

LIGHTS OUT! TEACHER GUIDE

Subject: Physics

Grade Level: High School

Last Updated: April 7, 2008

Case Summary

Poor planning and a few mishaps leave two cave-exploring friends in the dark. Will they be able to build a flashlight out of the random materials in their backpacks, or will they be lost in the gloom indefinitely?

Credits

This case was written by Jonathan Toebbe (MS student, Anthropology, Emory University, Atlanta, GA), a fellow of the Emory University PRISM program (<http://www.prism.emory.edu>). Author may be contacted at jtoebbe@kentdenver.org.

This case was adapted from *Crossed circuits* (Watson, 2001).

Watson, George and University of Delaware (2001) *Crossed circuits*. Accessed at the Problem Based Learning Clearinghouse April 2, 2008 from <https://chico.nss.udel.edu/Pbl/viewIndex.jsp?id=22243959088>

Learning Objectives

At the end of the case, students will be able to:

1. Define a circuit and explain how a circuit functions.
2. Create a functional circuit.
3. Explain how a battery functions.
4. Define voltage.
5. Calculate the voltage required to operate a flashlight.

Georgia Performance Standards

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A)

SCSh3. Students will identify and investigate problems scientifically. (NSES Content Standard A)

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.

SCSh6. Students will communicate scientific investigations and information clearly. (NSES Content Standard A)

- a. Write clear, coherent laboratory reports related to scientific investigations.

- b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data

SP5. Students will evaluate relationships between electrical and magnetic forces. (NSES Content Standard B)

- a. Describe the transformation of mechanical energy into electrical energy and the transmission of electrical energy.
 b. Determine the relationship among potential difference, current, and resistance in a direct current circuit.
 c. Determine equivalent resistances in series and parallel circuits.

Assessment

The assessment is divided into two parts: a written portion and an in-class activity. The students are to write a report based on the case explaining how the characters should construct their flashlight to maximize battery life while still providing a useful amount of light. The students will need to include circuit diagrams in their explanations. They will then write a narrative epilogue for the story. A sample grading rubric for the written portion of the assessment is included in the *Student Materials*.

For the in-class activity students will be provided with a flashlight bulb, 2 AAA batteries, and assorted small items. You are to turn out the lights and see if they can construct a working flashlight in the dark in 30 seconds.

Suggested “assorted small items” for constructing a makeshift flashlight include (but are certainly not limited to):

- a ball point pen with removable cap
- a small, spiral bound notepad
- plastic sandwich bags
- a half-eaten sandwich, wrapped in aluminum foil
- loose change
- a pack of gum (with or without foil gum wrappers)

Make sure that when the lights go out, it gets sufficiently dark in the room for this exercise to be a challenge. This works best without prior warning.

Implementation Strategy

This case can be completed in one 90-minute class session. A sample implementation strategy is given below:

Read Scene	15 min
Learning Issues	15 min
Work in groups on assignments	45 min
Makeshift flashlight activity	15 min

Facilitator Guide

The following are several questions/tips that facilitators should have in mind as they implement the case, sectioned by scene:

Scene 1

1. Which of Chris and Pat's many questions are relevant?
2. Would a circuit diagram help clarify the situation?
3. How are they going to connect the bulb to the batteries?

Resources

The following two websites include detailed product data sheets on standard batteries. A variety of useful data can be gleaned from these data sheets.

Procter & Gamble (2005) Technical/OEM: Primary Systems. Accessed June 20, 2007 from <http://www.duracell.com/OEM/>.

Energizer Holdings, Inc. (2007) Technical Information: Battery Engineering Guide. Accessed June 20, 2007 from <http://data.energizer.com/>.