

# Producing More Electricity with Solar Cells and Solar Panels

## Student Activity Sheets - Exploration

### Engagement

**Part 1:** You have a flashlight with an LED light bulb that requires 3 volts to light up. The batteries you have each produce 1.5 volts. Can you make the LED light up with the batteries that you have? Perform steps 1 – 9 in the Exploration section to help you answer this question.

**Part 2:** What if you do not have any batteries but do have some solar cells. Could you use the solar cells to make the LED light up? Perform steps 10 – 18 in the Exploration section to help you answer this question.

### Exploration

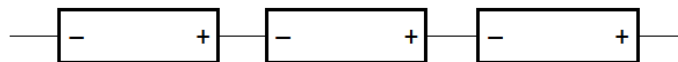
**Part 1:** Explore what happens when batteries are connected in different ways.

Series Connection: According to electrical theory when batteries are connected in series the total voltage available from the batteries is approximately equal to the sum of the voltages of the individual batteries. However, when batteries are connected in series the electrical currents available from the individual batteries do not simply add up so the total current available is not the sum of the currents from the individual batteries.

Parallel Connection: Electrical theory also states that when batteries are connected in parallel the total electrical current available from the batteries is approximately equal to the sum of currents from the individual batteries. However, when connected in parallel the voltages available from the individual batteries do not simply add up so the total voltage available is not the sum of the voltages from individual batteries.

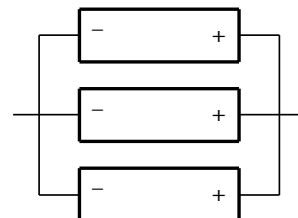
Series Connection -

Batteries End to End  
Positive to Negative



Parallel Connection -

Batteries Side by Side  
All Positives Connected Together  
All Negatives Connected Together



**Part 1.** Explore series and parallel relationships with batteries.

1. Use the multimeter to measure the voltage produced by one AA battery. Write the results of your measurement including the units for the measurement?

(20 volt DC multimeter scale)

2. Use the multimeter to measure the electrical current produced by one AA battery. Write the results of your measurement including the units for the measurement?

(10 amp multimeter scale)

3. Use the multimeter to measure the voltage in a simple circuit consisting of two AA batteries connected in series. Write the results of your measurement including the units for the measurement?

(20 volt DC multimeter scale)

4. Use the multimeter to measure the current in a simple circuit consisting of two AA batteries connected in series. Write the results of your measurement including the units for the measurement?

(10 amp multimeter scale)

5. Use the multimeter to measure the voltage in a simple circuit consisting of two AA batteries connected in parallel. Write the results of your measurement including the units for the measurement?

(20 volt DC multimeter scale)

6. Use the multimeter to measure the electrical current in a simple circuit consisting of two AA batteries connected in parallel. Write the results of your measurement including the units for the measurement?

(10 amp multimeter scale)

7. Was the voltage measured from two AA batteries connected in series (Step 3) twice the voltage from one AA battery (same as adding two separate AA batteries together)?

8. If you have a 3 volt LED, try to make it light up using one or more batteries. If you were able to make the LED light up use words or draw a diagram to describe how you connected the LED and the batteries together?

9. If you have a small motor, try to make it operate using one battery and then try two batteries. Did you observe any differences? Draw a diagram of your connections.

**Part 2:** Explore series and parallel relationships with solar cells.

10. Use the multimeter to measure the voltage produced by one solar cell. Write the results of your measurement including the units for the measurement?

(20 volt DC multimeter scale)

11. Use the multimeter to measure the electrical current produced by one solar cell. Write the results of your measurement including the units for the measurement?

(200 milliamp multimeter scale)

12. Use the multimeter to measure the voltage in a simple circuit consisting of two solar cells connected in series. Write the results of your measurement including the units for the measurement?

(20 volt DC scale)

13. Use the multimeter to measure the electrical current in a simple circuit consisting of two solar cells connected in series. Write the results of your measurement including the units for the measurement?

(200 milliamp multimeter scale)

14. Use the multimeter to measure the voltage in a simple circuit consisting of two solar cells connected in parallel. Write the results of your measurement including the units for the measurement?

(20 volt DC scale)

15. Use the multimeter to measure the electrical current in a simple circuit consisting of two solar cells connected in parallel. Write the results of your measurement including the units for the measurement?

(200 milliamp multimeter scale)

16. Was the voltage measured from two solar cells connected in series (Step. 12) twice the voltage from one solar cell (same as adding two separate solar cells together)?

17. If you have a 3 volt LED, try to make it light up using one or more solar cells. If you were able to make the LED light up use words or draw a diagram to describe how you connected the LED and the solar cells together?

18. If you have a small motor, try to make it operate using one solar cell and then try using two. Did you observe any differences? Draw a diagram of your connections.