, clips, 10-ohm resistor, 50-ohm resistor, light bulb (6.3V), lamp holder, and multimeter

### Part I. Mathematical relationship between voltage, current, and resistance in a single resistor circuit

**Experiment setup:** Connect the differential voltage sensor to channel 1 of the Lab Pro. Connect the current sensor to probe 2 on the DCA, and channel 2 on the DCA to channel 2 on the Lab Pro. Connect the Lab Pro to the Laptop. With the **power supply turned off**, connect the current sensor and a 10-ohm resistor to the power supply using wires and clips to complete the circuit shown. (Make sure the red (+) lead on the current sensor connects to the red (+) lead on the power supply.) Then connect the red (+) clip on the voltage sensor to the side of the resistor that is electrically closer to the red (+) lead of the power supply and connect the black (-) clip on the voltage sensor to the other side of the resistor.



**Computer program:** Open Logger Pro 3.3 on the laptop. Click (**Scan > OK**) **File > Open > Physics with Computers > 25 Ohm's Law** > Click the **Zero** button to reset the sensors. To use the Logger Pro software: Click **Collect** to begin taking data. Each time you click the **Keep** button a data point will be stored. The voltage sensor will read the voltage across the resistor and the current sensor will measure the current through the resistor.

**Activity 1:** The goal of this experiment is to test Ohm's law. To conduct a scientific testing experiment, it's very crucial to make predictions first.

**a) Make your prediction:** Write down your prediction for this experiment (Don't forget to apply the if...then...logical reasoning.). You may plot a graph to represent your prediction.

**b) Conduct the experiment:** Double check your group circuit set up and make sure it correct. Then set the voltage and current control knobs to zero (counter clockwise all the way down). Turn on the power supply. Turn the current control clockwise slowly to open the limit. From zero to slowly add up the voltage (**Watch your current readings during the experiment. The maximum current is 0.6A! If the current is over 0.6 A, the current sensor is possibly burned!**). Now you group can start to record your data. It is up to your group to select enough data points based on your logical judgment. After you group have recorded your data, click **Stop**. **Please always turn down and turn off the power supply when your group does not use it.**

**c) Analyze the data:** Click **Analyze> Curve Fit** to analyze your data graph (In *Logger Pro*, you can obtain the uncertainty in the slope of the best-fit line by double-clicking the fit box and checking the box for the standard deviation in the slope. You group may print out the graph including the data table on the computer. Otherwise, make sure you copy down the data table, sketch the graph, and write down the data analysis results from *Logger Pro*.

**d) Make your conclusion:** Compare your prediction with your actual experimental result above and make your conclusion about Ohm's law.

**Activity 2:** Design and conduct an additional experiment to test Ohm's law on a different resistor. Please make sure that your group follows the scientific experimental procedures above to do and record the experiment.

**Activity 3:** Replace the resistor in the circuit with a lamp holder. Screw in a light bulb and test Ohm's law using the light bulb. Please make sure that your group follows the scientific experimental procedures above to do and record the experiment. Let the light bulb on for several minutes before your data collection.

## **PART II. Design tasks**

From the front cart get a piece of Nichrome wire of 1~ 2 meters long. Using the equipment on your table (but **NOT** the *Logger Pro* and the voltage and current sensors), design and conduct **three different experiments** to measure its resistance. (Your group may use information from the two-page printouts on your table.) For each experiment, make sure you clearly record the experimental procedure, data, and result. At the end, please discuss any discrepancies between the three results.

(Please put the Nichrome wire back to the cart for future usage after your experiment. Thanks.)

## **PART III. Light up a bulb**

Using one bulb (without a holder!), one battery, and one wire to come up with as many as possible different ways to light up the bulb. Everyone should try it. It is fun! Carefully sketch your setup for each situation.