Simulation 3: Circuits

In this lab we are going to build circuits!


On the left are the various elements that you find in circuits. Notice that the full palette is larger than displayed. We are not planning to use battery resistance nor wire resistivity. All our wires and batteries have no resistance. From the bin on the left, you will extract the things we need.

Start with a battery on the left. Orient it vertically. Put a resistor on the right, also vertical. Now connect the resistor to the battery at the top and bottom with the wires. See the current start to flow? Now the simulation starts with the real thing...namely, the flow of electrons...but as you know, we think of positive charge flow for convenience, so you can flip it to conventional current. Flip to conventional current. Notice the reversal?

If you click on the resistor itself, a new window opens at the bottom where you can change the resistance.

1. If you increase the resistance, what should happen to the current? Try it.
2. If you decrease it? Try it. What happens if you decrease it to zero?

Now we are going to put two resistors in series.

3. Before we do so, what you expect from the current? Now do it.
4. Does the experiment support your assumption?

We can measure the current coming out of the battery by cutting the wire and inserting an ammeter (short for amp-meter, to measure amps). Make one resistor 10 ohms and the other 100 ohms. Read the current.

Switch them now...you don’t actually have to move them, just increase one and decrease the other so their values are swapped.

5. Has the current changed?

As we mentioned, the current can’t be “fooled” by thinking it’s going to have an easy time and flowing fast but then getting jammed up. It’s always continuous, like the bicycle chain. Make a note of your current.

Now keep the ammeter in place, but rearrange the resistors to be in parallel.
6. What do you notice? How does the current compare to the current when the same resistors were in series?

Just for fun, put in a wire (or two) that connects the two ends of the battery, bypassing the resistors. (This gives the electrons a really short path to travel, and is called a “short” in the circuit, or just a short circuit.).

7. What do you notice?

Ok, remove that wire...no more burning batteries for us.

Now we want to use the voltmeter from the right panel. Voltage is a difference in potential. (If it were gravity, we’d be talking about the difference in height.). But the key idea here is difference. This is why voltmeters have two probes (the pointy things, red and black). The meter shows you the potential difference between its two probes. Try it on the 9 v battery itself. Did you get 9 V?

8. Ok, now move it to measure the potential difference (voltage across) each resistor.

The beauty of our simulation is that you can use as many ammeters as you want. So let's put ammeters right before each resistor AFTER the current has split.

9. Compare the sum of the two to the current out of the battery.

Go back and set up the series circuit again. Set up the ammeter after the battery, between the resistors, and at the end. (That’s 3 ammeters...we’ve got a million of ‘em).

10. What do you notice about the current?

Measure the voltage across each resistor.

11. What do you notice about the voltages?

12. What did you learn from this lab?