

Series and Parallel Circuits

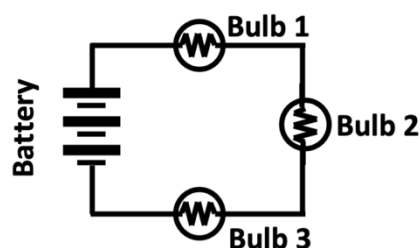
There are a couple of ways to connect two or more devices in a circuit. One is called a *series connection* and the other is called a *parallel connection*. In a **series circuit** such as in **Figure 1**, devices are connected in consecutive fashion. Any charge passing through one device passes through all of them. Bulbs 1, 2 and 3 of **Figure 2** are connected in **parallel**, each in its own *branch*. The charge divides into multiple pathways at the branching location and passes through only one of the branches. A charge passing through Bulb 1 will not pass through Bulb 2 or Bulb 3.

Three experiments were performed to compare and contrast the characteristics of series and parallel connections. Light bulbs were used to indicate the amount of current (rate of charge flow) at each location. The brightness of the bulbs is proportional to the amount of current.

Experiment 1

Students constructed a series circuit consisting of a battery and three identical light bulbs; see **Figure 1**. All the bulbs are lit. When they remove Bulb 1 from its socket, they observe that Bulb 2 and Bulb 3 are no longer lit. And when they remove Bulb 3, they observe that Bulb 1 and Bulb 2 are no longer lit.

Figure 1



Experiment 2

Students observe that the brightness of all three bulbs in **Figure 1** is identical. The students remove Bulb 3 from the circuit and then *re-wire* the circuit so that it includes only two bulbs. They observe the brightness of the remaining bulbs are equal, but brighter than when there were three bulbs. Students then remove a second bulb so that there is only bulb in the circuit; the remaining bulb is brighter than when present in the 2-bulb and the 3-bulb circuit.

Experiment 3

Students construct a parallel circuit using three identical bulbs - 1, 2, and 3; see **Figure 2**. A fourth bulb (a different type than bulbs 1, 2 and 3) is added outside the branches to serve as an indicator of the amount of current in the entire circuit. All the branch bulbs are lit and the students observe that their brightness is the same. The Indicator Bulb is lit as well; it is brighter than the branched bulbs. Students remove bulb 1 from its socket; Bulb 2 and Bulb 3 remain lit and the Indicator Bulb becomes dimmer than it was with all three bulbs present. Students remove both Bulb 1 and Bulb 2 from their sockets; Bulb 3 remains lit and the Indicator Bulb is dimmer than it was with two and with three branched bulbs.

Figure 2

