



Physics Lab Instructions

Read and follow the steps to complete the investigation.

Resistance in Series Circuits Online Lab

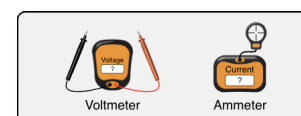
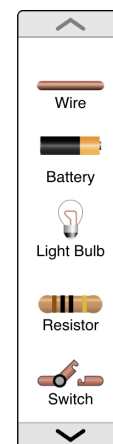
Exploring the Simulation

Click the “Intro” mode of the simulation.

In this part of the investigation, you will explore the simulation by creating a series circuit.

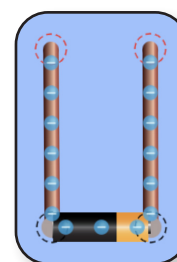
When you first open the simulation, a section on the left shows several choices of items that can be a part of your circuit. To use any of these items, click on it and drag it to the middle of the screen. You will use these items to create a series circuit.

On the right side of the screen is a section with a voltmeter and ammeter. To use either of these tools, click and drag it where you want to use it. When you are finished with it, you can put it away by clicking and dragging it back to the section on the right side of the screen.



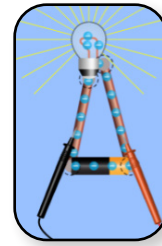
Follow the directions to create a series circuit.

1. Drag a battery to the middle of the screen. Circles appear at the ends of the battery; this is where other items can attach. To modify the battery, click on it. A section opens at the bottom where you can rotate it, change its voltages using the slider, or delete the item.
2. Drag a wire onto the screen. To rotate it, click on one end and drag it around until it is in the position you want it. Match one end of the wire with one end of the battery. A connection is made when the circle around the end of the battery and the wire changes color. Drag another wire onto the screen and attach it to the other end of the battery.
3. Drag the lightbulb onto the screen. There are two circles representing attachment points for the lightbulb. Attach one of the wires to each of the attachment points. Observe what happens and answer Question 1 on your assignment worksheet.
4. To measure the current, use the ammeter. Drag it from the section on the right side of the



screen. Place it near the wire and place the sensor over the wire. The current will appear on the ammeter. Answer Question 2 on your assignment worksheet.

5. To measure the voltage, use the voltmeter. Drag it from the right side of the screen and place one lead on the wire on one side of the battery and the other lead on the wire on the other side. Answer Question 3 on your assignment worksheet.



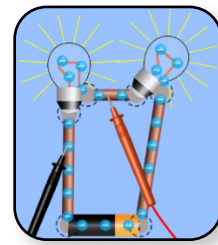
6. Calculate the resistance of the lightbulb by using the voltage and the current, using the equation:

$$V = IR$$

In this equation, V stands for voltage in volts, I for current in amps, and R for resistance in ohms.

Answer Question 4 on your assignment worksheet.

7. To break the circuit, click on one of the lightbulb connections and click on the scissors. Add another wire and another lightbulb to the circuit. Use the voltmeter to measure the voltage between the two wires on either side of the first lightbulb and answer Question 5 on your assignment worksheet.

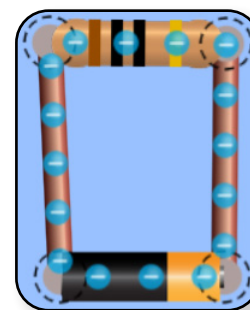


8. Use the voltmeter to measure the voltage on either side of the second lightbulb and answer Question 6 on your assignment worksheet.
9. Measure the voltage on either side of the battery and answer Question 7 on your assignment worksheet.
10. Use the ammeter to measure the current on either side of the battery and through the wire between the 2 lightbulbs. Answer Question 8 on your assignment worksheet.
11. Find the resistance of each lightbulb using the equation $V = IR$ and answer Question 9 on your assignment worksheet.

Calculating Equivalent Resistance

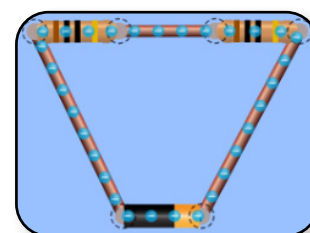
In the previous section you used lightbulbs as the resistance. You can also use resistors from the list of items on the left. In this section you will put multiple resistors together. The overall resistance produced from these resistors is called equivalent resistance. In this section you will determine how the equivalent resistance is calculated.

1. Click the “Reset” button. Drag a battery, two pieces of wire, and a resistor to the middle of the screen and connect them in a circuit similar to the one with the lightbulb you made for the last section.



2. Use the ammeter and voltmeter to measure the current and the voltage in this circuit. Answer Question 10 on your assignment worksheet.
3. Find the resistance using the equation $V = IR$ and answer Question 11 on your assignment worksheet.
4. Click on the resistor and its resistance will appear at the bottom of the screen. Answer Question 12 on your assignment worksheet.

5. Break the circuit at the right corner between a wire and the resistor. Add another wire to the right side of the first resistor. Add another resistor and attach it to the 2 available ends of wire. Click on the second resistor and use the slider or right-facing arrow at the bottom of the screen to change its resistance to $20\ \Omega$. Enter the resistance of each resistor in the data table on Question 13 of your assignment worksheet.



6. Use the voltmeter and ammeter to measure the voltage and current of the whole circuit. To measure the voltage, place the probes on the wires connected to either side of the battery. To measure the current, place the sensor on any of the wires. Record this data on the data table on Question 13 of your assignment worksheet.
7. Calculate the overall resistance and enter that on the data table on Question 13 of your assignment worksheet.
8. Cut the circuit after the second resistor and add another wire and resistor. Close the circuit and change the resistance of the third resistor to $30\ \Omega$. Enter the resistance of each resistor in the data table on Question 14 of your assignment worksheet.
9. Measure the voltage and current of the whole circuit (as you did in step 6) and calculate the resistance for the circuit. Enter these values on the data table on Question 14 of your assignment worksheet.
10. Make one more circuit. Use 4 resistors and vary the resistances. Measure the voltage and current for each of the circuits and calculate the overall resistance. Enter your data on the data table on Question 15 of your assignment worksheet.
11. Study the individual resistances for each circuit and overall resistance for each circuit and answer Question 16 on your assignment worksheet.