



Discovering Ohm's Law

(<http://www.shodor.org/refdesk/Resources/Activities/OhmsLaw/lessonplan.php>)

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Ohm's Law Computer Module and simulator

The first exercise is Building Batteries. The Student worksheet for the background and activity is provided.

Using a computer model of a circuit board the students will explore the relationship of resistance, voltage and current in series and parallel circuits. They will discover Ohm's Law by constructing series circuits with one resistor and putting the resultant resistance, current and voltage into a worksheet. Next they need to discover how to apply their law to series circuits with multiple resistors and or batteries. Finally they propose a plan for applying their understanding of ohms law to parallel circuits they construct.

Goals and Objectives

This lesson addresses these National Science Education Standards:

Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced.

Materials - Discovering Ohm's Law

You will need the Circuit Builder model for this activity. It is available from the Physlets website at Davidson College.
(<http://webphysics.davidson.edu/Applets/circuitbuilder/default.htm>)

Two "word" worksheets are also available.

- [The single resistor worksheet](#) is used to discover Ohm's Law.
- [The dual resistor/battery worksheet](#) is used to help the students discover how to apply Ohm's Law to more complex circuits.

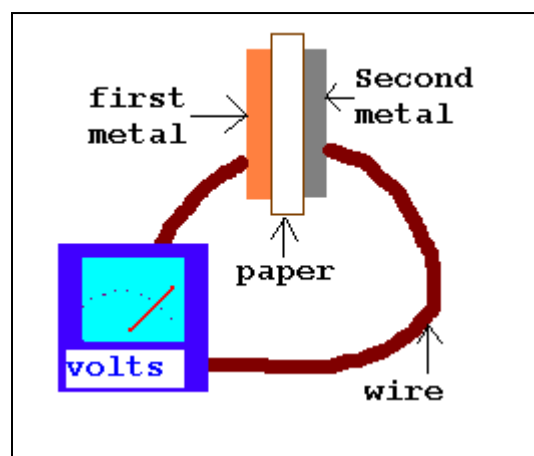
If you chose to have your students build batteries you will need the following materials:



- A voltmeter or battery tester to check if you are making electricity.
- Wires to connect your battery to your voltmeter.
- Several different kinds of metals, coins, jewelry, metal chairs, doorknobs, copper pipes, scissors, lead sinkers, etc.
- Paper soaked in salt water.

First, have the students practice using their voltmeter with a flashlight battery. Be sure that they know what to expect when electricity is flowing through the meter.

Select two different kinds of metals. Separate them with the paper towel soaked in saltwater. Both of the metals must touch the paper. Don't let the metals touch each other. This is their battery. Connect the voltmeter the same way they did with the battery. Record the voltage of their battery. Repeat the process with different metals.



Questions:

1. Which pairs of metals make the strongest and weakest battery? (Answers will vary depending on the metals used. If the battery consisted of 2 examples of the same metal i.e. steel chair and steel scissors the voltage will be approximately 0)
2. Were any of your batteries as strong as the flashlight battery? (Answers will vary.)

When the students drop a battery or meter on the Circuit Builder applet board, a dialog box will appear. All components have some internal resistance. By assuming an ideal condition with no internal resistance our calculations are greatly simplified. Be sure to remind the students to test their circuits using this ideal condition. After they have found Ohm's Law they can go back and check the real world condition by replacing the internal resistance in their circuit board and their calculations.



Change the light bulb values by right clicking or control clicking the light bulb. Experiment with different values.

3. What values give a bright light that doesn't burn up? Answers will vary depending on the voltage of their battery. A 3 volt battery, with a 3 watt, 3 volt bulb is bright.

Change the value of the resistance and or battery's voltage in your circuit. Put the circuit's values into the second row on the worksheet.

4. Do the operations from the first row work for the second row? *If the student has the correct operations they will work for each row.*

Voltage = resistance X current

resistance = voltage / current

Current = voltage / resistance

Check the operations using several different values. Fill out each row with different values.

5. How dependable do you feel this relationship is? *Answers will vary. Scientist have checked this relationship many times and found that metals follow this rule at normal temperatures. Non-ohmic materials and even metals at exotic temperatures don't follow Ohm's law. The usefulness of most modern electronic devices and even light bulbs comes from how they violate Ohm's law.*

Build several circuits with 2 resistors and one battery in series. Put the values into the worksheet "Ohm's Law with 2 resistors in series". Replace the ? between voltage and current with the operation you discovered in the first worksheet. Replace the ? between the resistors with + - / or X to make the statement true.

6. In a series circuit with 2 resistors, do you add, subtract, multiply or divide the resistors? *Add.*

7. Does the same operation work if you have 3, 4 or more resistors connected in



series? Yes. By adding the resistances together you get the total resistance. Putting that into Ohms law you get the current for the circuit. The voltage for the entire circuit can also be found this way. The voltage or potential difference on either side of a resistor can be calculated using the circuit's current and the resistor in question as seen below.

Ohm's Law Resources

These are additional background materials and links to resources that may help you prepare for and extend the lesson.

<http://jersey.uoregon.edu/vlab/Voltage/> has an interactive circuit with interchangeable batteries and resistors. The students goal is to pick the correct battery/resistor combination to light up the bulb without burning it out.

http://www.grc.nasa.gov/WWW/K-12/Sample_Projects/Ohms_Law/ohmslaw.html has a short quiz on Ohm's law.

<http://hyperphysics.phy-astr.gsu.edu/hbase/electric/watcir2.html#c2> A discussion with diagrams of the analogy of water pressure to voltage in simple circuits.

<http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Ohm.html> A biography of George Simon Ohm.

Feedback on Discovering Ohm's Law:

Share your suggestions to enrich, expand and improve this lesson. How did you use this lesson in your classroom?

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