

Holiday Light Series and Parallel Circuits

Lesson Focus

Demonstrate and discuss simple circuits and the differences between parallel and serial circuit design and functions.

Lesson Synopsis

The series and parallel circuits' activity encourages students to test two different circuit designs through the use of low voltage light bulbs. Students work in teams to predict the difference between the two circuit designs, and then build examples of the two different circuits using foil (as the wires), holiday lights, file folder, tape, brass brads, and batteries.

Objectives

- Learn that different circuit designs result in different electrical behaviors.
- Learn about current flow and the operational differences between series and parallel circuits.
- Learn to predict outcomes and draw conclusions.
- Learn about teamwork and working in groups.

Anticipated Outcomes

As a result of this activity, students should develop an understanding of:

- Parallel and Series Circuits
- Circuits and current flow
- Making and testing predictions
- Teamwork

Lesson Activities

Students perform experiments using two different types of circuit arrangements: series and parallel circuits. Students compare a set-up of series and parallel bulbs, make

predictions about how the circuit will function, record results, and discuss the circuits as a group.

Materials

- Student Resource Sheets
- Student Worksheets
- Pencils
- Aluminum Foil cut into strips
- 3 Brass Brads
- Holiday Lights (cut apart and score about a $\frac{1}{4}$ " from the bottom of each light to remove the plastic)
- Tape
- File Folder
- 9-Volt Battery

Procedure

1. Review the definitions of series and parallel circuits with the class. Use Student Resource Sheets for background information.
2. Divided students into small groups of 2 - 3 students and distribute Student worksheet and materials for each group.
3. Ask the groups to examine the schematic of a series circuit on the Student Worksheet and draw their own plan for a series and parallel circuits in the space provided.
4. Have each group test their lights on the battery to determine the positive and negative ends of the light.
5. Have each group make a series circuit on one side of the file folder and a parallel circuit on the other side using aluminum foil for wires, 3 brass brads for the switch, tape, holiday lights, and a 9-Volt battery. Remind students to leave a space between the wires for the switch and the battery.
6. Once the circuits are complete, ask the groups to make predictions as to how the circuits will function if the light bulb is removed. Also discuss whether the bulbs might burn brighter in one set up than another. Students should record their predictions on the student worksheet.

7. Have the groups test their predictions using their circuits, and compare their results to their predictions.

8. Bring the groups together and discuss the findings.

Standards

Next Generation Science Standards

Energy

Students who demonstrate understanding can:

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another

ELA

W.4.7. Conduct short research projects that build knowledge through investigation of different aspects of a topic.

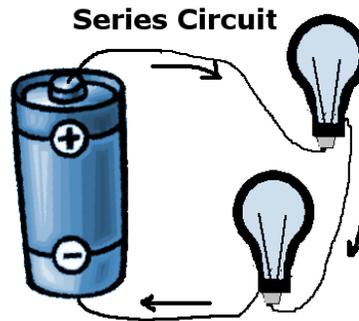
W.4.8. Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Series and Parallel Circuits

What is a Simple Circuit?

❖ Simple Circuit

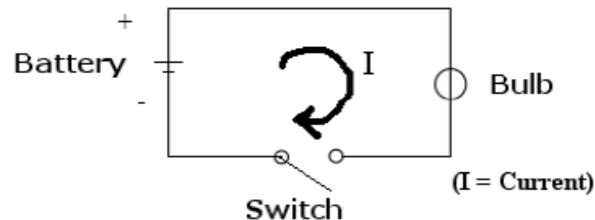
A simple circuit consists of three elements: a source of electricity (battery), a path or conductor on which electricity flows (wire), and a electrical resistor (lamp) which is any device that requires electricity to operate. The illustration below shows a simple circuit containing a battery, two wires, and a low voltage light bulb. The flow of electricity is caused by excess electrons on the negative end of the battery flowing toward the positive end, or terminal, of the battery. When the circuit is complete, electrons flow from the negative terminal through the wire conductor, then through the bulb (lighting it up), and finally back to the positive terminal - in a continual flow.



❖ Schematic Diagram of a Simple Circuit

The following is a schematic diagram of the simple circuit showing the electronic symbols for the battery, switch, and bulb.

Schematic Diagram of a Simple Circuit



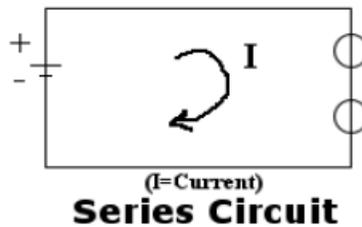
Series and Parallel Circuits

What are Series and Parallel Circuits?

Series and parallel describes two different types of circuit arrangements. Each arrangement provides a different way for electricity to flow throughout a circuit.

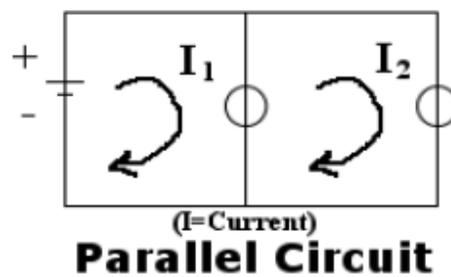
❖ Series Circuits

In a series circuit, electricity has only one path on which to travel. In the example below, two bulbs are powered by a battery in a series circuit design. Electricity flows from the battery to each bulb, one at a time, in the order they are wired to the circuit. In this case, because the electricity can only flow in one path, if one of the bulbs blew out, the other bulb would not be able to light up because the flow of the electric current would have been interrupted. In the same way, if one bulb was unscrewed, the current flow to both bulbs would be interrupted.



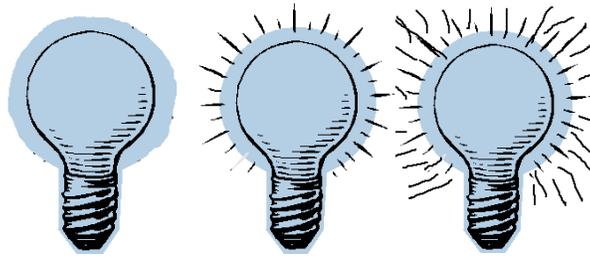
❖ Parallel Circuits

In a parallel circuit, electricity has more than one path on which to travel. In the example below, two bulbs are powered by a battery in a parallel circuit design. In this case, because the electricity can flow in more than one path, if one of the bulbs blew out, the other bulb would still be able to light up because the flow of electricity to the broken bulb would not stop the flow of electricity to the good bulb. In the same way, if one bulb were unscrewed, it would not prevent the other bulb from lighting up.



❖ What About Resistance?

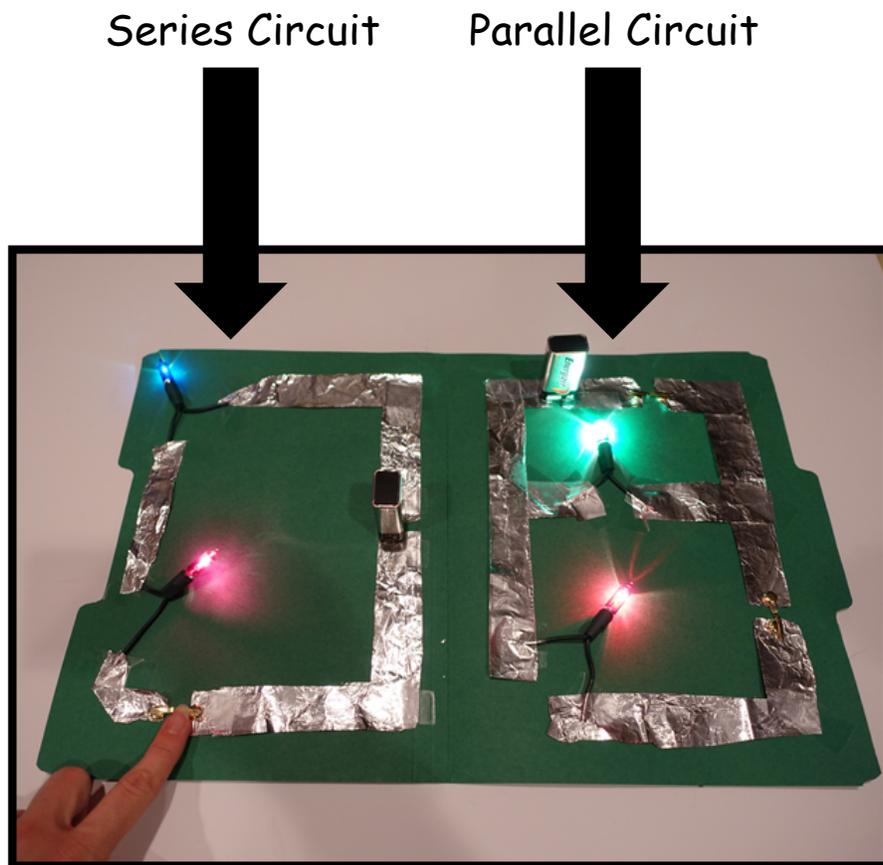
The flow of electricity depends on how much resistance is in the circuit. In our examples, the bulbs provide resistance. In a series circuit, the resistance in the circuit equals the total resistance of all the bulbs. The more bulbs in the circuit the dimmer they will light. In a parallel circuit, there are multiple paths through which current can flow, so the resistance of the overall circuit is lower than it would be if only one path was available. The lower resistance means that the current will be higher and the bulbs will burn brighter compared to the same number of bulbs arranged in a series circuit.



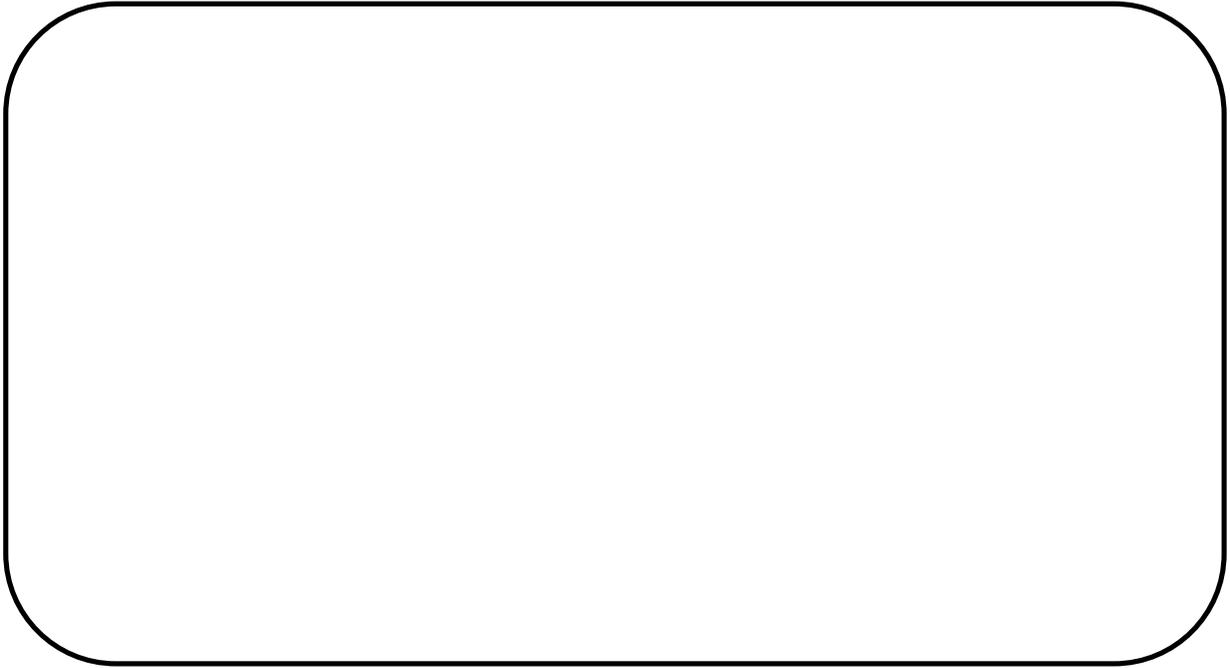
Holiday Light Series and Parallel Circuits

❖ Instructions

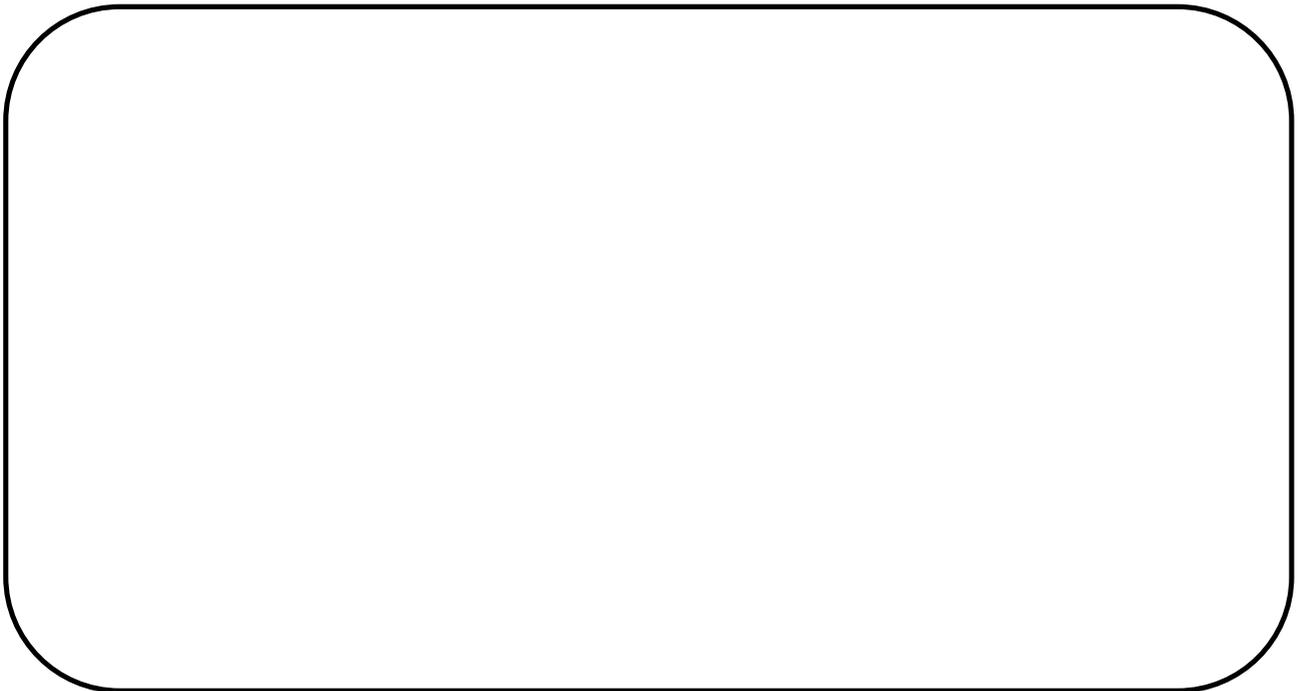
You are the engineer! You need to design a system where one switch can turn on multiple lights! An example might be a string of holiday lights. Now, construct both a series circuit and a parallel circuit using aluminum foil as wires, holiday lights, 3 brass brads as the switch, tape, file folder, and a 9-Volt battery. Below is an example of a series and parallel circuit.



Draw your own diagram below that illustrates how your *Series Circuit* will look:



Draw your own diagram below that illustrates how your *Parallel Circuit* will look:



❖ *Group Predictions:*

After you have constructed both a series and parallel circuit, make some predictions on the following as a group:

1. Do you think holiday lights are an example of parallel or series bulbs in a circuit?

2. Do you think the bulbs in the parallel circuit or the series circuit will burn brighter?

Explain why:

3. If you remove a bulb in your parallel circuit, will the other bulb(s) still light? Explain

why:

4. If you remove a bulb in your series circuit, will the other bulb(s) still light? Explain why:

❖ Test and Results

Now test your predictions for questions 2, 3 and 4 above. Then respond to the questions below:

1. Were your predictions about the brightness of the bulbs accurate? If not, what happened that was different from what your group expected?

2. Were your predictions about what happened if a bulb was removed from the parallel and series circuits accurate? If not, what happened that was different from what your group expected?