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## LAB 24B. ELECTRIC CIRCUITS

### Purpose

Explore electric currents through the components in circuits.

### Materials

Multimeter, Two batteries, wire leads, voltage source, resistors, breadboards, battery, light bulbs, light bulb holders, alligator clip wires, two flashlight bulbs, two sockets, two three-way switches

### Base circuit

Construct a switched circuit comprising one battery, one bulb, and one switch.

### Stairway Circuit

In many rooms and stairways, the lights can be controlled by either of two switches at opposite ends. If the lights are off, flipping either switch turns them on. If the lights are on, flipping either switch turns them off. Flipping one switch does not change the setting of the other one. How do these circuits work? Your task is to find out.

The switches used in this type of circuit are “three-way” switches: each switch has three leads. The lever arm of the switch can take any of three positions:

1. bridging the left and center leads,
2. in between, so that no two leads are bridged, and
3. bridging the right and center leads.

Wall switches used for this type of circuit are spring-loaded so that they skip over position 2. Flipping the switch changes between positions 1 and 3. When you use the switches in this activity, do not leave them in the “open” position (2)! Make them behave like the spring-loaded switches in real stairways.

1. To keep things as straightforward as possible, place the battery in a battery holder and screw the light bulb into a socket. Using the light bulb, battery pack, two three-way switches, and as many segments of wire as you need, create a “stairway circuit.”
2. When you have made a stairway circuit, do a victory dance. Call me over to show off and explain how your circuit works. Sketch your circuit here.

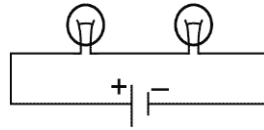
### Series and parallel circuits

Components can be combined in a circuit in two basic ways: in series and in parallel. In **series**, current flows through one component and then the other before returning to the source. In

**parallel**, the path forks so that some current flows through one component and the rest through the other before returning to the source.

*Bulbs in series*

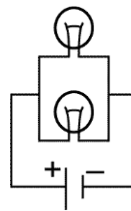
1. Build the circuit illustrated.



2. Are the two bulbs as bright as in a simple circuit with one bulb?
3. Unscrew one bulb. What happens to the other?

*Bulbs in parallel*

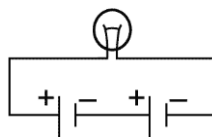
1. Build the circuit illustrated.



2. How does the brightness of the bulbs compare to the series circuit?
3. Unscrew one bulb. What happens to the other?

*Batteries in series*

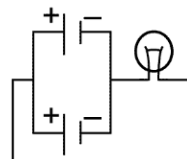
1. Build the circuit illustrated.



2. How does the brightness of the bulb compare to the circuit with one battery?
3. Remove one battery. What happens to the bulb?

*Batteries in parallel*

1. Build the circuit illustrated.



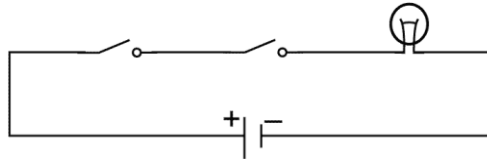
2. How does the brightness of the bulb compare to the circuit with one battery?

3. Remove one battery. What happens to the bulb?

Now you will use the three-way switches as on-off switches. Connect wires only to the center post and one of the end posts, ignoring the other end post.

### *Switches in series*

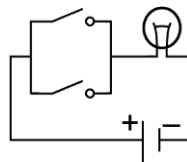
1. Build the circuit illustrated.



2. What happens when both switches are closed?
3. What happens when one switch is closed and one open?
4. What happens when both switches are open?
5. This is known as an “AND” circuit. Why?

### *Switches in parallel*

1. Build the circuit illustrated.



2. What happens when both switches are closed?
3. What happens when one switch is closed and one open?
4. What happens when both switches are open?
5. This is known as an “OR” circuit. Why?