

# An Activity You Can't Resist

## Introduction

Will graphite from a pencil conduct electricity? If so, does the resistance to the flow of electrons increase or decrease as electrons flow through a greater length of graphite?

## Concepts

- Ohm's Law
- Resistance
- Current
- Voltage

## Background

*Ohm's Law* describes the relationships between current ( $I$ ), voltage ( $V$ ), and resistance ( $R$ ). The electromotive force ( $V$ ) in volts is equal to the current ( $I$ ) in amperes times the resistance ( $R$ ) in ohms;  $V = I \times R$ . To solve for any single value in this equation when the other two are known, use Figure 1 and cover up the unknown value with a pencil eraser. Then, solve the mathematical equation by performing the mathematical operation indicated by the position of the remaining letters. Thus, to find voltage,  $V = I \times R$ , to find current,  $I = V/R$ , and to find resistance,  $R = V/I$ .



Figure 1.

Electromotive force ( $EMF$ ), also called electrical potential or voltage, is measured in a basic unit called the volt ( $V$ ) and can be measured using a voltmeter. Current is measured using an ammeter in the basic unit called an ampere ( $A$ ) or amp. Current is the flow of electrons in an electrical circuit. The basic unit of resistance is the ohm ( $\Omega$ ), which is measured using an ohmmeter. In an electrical circuit, resistance is the opposition to the flow of electrons. A resistance of 1 ohm occurs when 1 volt is applied to a circuit and only 1 amp of current flows.

Resistors are very important components in electrical circuits because they control the amount of current that flows when a particular voltage is applied. Resistors provide resistance, thereby controlling the flow of electrons in an electrical circuit.

## Materials

- Ohmmeter or multimeter
- Pencil, #2

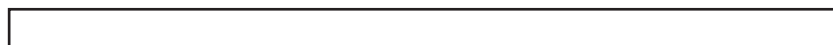
## Safety Precautions

*The materials in this experiment are considered nonhazardous. Please follow all laboratory safety guidelines. Wash hands thoroughly with soap and water after performing laboratory experiments.*

## Procedure

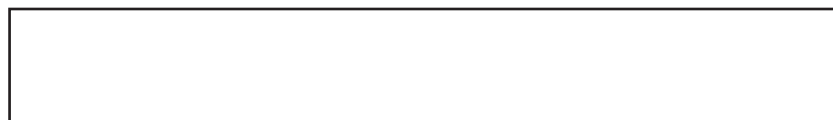
1. Using a #2 pencil, completely color in rectangles A and B. For best results, color them in very dark.
2. Place one test probe from an ohmmeter or multimeter at point X on rectangle A. *Note:* Make sure the probe is touching the graphite from the pencil.
3. Slide the second test probe from point 1 to point 10 and record the measured resistance on the ohmmeter for each point on the rectangle. How much does the resistance change as the probe is moved farther away from point X?
4. Repeat steps 2 and 3 with rectangle B. Does the width of the rectangle affect the resistance compared to rectangle A?
5. Graph the results.

X    1    2    3    4    5    6    7    8    9    10    Y



Rectangle A

X    1    2    3    4    5    6    7    8    9    10    Y



Rectangle B

## Tips

- Shave the wood off one side of a #2 pencil and place one test probe of an ohmmeter close to the tip of the pencil. Run the other ohmmeter test probe down the exposed graphite, toward the eraser. Note the resistance at each centimeter away from the tip. Does the resistance change as the length increases?
- Instruct students how to properly use an ohmmeter or multimeter before performing this activity.
- In general, the resistance increases as the second probe moves farther away from point X. Point for point, the resistance is greater for rectangle A than it is for rectangle B because the electricity has more paths to take in the wider rectangle.
- There is a common misconception about the term “pencil lead.” Students often think “pencil lead” is the element lead rather than graphite (a form of carbon). This misconception can be used as a learning exercise or opportunity for teachers to reinforce with students the importance of learning the specific scientific definitions of certain terms. The scientific usage of a term may be quite different from the common usage—other examples include theory, hypothesis, spontaneous, magnetic, velocity, composition, etc.

## Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

### ***Unifying Concepts and Processes: Grades K–12***

Constancy, change, and measurement

### ***Content Standards: Grades 5–8***

Content Standard A: Science as Inquiry

Content Standard B: Physical Science, properties and changes of properties in matter.

Content Standard E: Science and Technology

### ***Content Standards: Grades 9–12***

Content Standard A: Science as Inquiry

Content Standard B: Physical Science, structure of atoms, structure and properties of matter.

Content Standard E: Science and Technology

**Materials for *An Activity You Can't Resist* are available from Flinn Scientific, Inc.**

| Catalog No. | Description         |
|-------------|---------------------|
| AP9000      | Multimeter          |
| AP4639      | Multimeter, Student |

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.