

Y7 PRM Day Work

Introduction

Today you are going to explore the basics of electronics and circuits. You will be working to understand some important essentials regarding the nature of circuits, and building test circuits. Normally we would do this lesson with physical “breadboard” type circuits (which you can read about in the attached slides) but today you will instead use an online circuit simulator.

What is a circuit?

A circuit is one of the most basic concepts in any electronic device. They enable the flow of electricity. Electricity is the movement of electrons (a tiny particle), and this movement creates a supply of energy for components to use. Once components have this supply of energy, they are able to work.

So, what makes electricity flow? We need two things:

1. A complete circuit. This means everything is connected in a loop, as the electrons are not allowed to stop at the end.
2. Some motivation for the electrons to move. This “push” force comes from something like a battery, and how much “push” there is is a concept called Potential Difference, or Voltage.

Potential Difference

Potential Difference, or Voltage, is probably the most important concept you need to understand about electricity. Potential Difference is measured in Volts. Both the unit and the symbol for Voltage is a capital V. When a potential difference is applied to either ends of a wire (by using a battery or a power supply for instance), a force acts on electrons inside the wire. The force pulls the electrons towards the positive side of the battery or power supply.

Try it:

The best way to think about Voltage is to imagine it as the amount of energy each electron carries. This energy causes the electron to move, so the more energy it has, the faster it moves.

If there is a voltage of 1 volt across a wire, each electron carries about 0.000000000016 Joules of energy. It takes about 1 Joule of energy to lift a small apple a metre into the air, so each electron carries a tiny amount of energy.

In your own words, try to describe the effect on increasing and decreasing the voltage. There are some animations here that might help you:

https://bournetoinvent.com/projects/7-SC-Torch/pages/1_Lesson.html

Current

Another thing we might want to measure is how fast the electrons are flowing. This flow of electrons is called Current. Writing down current is a little annoying. Its symbol is I but it is measured in Amps (A). Current is described as the rate of flow of electrons. Basically, this is how many electrons are passing a point in the circuit every second.

In your own words, try to describe the relationship between the current flowing through the wire and the potential difference across it.

Resistance

The last property you need to be aware of is the resistance of a component or a wire. Resistance is a measure of how difficult it is for electricity to flow.

As the electrons pass through a wire or component they collide with atoms. This causes them to lose a bit of their energy, which makes the voltage drop. If a wire is very narrow, there will be more collisions, so the resistance is higher. If a wire is very long, there will be more collisions so the resistance is higher. Some materials have arrangements of atoms inside them that means there are more collisions, so their resistance is higher too.

Circuit Lab

Now, it is your turn to try it!

Go to the following site:

https://phet.colorado.edu/sims/html/circuit-construction-kit-dc-virtual-lab/latest/circuit-construction-kit-dc-virtual-lab_en.html

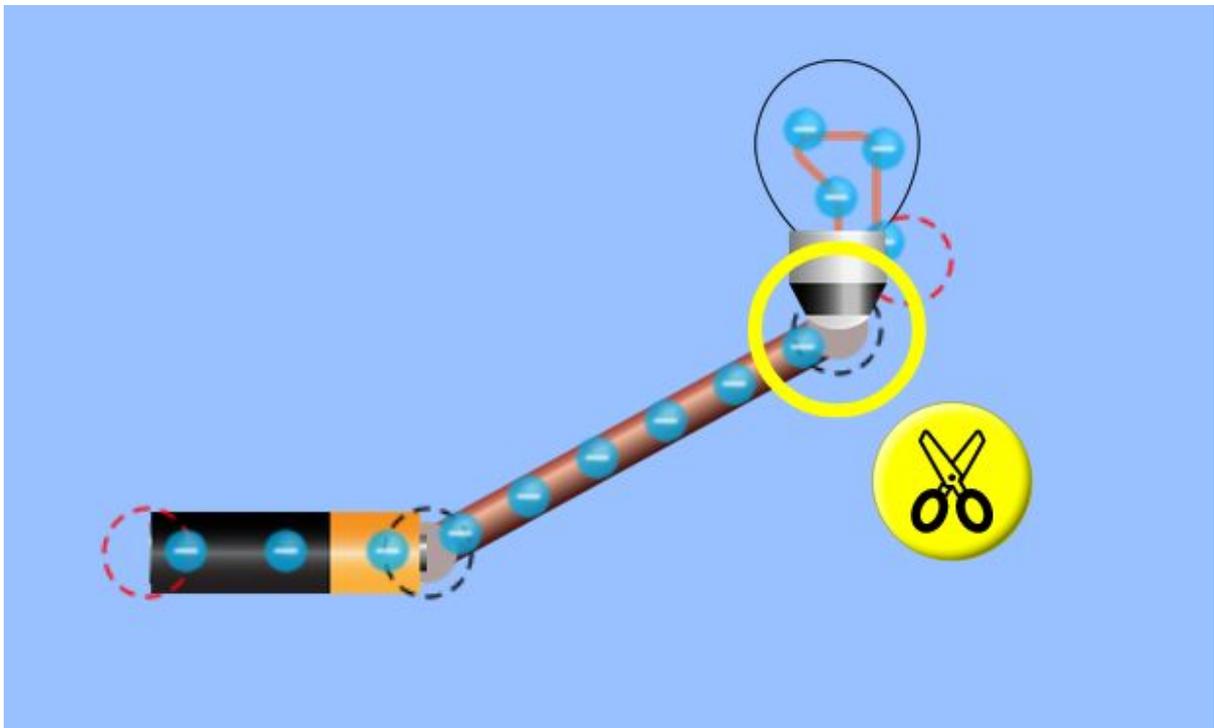
You will see a screen that looks like this:



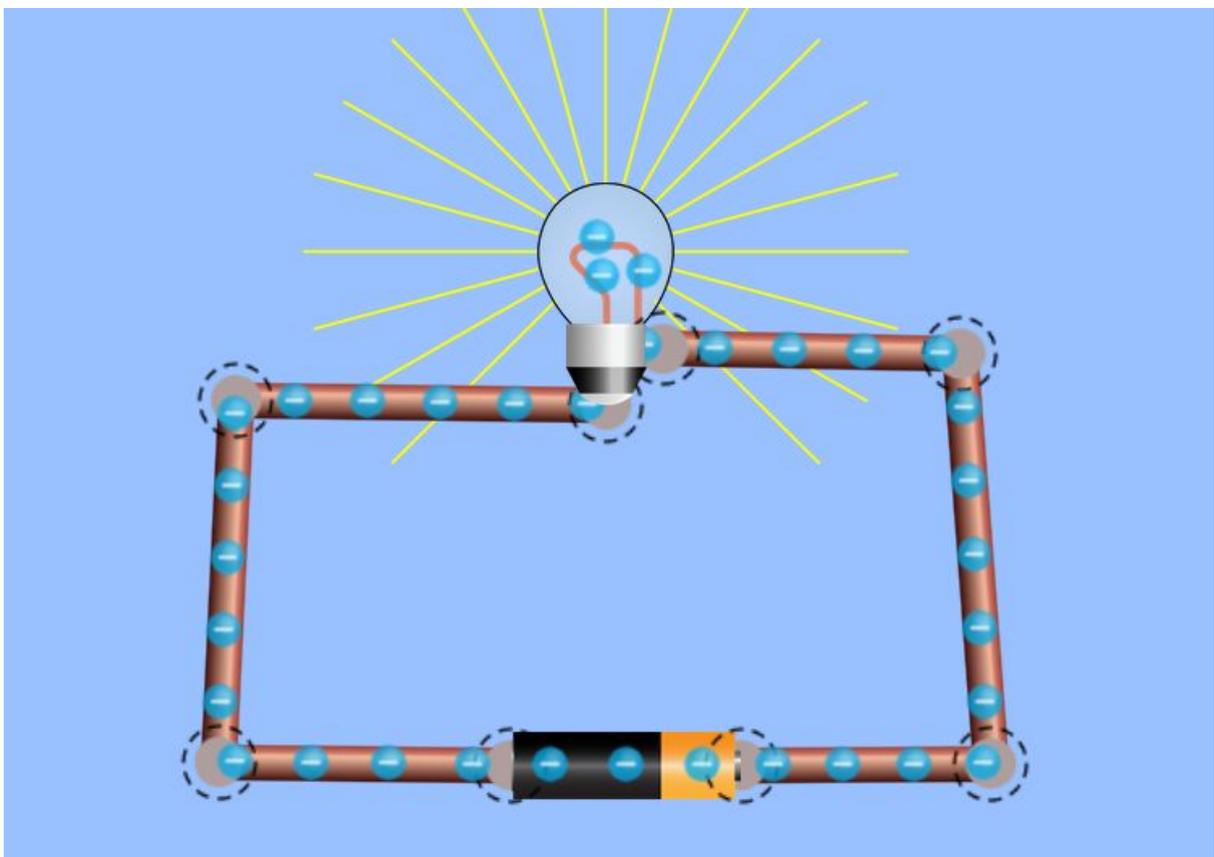
On the left, you have a components toolbox. Press the down arrow to see more items. On the right, you have a number of settings. Do not worry about these for now.

To place items, simply drag them from the left and place them into the blue world. In order to connect items together, you need to use the wires, these just drag and extend to connect.

If you wish to disconnect items, simply click on them and press the scissor button:



The following screen shows a simple circuit. What does it do?

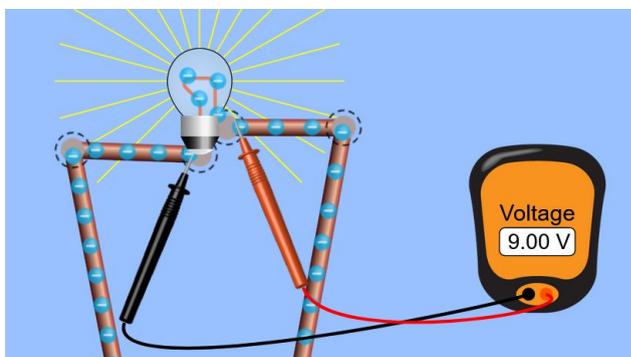


Your tasks are as follows:

1. Recreate the circuit above.
2. Add a switch so that the circuit can be turned off and on.
3. Modify the circuit in the following ways:
 - a. Two bulbs that turn on and off together
 - b. Two bulbs that turn on and off separately.
4. What do you notice about the *brightness* of the bulbs in the two examples above? What is happening? Why do you think this is? Research this if you are not sure.
5. Add a resistor to the original circuit. What happens? Why?
6. Find the high-voltage battery shown below. What happens if you put this in the circuit?



7. Find the following items: Paper Clip, Dollar Bill, Eraser, Pencil, Hand, Dog. Try replacing a wire with each of them. What happens? What do you think causes this?
8. Have a go with the Voltmeter with the circuits from Q3. You need to place the ends of the probes inside the circles of the bulb or other components. What do you notice about the values on the bulbs in the two designs?



Time permitting, I may hold a short Teams help session should I have the availability on PRM day.