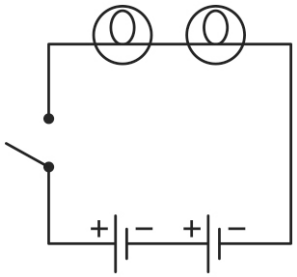
Investigation 17D: Series and parallel resistances

Essential question: What are the advantages and disadvantages of series versus parallel circuits?

Have you ever had a string of holiday lights where one bulb is burned out, preventing all the other bulbs from lighting? Was it easy to find the burned out bulb? This investigation explores series and parallel circuits by connecting bulbs and observing their brightness. By comparing the two circuit types, you will learn why the wiring of *some* strings of lights allows one bad bulb to disconnect all the other bulbs.

Part 1: Connecting bulbs in series



1. Create a circuit using two batteries, one bulb, a switch, and any necessary wire modules.
2. Close the switch and observe the brightness of the bulb.
3. Create a circuit with two bulbs *in series*, as shown in the circuit diagram. Compare the brightness of the two lamps to the previous circuit with one lamp.

Questions

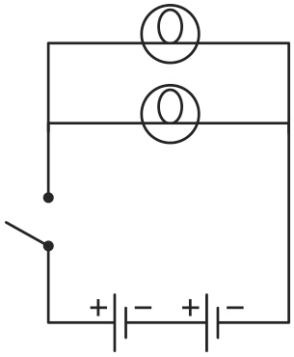
a. What property makes this a series circuit?

b. How bright are the two bulbs in series compared to a single bulb circuit? Why?

c. Unscrew one bulb from the series circuit. What happens to the other bulb? Why?

Part 2: Connecting bulbs in parallel

1. Create a circuit with two bulbs *in parallel*, as shown in the circuit diagram.
2. Compare the brightness of the bulbs in this circuit to the prior circuit with two bulbs in series.



Questions

a. What property makes this a parallel circuit?

b. How bright are the parallel bulbs compared to the series bulbs? Compared to the single bulb? Why?

c. Unscrew one bulb from the parallel circuit. What happens to the brightness of the other bulb? Why?

d. Is a series or parallel circuit better for connecting a string of lights? Why?

e. Design a circuit of three bulbs that combines series and parallel arrangements, and sketch the circuit diagram. Predict the relative bulb brightness based on the previous experiments. Build the circuit and test your predictions. Were you correct?

Applying new knowledge

1. When resistors are connected in series:
   a. Is their equivalent resistance smaller or larger than the individual resistances?

   b. Iis the current through them when connected together larger or smaller than their current if alone in the circuit?

2. When resistors are connected in parallel:
   a. Is the combined resistance smaller or larger than the individual resistances?

   b. Is the total current through the circuit larger or smaller than the total current if there were one resistor alone in the circuit?

   c. Is the current through each individual resistor larger or smaller than the current if it was alone in the circuit?

3. Two strings of tree lights, each with a resistance of 200 Ω, are connected together. What is their equivalent resistance if they are:
   a. connected in series?

   b. connected in parallel?

4. For two resistors with resistances of 10 Ω and 23.7 Ω, what is the equivalent resistance if they are:
   a. connected in series?

   b. connected in parallel?

5. What would be the equivalent resistance if a third resistor of 12.8 Ω were:
   a. added in series with them?

   b. added in parallel with them?