Introduction to Circuits Activity

Physics

In this activity you will explore with virtual circuits using the PhET "Circuit Construction Kit (DC Only)". You will need to use a laptop or desktop computer. The app is located at http://phet.colorado.edu/en/simulation/legacy/circuit-construction-kit-dc.

In order to understand circuits, we need to understand the three basic properties that affect them; Voltage, Current, and Resistance. You should already understand voltage; current and resistance will be investigated in this activity.

You may work with a partner to use the applet, but each of you should answer the lettered questions individually (hand-write on paper and turn into the silver bin).

Part 1

1. Open up the applet and experiment with dragging different components into the work space. To delete a component, just click on it and hit delete. Once you feel comfortable with how the app works, build a circuit using any of the components that you would like. For now, limit your circuit to only one loop. Keep the "Lifelike" box checked in Visual Settings and make sure that the blue circles are moving in your circuit. Your circuit will need to have at least one power source (battery). You'll also need at least one other component in your circuit to keep it from igniting!
    a. **Draw the circuit that you created as it appears in the lifelike setting. You do not need to draw all of the blue circles, but indicate which direction they are going.**
    b. **What do the moving blue circles represent?**

2. Use the internet to find a brief, formal definitions of current and resistance.
    c. **In your own words, what is current?**
    d. **What is the common unit used to quantify current, and what does this unit mean?**
    e. **What is resistance, and what are the units of resistance?**

3. Ammeters measure current. Under the tools option, select Non-Contact Ammeter and move the crosshairs over a junction in your circuit. You will use this tool during the rest of the lab to measure current.
    f. **Move the Ammeter around the loop of your circuit while current is flowing. What do you notice regarding the value of current as you move around the loop?**

4. Now that you understand what current is, we need to investigate resistance. Edit your circuit, if necessary, to make sure that it has at least one light bulb that is emitting light.

g. **Now that you have added the light bulb, under the "Advanced" option, click the "Show >>" box. Move the Wire Resistivity bar from the left to the right. How does this affect the light bulb the flow of electrons in the circuit?**
h. **Based on your observation, define resistance in your own words.**
i. **With the wire resistance still set on high, what is one way that you can increase the current in the circuit without adding components, removing components, or changing the voltage of the power source? Test your idea to verify that it works.**
j. **How is current related to resistance? (Describe the mathematical relationship to the best of your ability.)**

5. The observation that you made regarding the relationship of current to resistance is the first step in developing an equation that relates voltage, current, and resistance. Next we need to see how current is related to voltage.
    k. **With your light bulb still illuminated and your ammeter still reading current, right click on the battery and slide the voltage bar right, increasing the voltage. How does this affect current? How are current and voltage related mathematically?**
6. Now we can use quantitative observations to develop an equation relating them. This will require the use of the Voltmeter to measure voltage. To do this, click the voltmeter box and then position the two probes over the battery. The red probe expects to sense a region of high potential (which should be at the black end of the battery) and the black probe expects to sense a region of low potential (which should be at the silver end of the battery).
    l. **Touch the probes to your battery and determine which end has high potential (+) and which has low potential (-). Does this agree with the direction of the flow of electrons? Explain.**
    m. **Now move the probes over the two terminals of the light bulb. Right click on the bulb and select "show value". Once you have done this, record the values for resistance, current, and voltage for the light bulb. Change the values by adjusting either the resistance value for the light or wire, or by adjusting the value of voltage for the battery. Record two more sets of data based on these changes.**

	Run 1	Run 2	Run 3
Voltage			
Current			
Resistance			

    n. **Now, based on your data, develop (and write) an equation relating the three quantities. This equation is called Ohm's Law.**
    o. **Explain how this equation confirms the relationships that you observed in 4(j) and 5(k).**

Part 4

At this point in the lab you should understand some of the basics of electrical circuits. Now you need to learn the conventional symbols for the components in a circuit and we will be ready to continue through the rest of the unit. Edit your circuit (or create a new one) so it contains at least one battery, resistor, light bulb, and switch.

p. **In the app, change the Visual option from Lifelike to Schematic. For a clearer view, under the Advanced menu, click the Hide Electrons box. Now draw the circuit that you are looking at in using the schematic symbols.**
q. **On your drawing, label your circuit components (you don't need to label wires, but you should label each of the following: resistor, switch, and battery). For the battery, show which side has the higher electrical potential.**