

Overview:

Students will make predictions about the brightness of lightbulbs connected in parallel and in series, then build the circuits to test their predictions.

Objectives:

The student will:

- be able to identify a simple circuit;
- build a circuit with lightbulbs in series; and
- build a circuit with lightbulbs parallel.

Targeted Alaska Grade Level Expectations:**Science**

[9] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[9] SB2.2 The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by recognizing simple electrical circuits.

Whole Picture:

Electrical current is the flow of electric charge. In a cell (commonly called a battery) the charge is a result of the flow of electrons from the negative terminal to the positive terminal. A path that allows the charge to flow is called a circuit. There cannot be any gaps in the circuit to allow for a continuous flow of electrons. In a circuit there is usually a device that will have some resistance to the current. The devices can be connected in two ways, series or parallel. When there is a single pathway for current, it is said to be in series. When there are multiple paths for current to flow it is called parallel. Each type of circuit has its own characteristics. In this activity students will examine a circuit and compare how series and parallel circuits affect the brightness of lightbulbs. Before beginning the activity students should be familiar with the electrical concepts of amperes, ohms, and voltage.

Materials:

Per group:

- D cell battery (one)
- Lightbulbs in sockets
- Insulated copper wire (approx. 30cm each, 8 strips)
- Screwdriver

Alternate (If there is access to computers the Circuit Construction Kit from the University of Colorado Boulder can be used for this activity. It is available at: <http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc>)

- MULTIMEDIA: "Circuit Construction Kit" (<http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc>)
- OTHER RESOURCE: "Teachers Guide for Circuit Construction Kit" (<http://phet.colorado.edu/files/teachers-guide/circuit-construction-kit-dc-guide.pdf>)
- STUDENT WORKSHEET: "Let It Shine"
- STUDENT LAB: "Let It Shine"

Activity Preparation:

1. Make an overhead and copies of STUDENT WORKSHEET: "Let It Shine."
2. Make copies of the STUDENT LAB: "Let It Shine."

3. Remove the insulation from the ends of the copper wires.
4. If students are using the Circuit Construction Kit it should be downloaded on the computers before students do the lab.

Activity Procedure:

1. Hand out copies of the STUDENT WORKSHEET: "Let It Shine." Give students time to look at the four examples of the flow of current in the circuits on the page then ask them to decide which one(s) are correct. If there are ones they do not think are correct they should list the reasons why they think it is wrong.
2. Show an overhead of the STUDENT WORKSHEET: "Let It Shine." Ask students to share which ones they think are correct and which are wrong. Also ask them to share their reason why they think some are wrong. After the discussion, clear up any misconceptions by explaining which one is correct and what is wrong with the others.
3. Hand out copies of the STUDENT LAB: "Let It Shine." Go over the different circuits and explain the difference between parallel and series circuits. Before building the circuits students should write their predictions in the column on the left.
4. After the predictions have been made, give students the materials, or have them launch the Circuit Construction Kit, to build the circuits to test their predictions. After making the circuits they should write their observations in the column on the right. When students are finished building circuits they should answer the questions at the end of the lab.
5. Once all students have completed the lab discuss the results with the class.

Extension Ideas:

1. If a voltmeter, and ammeter are available let students test the voltage and current in the circuits. Both an ammeter and voltmeter is available with the Circuit Construction Kit.
2. Have students use 2 or more D Cells with the circuits to see the effects on the brightness of the bulbs.

Answers:

STUDENT WORKSHEET: "Let It Shine"

- A. No. The flow of current will be the same on both sides of the lightbulb.
- B. No. The flow of current must go around in a circle from the negative pole to the positive pole to complete the circuit.
- C. Yes. This diagram correctly shows the flow of current in the circuit.
- D. No. Same explanation as "B." The flow of current must go completely around the circuit. It does not stop at the lightbulb.

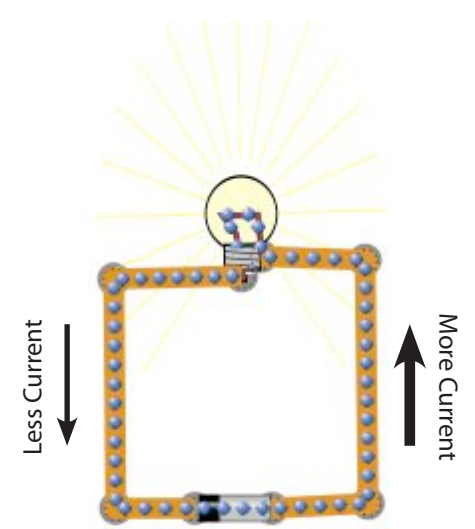
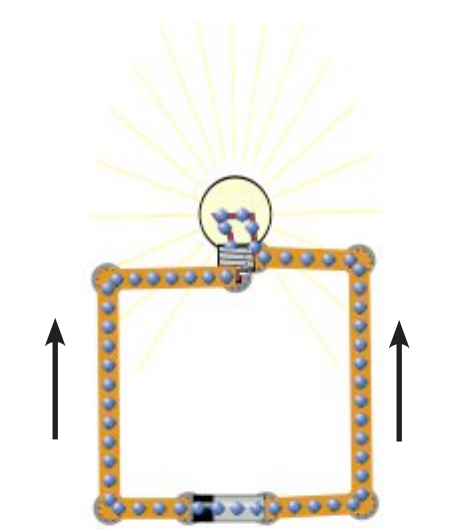
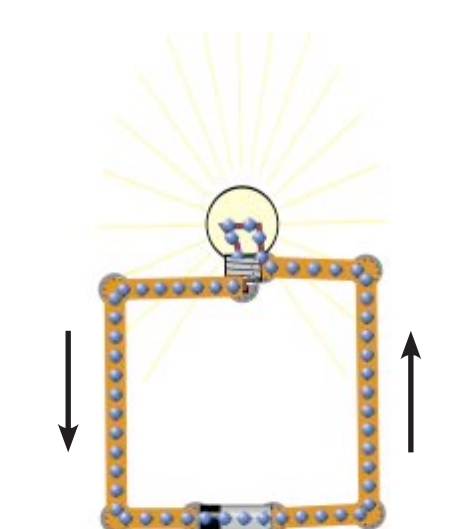
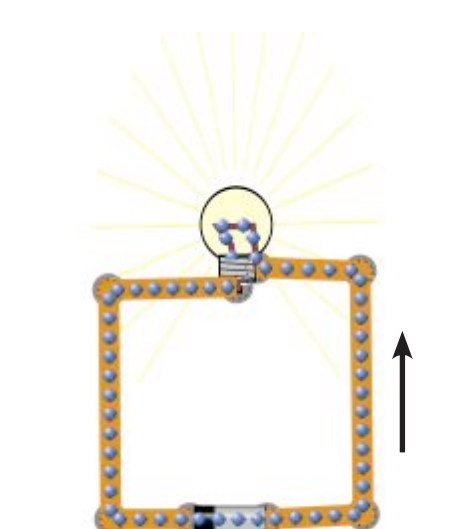
STUDENT LAB: "Let It Shine"

- A. Lights #2 and #3 will be equally bright. They will be less bright than #1.
 - B. Lights #4 and #5 will be equally bright. They will be equally bright to #1.
 - C. Light #6 and #7 will be equally bright and less bright than #8.
1. They will all be equal brightness and less bright than if there were only two.
 2. They would be equally bright as only two.
 3. Lights in series are equally bright but each light will be dimmer as additional lights are added. Lights in parallel allow more paths for the flow of current so they will remain equally bright as more lights and paths are added.

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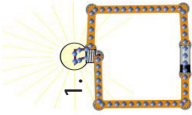
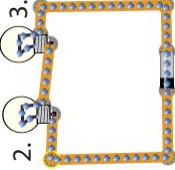
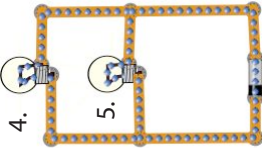
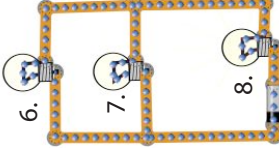
LET IT SHINE

Below are four diagrams of circuits with arrows showing the flow of current in the circuit. Circle (yes/no) whether you think each one is correct or not. If it is not correct give your reason why you think it is not.

<p>A. Correct? Yes/No Reason:</p> 	<p>A. Correct? Yes/No Reason:</p> 
<p>A. Correct? Yes/No Reason:</p> 	<p>A. Correct? Yes/No Reason:</p> 

NAME: _____
LET IT SHINE

Look at the examples in the middle column. Before making the circuits, write your prediction in the column on the left. After completing the predictions build the circuits using the materials provided. Once the circuits have been completed, write your observations about the brightness of the lightbulbs.

Prediction	Example	Actual
<p>A. Lights in Series</p> <p>Predict how bright lightbulbs #2 and #3 will be compared to each other.</p> <p>Predict how bright lightbulbs #2 and #3 would be compared to #1.</p>	 	<p>Lights in Series</p> <p>Compare how bright lightbulbs #2 and #3 are compared to each other.</p> <p>Compare how bright lightbulbs #2 and #3 are compared to #1.</p>
<p>B. Lights in Parallel</p> <p>Predict how bright lightbulbs #4 and #5 will be compared to each other.</p> <p>Predict how bright lightbulbs #4 and #5 would be compared to #1.</p>		<p>Lights in Parallel</p> <p>Compare how bright lightbulbs #4 and #5 are compared to each other.</p> <p>Compare how bright lightbulbs #4 and #5 are compared to #1.</p>
<p>C. Lights in Series and parallel</p> <p>Predict how bright lightbulbs #6, #7 and #8 will be compared to each other.</p>		<p>Lights in Series and parallel</p> <p>Compare how bright lightbulbs #6, #7 and #8 are compared to each other.</p>

NAME: _____
LET IT SHINE

STUDENT LAB
(page 2 of 2)

Directions: Provide directions on how to complete the worksheet here.

1. If you added another lightbulb to circuit A, what do you think will happen to the brightness of the lightbulbs?

2. If you added another lightbulb to circuit B, what you do think would happen to the brightness of the lightbulbs?

3. Are there some general rules that you can state about the brightness of lights in parallel and lights in series?
