Instructors Guide to:

Series Circuits and Ohm's Law

This exercise is designed to build upon knowledge of parallel and series circuits, and teach students to calculate the properties of the circuits that they have built.

Ohm's Law describes the relationship between the voltage, current, and resistance of a circuit. This relationship is given in the relationship Voltage = Current x Resistance. Knowing this relationship, it is possible to find any of the three values as long as the other two are known.

Electrical concepts such as voltage and current are abstractions that can be difficult to grasp at first. The following analogy is useful as a visual representation.

One way to think about circuits is to imagine electricity as water flowing through a pipe. If the pipe represents the wire, then the water flowing through it represents the moving electrons. Just like a circuit has a battery that pushes the electrons through it, our imaginary pipe has a pump that pushes water. The size of the pump determines how hard the water gets pushed though the pipe – a larger pump will be able to push more water than a smaller one.

Of the three variables that we're trying to calculate, the voltage is usually the easiest – usually, you can find it written on the side of the battery that you're using. Resistance, however, can be a little more complicated. Going back to our water pipe example, resistance in a circuit can best be compared to the size of the water pipe. The smaller the pipe, the more difficult it is for the pump to push water through the system.

Now that we have two of the three values, we can calculate the final one. The current in a circuit can be thought of as the amount of water flowing through the pipe. For example, say that you have two water pumps of the same size. The first one is connected to a large pipe, while the second one is connected to a pipe that is half the size of the first one. Because the second pipe is only half the size, we would say that it has twice the resistance. Because Voltage = Current x Resistance, we can rearrange this relationship to say that Current = Voltage / Resistance. Seeing as the second system has twice the resistance of the first system, it would make sense to say that it has half the current. This means that the bigger pipe can deliver twice as much water as the smaller pipe given the same amount of time.

In order to design and analyze circuits, electrical engineers use symbols to represent wire and components. Below are some of the symbols that we will be using to represent circuits in our activities.