

## Resistance

### Physics 225 – Week 3 Activity

#### LEARNING OBJECTIVES

This lab connects with all five learning objectives presented in the course learning outcomes:

- Perform basic error analysis/propagation.
- Perform graphical analysis of data, including a variety of functional fits (e.g. linear, parabolic, power law).
- Measure/calculate the electrical resistance.
- Assemble electrical circuits based on a diagram, using circuit elements, power supplies, and meters.
- Write your results in the post-lab report.

#### BEFORE, DURING, AFTER

1. Before the experiment, read this document and finish the prelab on Blackboard.
2. During the experiment, take notes in your lab notebook.
3. After the experiment, collaborate with your team on the post-lab report.

#### PRACTICE QUESTIONS

Here are questions that you will answer using this week's materials:

- ① How is the current through a resistor related to the potential difference (voltage) across it?
- ② How does resistance depend on length of a conductor?
- ③ How does wire resistance depend on cross-sectional area of a conductor?

You'll answer these questions using cylindrical nichrome wires.

#### RESOURCES

Materials list and safety notes:

[https://drive.google.com/open?id=1m1xD8AwxKddE9tZ\\_SGJjoxrixe5KI6jH](https://drive.google.com/open?id=1m1xD8AwxKddE9tZ_SGJjoxrixe5KI6jH)

Background information and equations about resistance and resistivity:  
<https://drive.google.com/open?id=1baEkIRUrX5LRilxTEDXtP7v-ZtMVUyvR>

### EXPLORE QUALITATIVELY

① Use your power supply to apply a potential difference (voltage) across one of the nichrome wires. Use one multimeter (as a voltmeter) to measure the potential difference across the wire, and another multimeter (as an ammeter) to measure the current through the wire. Make qualitative observations about the behavior of current and voltage.

**Turn off, and remove, the power supply:** next you will measure resistance directly.

② Use an alligator clip to measure the resistance of only a segment of one of the wires. Does a longer wire have more, or less, resistance?

③ Measure the resistances of each wire using a multimeter as an ohmmeter. Does a thicker wire have more, or less, resistance?

### EXPLORE QUANTITATIVELY

Now, you should repeat your approach in the “explore qualitatively” section, but collect and graph detailed data.

① Measure the current through a wire as a function of voltage. Test multiple wires.

② Measure the resistance of a wire as a function of its length. Test multiple wires.

③ Measure the resistance of a wire as a function of its cross-sectional area. You can use a micrometer to measure wire diameter. Test all wires.

Use Vernier Graphical Analysis to graph your data, and also include appropriate fits to test agreement with the background equations. Add error bars to represent the uncertainties in your data. You should refer to the uncertainty guide when calculating the uncertainty in the cross-sectional area.

Have your instructor check your lab notebook and graphs.

### DELIVERABLES

**As a group**, use the Lab Work Submission form to finish the post-lab activity. Save your work as a PDF file, and then submit it on Blackboard.