

Prelab: Electric Circuits I

Everyday thing: Electric circuits, as I'm sure you've suspected by now, are everywhere. They are printed on microchips, on the scale of few dozen atoms, they are what makes the light turn on when you flip a switch, and they produce a faint humming noise in the power stations as they handle hundreds of thousands of volts.

It is physics: All of these circuits behave according to a simple set of laws governing the movement of electrons through the different parts of the circuit.

Circuits

Watch: <https://www.youtube.com/watch?v=A097pVn5T58>

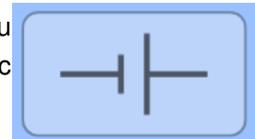
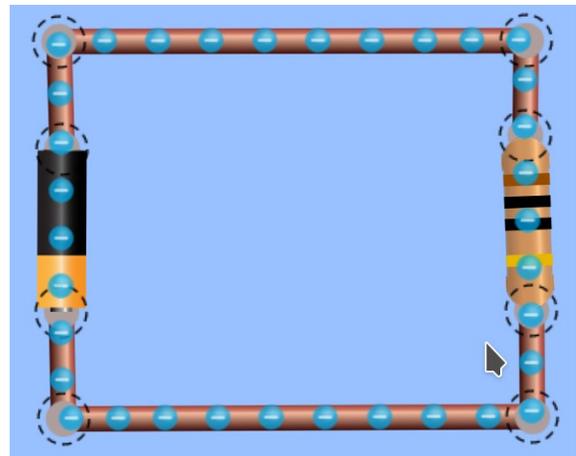
A circuit is a way for charges, i.e. electrons, to take a round trip through wires and electronic devices that we call circuit elements. A battery is also a circuit element, and as you know, charge flows within the battery thanks to the electrolyte. For most devices and for metal wires, it is electrons that actually move – the free electrons in a metal comprise a fluid, so it is very useful and correct to think of this in terms of the water analogy provided in the reading and video.

Open the following simulation:

https://phet.colorado.edu/sims/html/circuit-construction-kit-dc/latest/circuit-construction-kit-dc_en.html , click on “Intro” and follow along as you read this document.

Build the circuit on the right in the simulation. This is the analogon of the video you just watched:

- The “–” side of the battery has higher potential energy per charge (higher **voltage**), and the electrons flow through the resistor to the “+” side (lower voltage)
- Press the “Conventional” button on the right. You see that there is now positive charge flowing in the opposite direction. This is how people of the 1700s thought electricity work, and unfortunately it stuck. So we say current flows from + to –, even what's actually going on is that electrons flow from – to +.
- Turn “Show current” off. Now press this symbol here on the right. You should see what is called the “**circuit diagram**” of the circuit. It is a symbolic form of describing a circuit. Observe the symbols for resistor and battery.



Flashlight

Build a flashlight (circuit diagram on the right).

Go back from the circuit diagram view to the “real” view by clicking on the battery symbol. Turn on “Show current” and “Electrons”.

- Note that no current is flowing if the switch is open
- Close the switch and observe the light bulb.
- Take the voltmeter and measure the voltage between different parts of the circuit (before and after the battery, before and after the light bulb and so on). Think of the water analogy again.
- Take the ammeter and measure the current through different parts of the circuit. The current is equal everywhere, which is really saying that the same number of electrons are flowing through each part of the circuit per second.
- Remove the light bulb (click on it and press the bin symbol on the bottom). Connect the wires before and after the light bulb directly. Observe what happens to the battery. (So please don't do this in the lab!)

