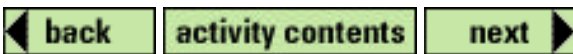


## ACTIVITY CONTENTS:

### Parallel versus Series Circuits

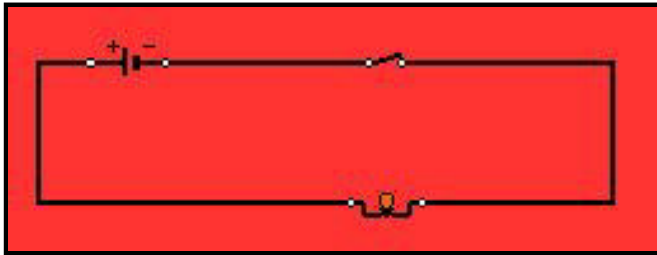
- [Introduction](#)
- [Thinking About the Question](#)
- [Materials](#)
- [Safety](#)
- [Investigation I: Testing a two bulb circuit](#)
- [Investigation II: Testing a series circuit](#)
- [Investigation III: Testing a parallel circuit](#)
- [Technical Hints](#)
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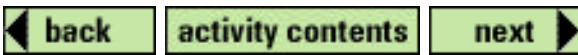


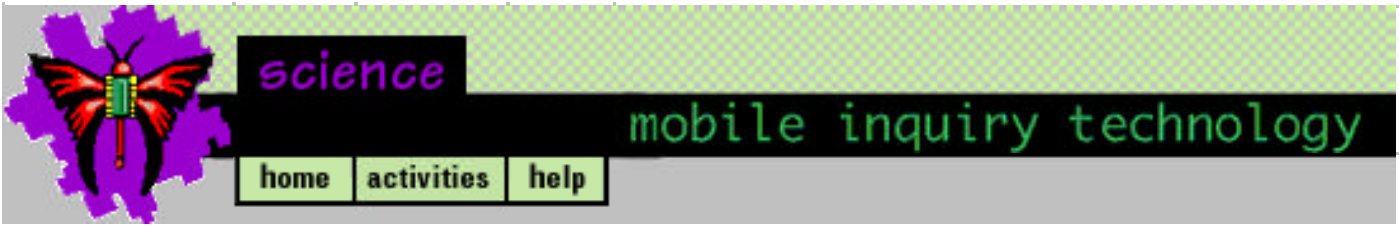
## Parallel versus Series Circuits Introduction

**Discovery Question:** What is the difference between series and parallel circuits?



In this activity you will compare voltage in a parallel and a series circuit.



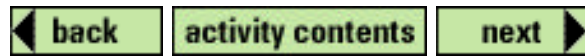


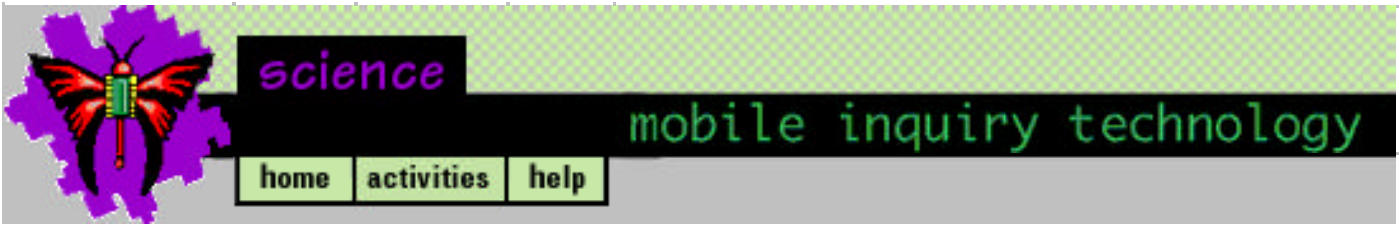
## Thinking About the Question

### What is the difference between series and parallel circuits?

Many of you have seen light fixtures in which there are more than one bulb. In your group make a list of the kinds of light fixtures that you know that hold more than one bulb.

Are some of the bulb arrangements with the same number of bulbs brighter than other arrangements? Write down your ideas about what might explain this.





## Parallel versus Series Circuits Materials

- CC DMM (digital multimeter)
- D-cell battery and battery holder
- insulated wire
- bulbs and bulb holders (at least three per group)
- switch





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## Parallel versus Series Circuits Safety

Connecting leads directly between battery terminals may result in overheating and damage to the battery. Disconnect the leads if they become overheated.

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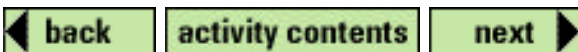
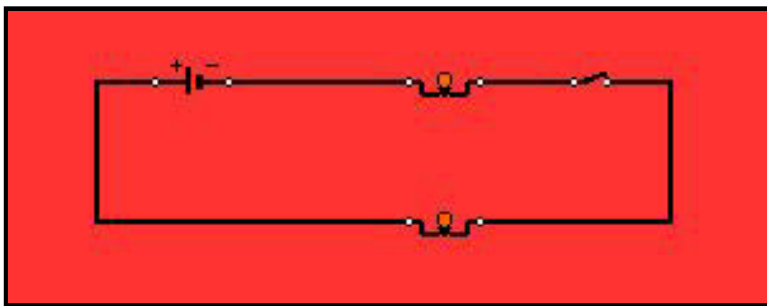
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## Parallel versus Series Circuits Investigation I

### Testing a two bulb circuit

1. Test the voltage of your battery. Use the CC DMM to measure the voltage. Refer to [Technical Hints](#) to see how to use the CC DMM program.
2. Construct the circuit.
3. Go the Question 1 in the "Analysis".
4. Now it's time to test your predictions. Use the CC DMM to measure the voltage across each bulb. Record your data.
5. Go to Question 2 in "Analysis".





## Parallel versus Series Circuits Investigation II

### Testing a series circuit

1. What do you think would happen to the brightness and the voltage of each bulb if you added a third bulb to your series circuit? Make a drawing of the circuit. Next to each bulb on the drawing write your prediction for the voltage across the bulb.



2. Using the same steps as in "Investigation I" test each bulb in the circuit. In a different color write the actual voltage reading next to each bulb on your drawing. Refer to [Technical Hints](#) to see how to use the CC DMM program.
3. Go to Questions 3 and 4 in "Analysis".

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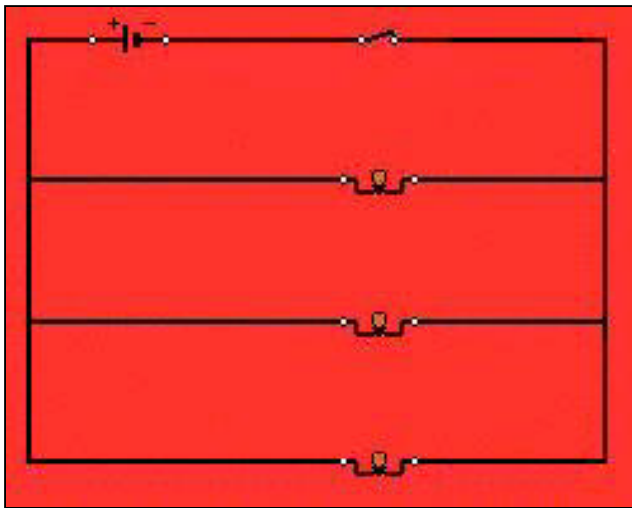
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## Parallel versus Series Circuits Investigation III

### Testing a parallel circuit

1. What do you think would happen to the brightness and the voltage of each bulb if you added a third bulb to your parallel circuit. Make a drawing of the circuit. Next to each bulb on the drawing write your prediction for the voltage across the bulb.



2. Using the same steps as in "Investigation I" test each bulb in the circuit. In a different color write the actual voltage reading next to each bulb on your drawing. Refer to [Technical Hints](#) to see how to use the CC DMM program.
3. Go to Questions 5, 6, and 7 in the "Analysis".

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## Parallel versus Series Circuits Technical Hints

- Using the CC DMM program
- Making a spreadsheet
- Finding a sum
- Creating a bar chart

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## **Parallel versus Series Circuits Technical Hints**

### **To use the CC DMM program:**

1. Set the knob on the multimeter to the 2 V (in yellow region) scale
2. Turn on the multimeter. The multimeter will not need to be connected to the computer.
3. Place the leads of the multimeter on either side of each bulb in the circuit. Observe the readout on the multimeter screen. Record a stable reading for each bulb. Remember if a negative value is obtained, switch the leads to opposite sides of the bulb.

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**Parallel versus Series Circuits Technical Hints**

**To make a spreadsheet:**

1. Open the ClarisWorks spreadsheet program by selecting it from the opening menu.
2. Title the first column as Bulb in Cell A1. Title the second column for Series Circuit in Volts in Cell B1. Title the second column for Parallel Circuit in Volts in Cell C1.

|    | A                    | B                      | C | D | E | F | G | H |
|----|----------------------|------------------------|---|---|---|---|---|---|
| 1  | Bulb                 | Series Circuit (Volts) |   |   |   |   |   |   |
| 2  | #1                   |                        |   |   |   |   |   |   |
| 3  | #2                   |                        |   |   |   |   |   |   |
| 4  | #3                   |                        |   |   |   |   |   |   |
| 5  | Sum of all the bulbs |                        |   |   |   |   |   |   |
| 6  |                      |                        |   |   |   |   |   |   |
| 7  |                      |                        |   |   |   |   |   |   |
| 8  |                      |                        |   |   |   |   |   |   |
| 9  |                      |                        |   |   |   |   |   |   |
| 10 |                      |                        |   |   |   |   |   |   |
| 11 |                      |                        |   |   |   |   |   |   |
| 12 |                      |                        |   |   |   |   |   |   |
| 13 |                      |                        |   |   |   |   |   |   |
| 14 |                      |                        |   |   |   |   |   |   |
| 15 |                      |                        |   |   |   |   |   |   |
| 16 |                      |                        |   |   |   |   |   |   |
| 17 |                      |                        |   |   |   |   |   |   |
| 18 |                      |                        |   |   |   |   |   |   |
| 19 |                      |                        |   |   |   |   |   |   |
| 20 |                      |                        |   |   |   |   |   |   |
| 21 |                      |                        |   |   |   |   |   |   |
| 22 |                      |                        |   |   |   |   |   |   |





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**Parallel versus Series Circuits Technical Hints**

**To find a sum:**

1. Highlight the cell that you wish for the sum to appear in.
2. Select Paste Function from the Edit menu.
3. Highlight within the parentheses and type the starting and ending cell separated by a comma.

| File Edit Format Calculate Options View Help |                      |                        |                          |   |   |   |   |   |
|--|----------------------|------------------------|--------------------------|---|---|---|---|---|
| untitled (SS)                                |                      |                        |                          |   |   |   |   |   |
| B5   |                      |                        |                          |   |   |   |   |   |
|  | A                    | B                      | C                        | D | E | F | G | H |
| 1  | Bulb                 | Series Circuit (Volts) | Parallel Circuit (Volts) |   |   |   |   |   |
| 2  | #1                   | 0.754                  | 1.51                     |   |   |   |   |   |
| 3  | #2                   | 0.745                  | 1.493                    |   |   |   |   |   |
| 4  | #3                   | 0.763                  | 1.503                    |   |   |   |   |   |
| 5  | Sum of all the bulbs |                        |                          |   |   |   |   |   |
| 6  |                      |                        |                          |   |   |   |   |   |
| 7  | Battery (Volts)      | 1.539                  |                          |   |   |   |   |   |
| 8  |                      |                        |                          |   |   |   |   |   |
| 9  |                      |                        |                          |   |   |   |   |   |
| 10   |                      |                        |                          |   |   |   |   |   |
| 11   |                      |                        |                          |   |   |   |   |   |
| 12   |                      |                        |                          |   |   |   |   |   |
| 13   |                      |                        |                          |   |   |   |   |   |
| 14   |                      |                        |                          |   |   |   |   |   |
| 15   |                      |                        |                          |   |   |   |   |   |
| 16   |                      |                        |                          |   |   |   |   |   |
| 17   |                      |                        |                          |   |   |   |   |   |
| 18   |                      |                        |                          |   |   |   |   |   |
| 19   |                      |                        |                          |   |   |   |   |   |
| 20   |                      |                        |                          |   |   |   |   |   |
| 21   |                      |                        |                          |   |   |   |   |   |
| 22   |                      |                        |                          |   |   |   |   |   |

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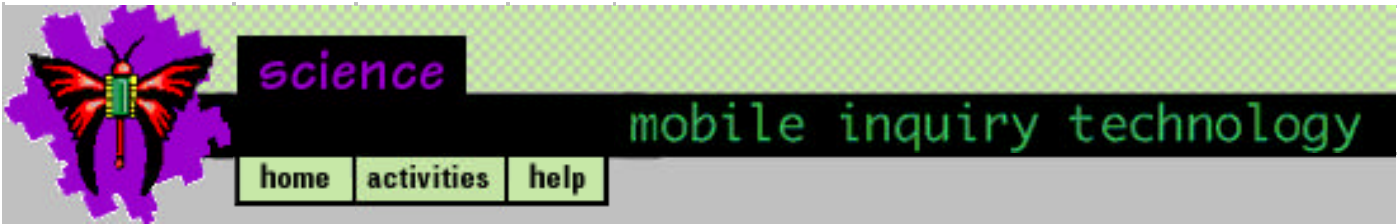
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**Parallel versus Series Circuits Technical Hints**

**To create a bar chart:**

1. Highlight your data and sums in Column B and Column C starting with Cell B1.
2. Select Make Chart from the Options menu. Click on Bar chart. If you want to title the graph, double click on the chart and select the Label button. Type Series and Parallel Circuits.

| File Edit Format Calculate Options View Help |                      |                        |                          |   |   |   |   |   |
|--|----------------------|------------------------|--------------------------|---|---|---|---|---|
| untitled (55)                                |                      |                        |                          |   |   |   |   |   |
| B1 x ✓ Series Circuit (Volts)                |                      |                        |                          |   |   |   |   |   |
|  | A                    | B                      | C                        | D | E | F | G | H |
| 1  | Bulb                 | Series Circuit (Volts) | Parallel Circuit (Volts) |   |   |   |   |   |
| 2  | #1                   | 0.754                  | 1.51                     |   |   |   |   |   |
| 3  | #2                   | 0.745                  | 1.493                    |   |   |   |   |   |
| 4  | #3                   | 0.763                  | 1.503                    |   |   |   |   |   |
| 5  | Sum of all the bulbs | 1.517                  | 3.013                    |   |   |   |   |   |
| 6  |                      |                        |                          |   |   |   |   |   |
| 7  | Battery (Volts)      | 1.539                  |                          |   |   |   |   |   |
| 8  |                      |                        |                          |   |   |   |   |   |
| 9  |                      |                        |                          |   |   |   |   |   |
| 10   |                      |                        |                          |   |   |   |   |   |
| 11   |                      |                        |                          |   |   |   |   |   |
| 12   |                      |                        |                          |   |   |   |   |   |
| 13   |                      |                        |                          |   |   |   |   |   |
| 14   |                      |                        |                          |   |   |   |   |   |
| 15   |                      |                        |                          |   |   |   |   |   |
| 16   |                      |                        |                          |   |   |   |   |   |
| 17   |                      |                        |                          |   |   |   |   |   |
| 18   |                      |                        |                          |   |   |   |   |   |
| 19   |                      |                        |                          |   |   |   |   |   |
| 20   |                      |                        |                          |   |   |   |   |   |
| 21   |                      |                        |                          |   |   |   |   |   |
| 22   |                      |                        |                          |   |   |   |   |   |

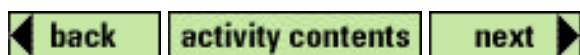




## Parallel versus Series Circuits Analysis

Answer the following questions on paper:

1. Before you use the multimeter predict the voltage through each bulb. Explain how you made your prediction.
2. How did your prediction about the voltage across each bulb in the two-bulb circuit compare to the voltage shown on the multimeter? How did the sum of the voltage across each bulb compare to the voltage of the battery?
3. How did your prediction about the voltage across each bulb in the three-bulb series circuit compare to the voltage shown on the multimeter?
4. Reread the ideas you wrote down about the difference in bulb brightness in series circuits in "Thinking About the Question". Think about the data you have gathered. Does this data support your original idea or does it suggest to you a different explanation? Revise your original explanation. Include evidence from Investigation II in your revised explanation.
5. How did your prediction about the voltage across each bulb in the three-bulb parallel circuit compare to the voltage shown on the multimeter?
6. Reread the ideas you wrote down about the difference in bulb brightness in parallel circuits in "Thinking About the Question". Think about the data you have gathered. Does this data support your original idea or does it suggest to you a different explanation? Revise your original explanation. Include evidence from Investigation III in your revised explanation.
7. Make a spreadsheet of your voltage data from each circuit. Refer to [Technical Hints](#) to see how to make a spreadsheet. Include a sum of the total voltage of each circuit. Refer to [Technical Hints](#) to see how to find a sum.
8. How did the sum of the voltages for each circuit compare to the voltage of the battery?
9. Create a bar chart for the voltages across each bulb in series and parallel for the circuits constructed in Investigation II and III. Refer to [Technical Hints](#) to see how to make a bar chart. Explain the differences in voltages between series and parallel circuits.





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### Parallel versus Series Circuits Further Investigation

What do you think will happen if you remove one bulb from a series circuit? What will happen in a parallel circuit? Explain your answer.

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