

# Secret Circuits

A real-world, inquiry-oriented activity to assess comprehension of the differences between series and parallel circuits


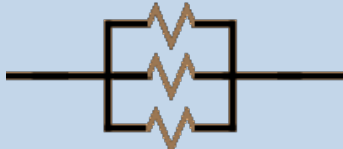
## Objectives

By the end of this inquiry activity, each student should:

1. Observe patterns to solve a challenging problem.
2. Apply knowledge of series and parallel circuits to form a hypothesis to explain the bizarre behavior of the light bulbs in the circuit.
3. Construct a circuit diagram that accurately describes his or her hypothesis.

## Materials

- 1 apparatus consisting of four light bulbs, wired according to the diagram below
- 1 half sheet of scratch paper per student

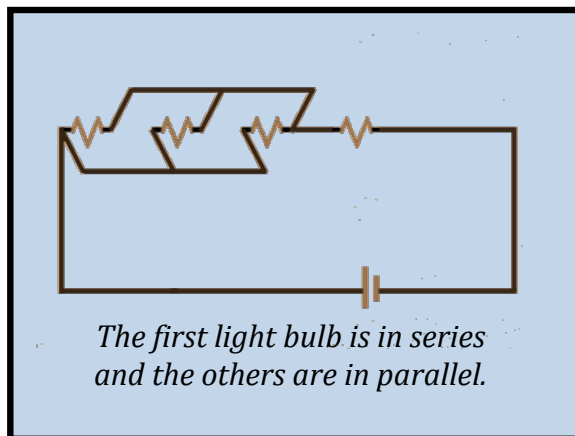
	
<b>Series</b>	<b>Parallel</b>
<ul style="list-style-type: none"><li>• Resistance adds each resistor's resistance</li><li>• Voltage is additive</li><li>• Current is equal</li><li>• <i>Removing one element will open the circuit</i></li></ul>	<ul style="list-style-type: none"><li>• <i>Resistance adds each resistor's inverse</i></li><li>• <i>Voltage is equal</i></li><li>• <i>Current is additive</i></li><li>• <i>Removing one element will not open the circuit</i></li></ul>

## Procedure

1. Explain to the students that today they will be playing a game. The students will be shown a group of four light bulbs that are all elements of one circuit. *Stress that students should not blurt out the answer if they realize how the circuit is wired.*
2. Turn out the overhead lights, leaving a lamp or other light source that is bright enough for students to write. Make sure all of the light bulbs in the apparatus are screwed in tightly, and then plug in the light bulb set to a wall outlet.

## Procedure (cont'd)

3. Ask the students to make observations of the relative brightness of the light bulbs. After the current state of the circuit has been adequately described, begin unscrewing bulbs one by one. *Unscrew the bulbs slowly to allow time for students to think about the patterns they observe.*
4. Continue to unscrew the bulbs in different combinations. Encourage students to suggest light bulbs to remove. It may be helpful to fully unscrew the bulb and take it out of the socket so that students can see that it has been removed. *Unscrew the light bulbs in a logical pattern to guide the students towards the patterns (series, parallel) in the circuit.*
5. Have students signal with a discrete thumbs up or thumbs down whether or not they think they have the solution. If the students seem especially stumped, quickly review series and parallel; emphasize that removing one element in series will open the circuit while removing one element in parallel will not. However, *never directly give students the answer while they should still be actively thinking.*
6. Challenge the students to develop a hypothesis to explain the circuit (which bulbs are connected in series vs. which bulbs are connected in parallel). Have them write their hypothesis at the top of their half sheet of paper. Then, instruct the students to use their hypothesis to construct a diagram of the circuit on their half sheet of paper.



**Wiring Diagram**

## Individual Assessment

In this activity, students will use their observations and their knowledge of series and parallel circuits to produce both a hypothesis and a circuit diagram to explain a real model circuit. Students' work can be graded and also used to assess overall class comprehension of the differences between series and parallel circuits.

## Safety Information

- Make sure the circuit is wired correctly and safely before beginning.
- During the activity, only touch the sides of the bulbs. The tops of the light bulbs will become hot very quickly.

