Procedures

In 1826, a German physicist, Georg Ohm, developed the relation between current flow, I, the electric potential, V, and the electrical resistance, R. The relationship is known as Ohm's law and is expressed in the following manner:

$$V = IR$$

Two other ways of expressing Ohm's Law are:

$$I = V/R$$

$$R = V/I$$

Please note that these equations imply the following:

There is a direct relationship between the current, I, and the voltage. That is, if the voltage increases the current flow also increases (assuming the resistance remains constant). Also, if the voltage decreases, the current decreases.

There is an inverse relationship between the current, I, and the resistance, R. That is, if the resistance increases the current decreases (assuming the voltage remains constant). Also, if the resistance decreases, the current increases.

You can determine any single value of the three (voltage, resistance or current), if you can determine the other two.

Students Will Be Able to:

• Demonstrate Ohm's Law

• Explain and use Ohm's Law to solve problems

• Assemble a circuit with a voltage and resistance source

• Use a multimeter to measure current, voltage and resistance

Materials Needed:

• 3 fixed resistors: 50 Ohm, 100 Ohm and 200 Ohm

• 4 Alligator clips

• 1 9 volt battery

• (optional but preferred) 1 9 volt battery snap on piece with positive and negative wires attached

• 1 Digital multimeter capable of measuring as little as 10 milliamps

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Set Up

1. If you are not familiar with the multimeter, go through the slide show resources/ Multimeter. It will explain how to use the multimeter.

2. Prepare the multimeter to measure direct current voltage. Plug the red lead into the voltage/resistance port, and the black lead into the com port. Switch the multimeter selector to direct current voltage (on most multimeters, it is marked by a V with a straight line and a dotted line over it.)

3. Use the multimeter to measure the voltage of the battery. Attach alligator clips to both the red and black leads. If your alligator clips are colored, always attach red to red and black to black. Attach the snap-on piece to the battery. Attach the red alligator clip to the red wire leading from the battery's anode (+) and attach the black alligator clip to the black wire leading from the battery's cathode (-). Record the Multimeter value in the appropriate place on your worksheet.

4. Prepare the multimeter to measure resistance. Plug the red lead into the voltage/resistance port, and the black lead into the com port. Switch the multimeter selector to Ohms (usually marked by the Greek letter Omega).

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**5.** Use the multimeter to measure the resistance of the 50 Ohm resistor. Attach the alligator clip attached to the red lead to either end of the resistor (it doesn't matter which). Attach the alligator clip attached to the black lead to the other end of the resistor. Record this value in the appropriate place on your worksheet.

6. Prepare the multimeter to measure direct current amperage. Plug the red lead into the amperage port, which is usually marked with an A, and the black lead into the com port. Switch the multimeter selector to direct current amperage (on most multimeters, it is marked by an A with a straight line and a dotted line over it.)

7. Create a circuit which includes a 9 volt battery, a 50 Ohm fixed resistor, and the multimeter you have prepared to measure current. In the arrangement below, the red alligator clip of the multimeter is attached to the red wire attached to the anode of the battery. The black alligator clip of the multimeter is attached to one end of the 50 Ohm resistor. The other end of the resistor is touching the black wire attached to the cathode of the battery. Record the amperage the multimeter measures from this circuit in the appropriate place on your worksheet.
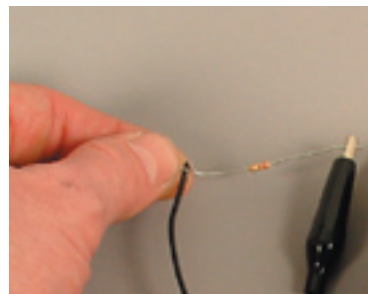
6. On your worksheet, insert the values you found in their proper places in the Ohm's Law equation V=IR. Have you demonstrated Ohm's law?

7. Perform steps 2-6 above for the other 2 resistors: 100 Ohm and 220 Ohm.

8. On your worksheet, answer the following question: If you substituted a 1000 Ohm resistor, what would the current value of the circuit be?

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9. On your worksheet, answer the following question: If you substituted a 1.5 Volt battery for the 9 volt battery in the circuit with a 1000 Ohm resistor described in question 8, what would the current value of the circuit be?

10. On your worksheet, answer the following question: If you had a circuit with a voltage of 9 volts, and you wanted it to have a current as close as possible to 3 amps, what kind of fixed resistor would you add to the circuit: .33 Ohms, 3 Ohms or 27 Ohms?

11. On your worksheet, answer the following question: If you had a circuit with a 9 volt battery, and the current was 1 milliamp, what would be the value of the fixed resistor?