Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block: \_\_\_\_\_\_\_\_\_\_

**Series and Parallel Circuits Lab**

**Purpose:** Describe the relationship between potential difference, current, and resistance for series and parallel circuits.

**Instructions:**

**Step 1)** Go to “Phet - Circuit Construction Kit: DC” simulation   
<https://phet.colorado.edu/en/simulations/circuit-construction-kit-dc>. Press play and select “Lab”.

**Step 2)** Play around and try to learn how to use the simulation (how to connect, disconnect, change values of a circuit element, how to use voltmeter and ammeters) for 5 minutes.

**Part 1: Ammeter and Voltmeter Tutorial**

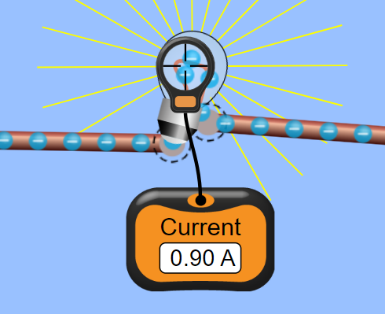
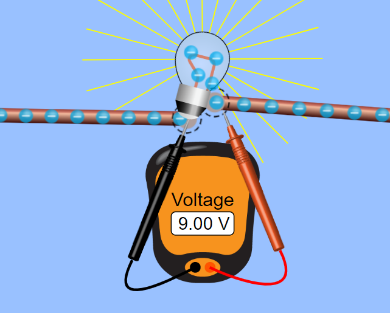
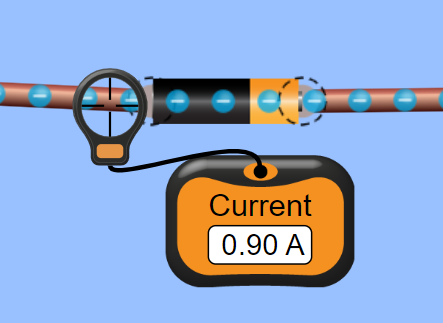
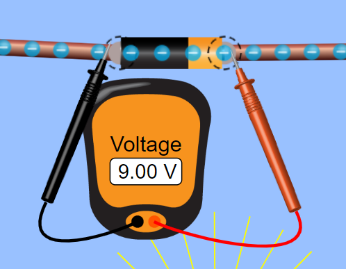
**Step 3)** Make a simple circuit with a default 9.00V battery and one default light bulb (10 ohms). Make the following measurements using an ammeter and a voltmeter. Your measurements should match what is shown in the diagrams.

To measure **potential difference across a single lightbulb** (e.g. V1, V2, V3), place the black probe to one end and place the red probe to the other end of the lightbulb.

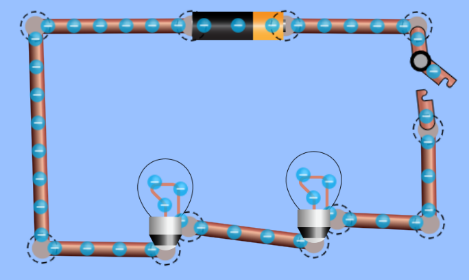
To measure the **current through a lightbulb** (e.g. I1, I2, I3), place the center of the circular probe on the wire inside the lightbulb.

To measure the **total current through the circuit** (Itot), place the center of the circular probe on the wire right after the battery.

To measure **total potential difference across the circuit** (Vtot), place the black probe on one end of the battery and the red probe on the other end of the battery.



**Part 2: Series Circuits**



1

2

**Step 4)** Construct the circuit on the right. It has two light bulbs in series. Set the battery to **60V** and resistance of the lightbulbs to **10 ohms** each.

**Step 5)**Use the voltmeter and ammeter to measure the voltage and current across each light bulb. Record your results in Table 1.(V1 = voltage of first light bulb; I1 = current of first light bulb;   
V2 = voltage of second light bulb; I2 = current of second light bulb; etc.)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 1: Voltage and Current in a Series Circuit with up to Four Lightbulbs | | | | | | | | | | |
|  | **Entire Circuit** | | **Lightbulb #1** | | **Lightbulb #2** | | **Lightbulb #3** | | **Lightbulb #4** | |
|  | **Vtot** | **Itot** | **V1** | **I1** | **V2** | **I2** | **V3** | **I3** | **V4** | **I4** |
| Step 4  (2 bulbs) | 60 V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | N/A | N/A | N/A | N/A |
| Step 5  (3 bulbs) | 60 V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | N/A | N/A |
| Step 6  (4 bulbs) | 60 V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A |

**Step 5)**Next, add one more lightbulb with **10 ohms** of resistance in **series** to the circuit. Measure the voltage and current across each light bulb. Record your results in Table 1.

**Step 6)** Lastly, add one more lightbulb with **30 ohms** of resistance in **series** and record the measurements in Table 1.

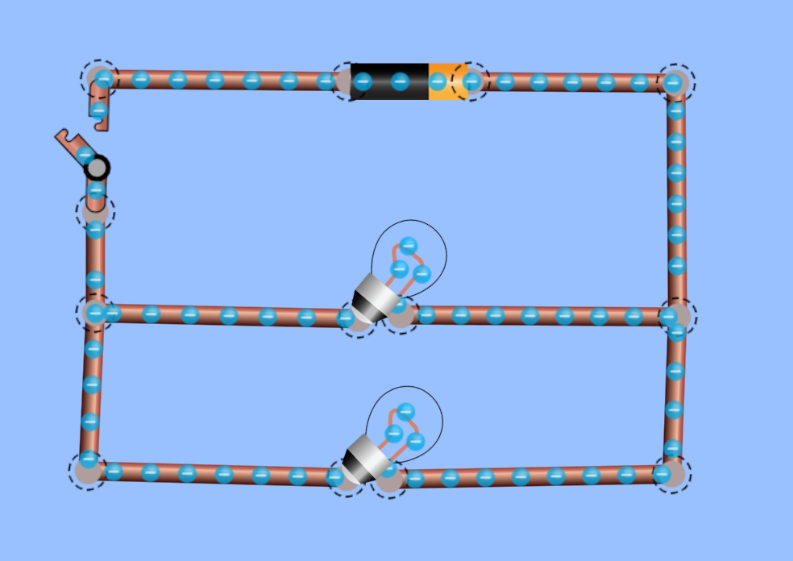
*3. How does the speed of electron movement change when more lightbulbs are added in series?*

*4. How does lightbulb brightness change when more lightbulbs are added in series?*

*5. What is the relationship between the total current of the circuit and individual lightbulb currents in series?*

*6. What is the relationship between the total voltage of the circuit and individual lightbulb voltages in series?*

**Part 3: Parallel Circuits**



1

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**Step 7)** Once you are ready, construct the circuit on the right. It has two lightbulbs in parallel. Set the battery to **60V** and the resistance of the lightbulbs to **10 ohms** each.

**Step 8)** Measure the potential difference and current of each lightbulb and the circuit. Record your results in Table 2.

**Step 9)** Add one more lightbulb with **10 ohms** of resistance in **parallel** to the circuits and measure the voltage and current on each bulb then record them in Table 2.

**Step 10)** Lastly, add one more lightbulb with **30 ohms** of resistance in parallel and record the measurements.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 2: Voltage and Current in a Parallel Circuit with up to Four Lightbulbs | | | | | | | | | | |
|  | **Entire Circuit** | | **Lightbulb #1** | | **Lightbulb #2** | | **Lightbulb #3** | | **Lightbulb #4** | |
|  | **Vtot** | **Itot** | **V1** | **I1** | **V2** | **I2** | **V3** | **I3** | **V4** | **I4** |
| Step 4  (2 bulbs) | 60 V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | N/A | N/A | N/A | N/A |
| Step 5  (3 bulbs) | 60 V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | N/A | N/A |
| Step 6  (4 bulbs) | 60 V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A | \_\_\_\_V | \_\_\_\_ A |

*7. How does the speed of electron movement change when more lightbulbs are added in parallel?*

*8. How does lightbulb brightness change when more lightbulbs are added in parallel?*

*9. What is the relationship between the total current of the circuit and individual lightbulb currents in parallel?*

*10. What is the relationship between the total voltage of the circuit and individual lightbulb voltages in parallel?*

*11. How do you suppose electrical appliances are connected in our homes? In parallel or in series? Why?(Hint: What happens to other appliances when one appliance is turned off?)*

*12. A student is recording the following measurements on the table.* ***Fill in the rest of the table*** *and construct a circuit that is going to be aligned with the numbers on the table below. Then* ***draw that circuit*** *below.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Vtot (V) | Itot (A) | R1 (Ω) | V1 (V) | I1 (A) | R2 (Ω) | V2 (V) | I2 (A) |
|  | 3 A |  | 12 V | 1 A |  | 12 V |  |