## I. Lighting a Light Bulb

**Target Group:** 3rd – 5th grade (meets 4th grade NGSS standard)

**Prior Knowledge:** Because this is intended as an introductory lesson on electricity, students do not need any prior knowledge of circuits.

**Learning Objective**: We will explore electricity and determine what makes a light bulb light by testing different electric pathways.

- **NGSS Standard 4-PS3-2:** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- **CDE Physical Science 1.1:** Energy comes in many forms such as light, heat, sound, magnetic, chemical, and electrical (1.1a) electricity in circuits requires a complete loop through which current can pass
- **CCSS.ELA-Literacy.SL.4.1**: Engage effectively in a range of collaborative discussions (1-on-1, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly.

**Time:** 45 - 60 minutes

**Materials:**

- Laptops/computers for each student*
- Activity sheet for each student (see below)
- Projector & document camera (optional)
- PhET simulation: Circuit Construction Kit (DC Only) http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc

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**Comment [1]:** •If necessary, students can be paired & share 1 laptop, but teacher must then monitor to ensure that both students have the opportunity to 'drive' the Sim. Periodic instructions to switch who controls the computer would be needed.

| Time | Procedure | Teaching Tips |
|---|---|---|
| 3 minutes | **Introduction**:<br>• Ask students to generate and share questions about electricity.<br>• Distribute activity sheets and review today's learning objective. | • *Time saver:* If possible, have computers logged on and set up for Circuit Construction sim. |
| 10 minutes | **Explore:**<br>• Allow 5 minutes to explore the PhET sim, *Circuit Construction Kit (DC only)* http://phet.colorado.edu/en/simulation/circuit-construction-kit-dc<br>• After 5 minutes, have students share ideas and findings with a partner. Monitor student discussion. Call attention to important findings or components of the sim and facilitate a discussion of these as a whole class. | • *Management tip:* Have turn-and-talk or think-pair-share norms in place. Once students have the routines for sharing collaboratively, time can be used most effectively. In my classroom, pairing is purposeful but varies depending upon activity.<br>• Project the sim as you highlight findings |

| | | |
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| 20 minutes | **Procedure:**<br>• Students will follow along on their activity sheet as teacher facilitates.<br>• Tell students that they will be exploring what is needed to make a lightbulb light.<br>• Draw students' attention to the first table (# 3). Explain the table to students: They will attempt to make a pathway using the components in the first column, determine its effectiveness in lighting the bulb, and record any additional observations. While the 1st portion of the table is directed, students may manipulate the sim as they choose for the next 3 parts.<br>• Allow students to explore different circuits, monitoring student findings to help facilitate class discussion.<br>• After 10 minutes, call class together. Allow students 2 minutes to record a successful attempt to light the bulb in #4.<br>• #5 Have students turn and share with their partner before having a whole class discussion.<br>• Highlight interesting findings. Ask students to share both successful and unsuccessful circuits: *What worked? What didn't work?* Emphasize that in order to light the bulb, the current (blue electrons) needed a pathway to move from a source (battery) to a receiver (bulb). | • Look for both successful and unsuccessful circuits to share both what *does* work and what *doesn't* work.<br>• For each class discussion, my kids move to our meeting area (out of their seats, away from distracting laptops!) The sim can be projected for students to manipulate when showing the whole class something; if moving the whole group does not work due to room set up or time, you can also have students simply turn their laptops. |
| *15* minutes | • Guide students to the second table (# 6) and allow them about 10 minutes to explore the 3 inquiry questions.<br>• Monitor student progress. After about 10 minutes, stop students and have them share findings with their partner before class discussion.<br>  • Possible questions/concepts to highlight during whole group discussion:<br>  ✓ What happens if we add one more battery? *Bulb gets brighter/the blue circles – electrons – speed up.*<br>  ✓ What happens to the current when the battery is flipped? *If the battery is flipped, the electric current flows in the opposite direction because the electrons (represented by the blue circles)* | • It is likely that students will discover problems or ideas in addition to these; be flexible! Monitor as students are working to highlight findings for whole group.<br>• For closing discussion, move students back to the meeting area if possible. |

| | | |
|---|---|---|
| | *flow from the negative (-) side to the positive (+) side.*<br>✓ How could you turn off the bulb? *Students may have done this by splitting the junction at any point on the circuit or by using a switch. In order to turn off the bulb, the pathway must be broken. This is called an open circuit. *Relate the switch in the circuit to a light switch on the wall. What happens to the circuit when the switch is turned off?*<br>• Writing: Send students back to their seats and have them share their understandings through writing and drawing in number 8 on their activity sheet. | |
| 5 minutes | **Wrap-Up Discussion**<br>• Review learning objectives and share new learning.<br>• Introduce the term *circuit.* Electric circuits are like a circle – a loop or pathway that electrons can follow to go from the source (battery) to the receiver (bulb). | • Optional: Use a document camera to project student answers in # 8. |

Name _____ Date _____

# Lighting a Light Bulb

**Objective**: We will explore electricity and determine what makes a light bulb light by testing different electric pathways.

1. **Explore:** Take 5 minutes to explore the sim.
2. **Turn and Talk:** Talk about your findings with a partner.

3. Try to create different pathways that will light the light bulb.

| Components (parts) I used to make a pathway: | Did the bulb light? (circle Y or N) | | Observations |
|---|---|---|---|
| 3 wires, 1 lightbulb, and a battery | Yes | No | |
| | Yes | No | |
| | Yes | No | |
| | Yes | No | |

4. Draw one of the working pathways here:

| |
|---|
| |

5. **Turn and Talk:** Share some of your findings with your partner.
   - Is there more than one way to create a working pathway?
   - What did you notice about successful pathways?

6. Complete the table below.

| How can you… | What did you do? (write or draw) | What other changes do you notice? |
|---|---|---|
| ..make the bulb brighter? | | |

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**Comment [2]:** Monitor student discussion so you can call attention to important findings or components of the sim. Facilitate a discussion of these as a whole class; preferably projected on whiteboard.

local 7/15/14 7:06 PM
**Comment [3]:** Explain table to students; they must first try to make a lightbulb light using 3 wires, 1 lightbulb and a battery. Then, they'll record if the light bulb lit and any observations. For the next 3 cells, students can choose the parts they will use and record them.

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**Comment [4]:** Students may have found a variety of ways to get the lightbulb to light. Base your discussion on their findings, but be sure to emphasize that every working pathway needed an energy source (battery) and a way (wires) to connect both sides of it to the bulb.

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**Comment [5]:** While students work, circulate and have discussions with individuals/partners. Refrain from directing their actions, but reinforce their understanding through questioning. For example, if a student added another battery to make the bulb brighter, you might ask "What do you think would happen if you added *another* battery?"

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**Comment [6]:** Students may write or draw what they did in this column.

| How can you… | What did you do? | What other changes do you notice? |
|---|---|---|
| …change the direction of the electrical current? | | |
| …turn off the bulb without pushing pause? | | |

7. **Turn and Talk:** Share your findings with your partner.
   - In order for the bulb to light, what needs to happen?
   - What components did every working pathway have?

8. In the box below, use your understanding to explain how a light bulb turns on. You can use words or pictures to help show what you know.

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**Comment [7]:** Watch as students complete this task. They may see that all you need to do is split the junction between to components; this opens the pathway so that the electrons cannot flow through. Another possible solution & topic for discussion would be adding a switch. How is using a switch similar to splitting the connection between 2 parts of your pathway?

local 7/15/14 7:11 PM

**Comment [8]:** You might also ask students what *didn't* work.