

Light Your Way



Background: You have been invited to join a group of scientists who are going to investigate a newly discovered cave in Virginia. There is one condition to your going on this adventure. You are required to design, build, and bring a lantern that will help you see where you are going and allow you to keep your hands free for climbing and digging. You will also be asked to present a diagram showing how your lantern works.

Design Challenge: Design and build a lantern that you can wear on your expedition to light your way without using your hands to hold it. Your lantern should be designed to point ahead of you when you walk, to have an on/off switch to conserve energy, and to be comfortable to wear. Remember to prepare a final labeled sketch to show the scientists, and be prepared to explain how your lantern works.

Criteria:

Your lantern must

- be wearable and keep your hands free
- have an on/off switch
- light the way ahead of you
- be accompanied by a labeled diagram showing how it was made
- stay lit for at least 15 minutes while you wear it in class.

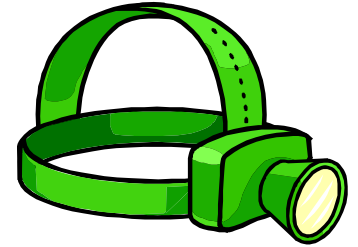
Materials: You may select from the items below.

- C battery
- AA battery
- film canister
- bell wire
- electrical tape
- masking tape
- bulb
- bulb holder
- brass fasteners
- paper clips
- Christmas tree lights
- wire cutter
- card stock
- wire stripper
- cardboard
- string
- general art supplies

Targeted Standard of Learning: Science 4.3
Supporting Standards of Learning: Science 4.1
Mathematics 4.11
English 4.1, 4.2, 4.5, 4.6

Targeted Standard for Technological Literacy: 9
Supporting Standards for Technological Literacy: 8, 10, 11

Light Your Way



Targeted Standard of Learning: Science 4.3

- The student will investigate and understand the characteristics of electricity.

Targeted Standard for Technological Literacy: Standard 9

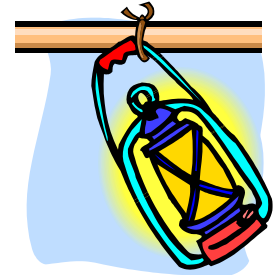
- Students will develop an understanding of engineering design.

Prior Knowledge & Skill	Materials & Preparation	Safety Issues	Class Management	Materials Provided	Time Management
<ul style="list-style-type: none"> • Exposure to targeted Science Standard of Learning 4.3 • Specific lessons on circuits, wires, and switches. Students can apply what they have learned in class. • Some understanding of the design process 	<ul style="list-style-type: none"> • Check Design Brief for recommended materials. Teacher may substitute materials. • Paper fasteners must be made of brass to work. Check the box label. • Film canisters can be obtained from photo centers for free. Canisters with flat tops work best. • Time Savers: <ul style="list-style-type: none"> – Precut and strip wire. – Put materials needed by each group into a tray, box, or small bag prior to class. This helps with quantity control and helps provide quick transition into the activity. – Poke one hole through each end of the film canisters using a round file. • Students may bring a hat, belt, or shirt with a pocket to help support their lanterns. Allow students to come up with these ideas or others when they brainstorm different designs. 	<ul style="list-style-type: none"> • Discuss the dangers of electricity in real- life situations. • Keep away from water. • Use wire-cutting tools safely. • Use eye protection. • If you have concerns about the students using the wire cutting tools precut the wire and strip the ends prior to class. 	<ul style="list-style-type: none"> • Small groups or pairs • Each student keeps own Guided Portfolio. • Each group member needs to complete a light following the group's plans. • Teacher should approve plans before students begin building. 	<ul style="list-style-type: none"> • Design Brief • Guided Portfolio • Final sketch form • Rubric Assessments 	<ul style="list-style-type: none"> • Session 1: Introducing Design Brief and Portfolio (60 min.) • Session 2: Building (60 min.) • Session 3: Sharing and evaluating (60 min.)

Guided Portfolio—1

Name _____

Light Your Way



Group Members: _____

1. What is the problem? State the problem in *your own words*.

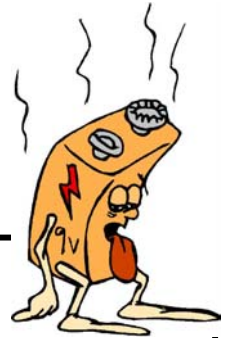
Targeted Standard of Learning: Science 4.3
Supporting Standards of Learning: Science 4.1
Mathematics 4.11
English 4.1, 4.2, 4.5, 4.6

Targeted Standard for Technological Literacy: 9
Supporting Standards for Technological Literacy: 8, 10, 11

Name _____

2. Brainstorm solutions.

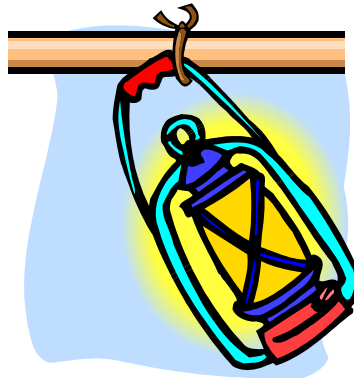
Draw or describe some possible solutions.

A large graphic of a lightbulb with radiating lines, positioned in the center of four large, empty rounded rectangular boxes. The lightbulb is drawn in a simple, bold style with several short lines radiating from it to indicate it is glowing. The four boxes are arranged in a 2x2 grid, with the lightbulb in the center. The boxes are empty, intended for drawing or describing solutions.

Name _____

4. Test your solution.

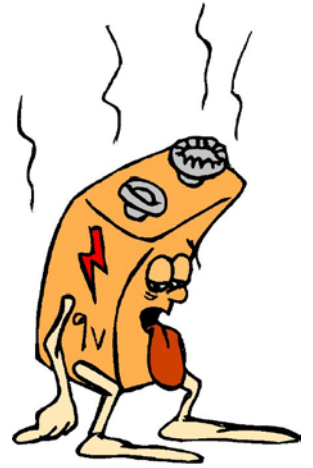
- Is your lantern wearable without using your hands to hold it? YES NO
- Does your lantern have an on/off switch? YES NO
- Does your lantern light the way in front of you? YES NO
- Is your lantern accompanied by a labeled diagram showing how it was made? YES NO
- Does your lantern stay lit for at least 15 minutes while you are wearing it in class? YES NO



Name _____

5. Evaluate your solution.

Was it the best solution? Would one of your other ideas have been better? Why or why not?



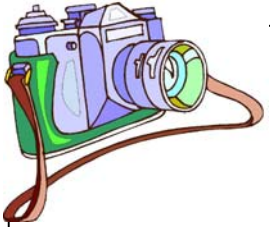
What would you have done differently?

Could you add to it to make it better? What would you add to it?

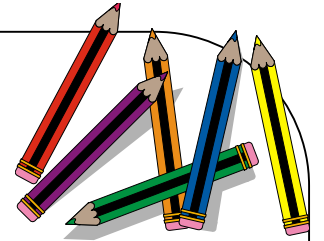
Guided Portfolio—6

Name _____

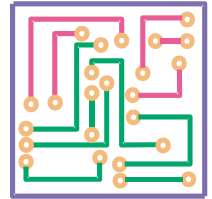
Attach a photograph of your final project here. If you do not have a photograph, draw a picture of your final project.



How would you make your project better? Draw a picture showing how it would look after you have made changes to it.



Name _____



Sketch: Light Your Way

Draw a diagram of the circuit that you created. Carefully label all of the parts and how they work. The sketch should be detailed enough for someone else to understand it and be able to create a lantern exactly like yours.

A large, empty rounded rectangular box with a black border, intended for the student to draw and label their circuit diagram.

Rubric for *Light Your Way*

Name _____

Date _____

Design Brief Rubric	no evidence 0	limited understanding 1	some understanding with room for improvement 2	good understanding with room for improvement 3	substantial understanding 4
The student restated the problem in his/her own words.					
The student brainstormed more than one idea.					
The student created and labeled a sketch to use as a "blueprint."					
The student included notes about problems that occurred and their solutions.					
The student prepared a final labeled sketch to show exactly how he/she built the lantern.					
The student tested the lantern to make sure <ul style="list-style-type: none"> • it was wearable and did not require hands to hold it • it had an on/off switch • it lighted the way in front of the wearer • it stayed lit for at least 15 minutes while being worn in class. 					
The student evaluated how he/she could make it better next time.					



Rubric for *Light Your Way*

Name _____

Date _____

<p style="text-align: center;">Oral Communication Rubric</p>	<p style="text-align: center;">no evidence 0</p>	<p style="text-align: center;">limited understanding 1</p>	<p style="text-align: center;">some understanding with room for improvement 2</p>	<p style="text-align: center;">good understanding with room for improvement 3</p>	<p style="text-align: center;">substantial understanding 4</p>
<p>4.1 The student will use effective communication skills in a variety of settings.</p> <p>a) Present accurate directions to individuals and small groups.</p> <p>b) Contribute to group discussions</p> <p>c) Seek ideas and opinions of others.</p> <p>d) Use evidence to support opinions.</p> <p>e) Use grammatically correct language and specific vocabulary to communicate ideas.</p>					
<p>4.2 The student will make and listen to oral presentations and reports.</p> <p>a) Use subject-related information and vocabulary.</p> <p>b) Listen to and record information.</p> <p>c) Organize information for clarity.</p>					



Standards of Learning

English (2002)

Oral Language

- 4.1 The student will use effective oral communication skills in a variety of settings.
- a) Present accurate directions to individuals and small groups.
 - b) Contribute to group discussions.
 - c) Seek the ideas and opinions of others.
 - d) Use evidence to support opinions.
 - e) Use grammatically correct language and specific vocabulary to communicate ideas.
- 4.2 The student will make and listen to oral presentations and reports.
- a) Use subject-related information and vocabulary.
 - b) Listen to and record information.
 - c) Organize information for clarity.

Reading

- 4.5 The student will read and demonstrate comprehension of nonfiction.
- a) Use text organizers such as type, headings, and graphics to predict and categorize information.
 - b) Formulate questions that might be answered in the selection.
 - c) Explain the author's purpose.
 - d) Make literal inferences using information from texts.
 - e) Draw conclusions using information from texts.
 - f) Summarize content of selection, identifying important ideas and providing details for each important idea.
 - g) Describe relationship between content and previously learned concepts or skills.
 - h) Distinguish between cause and effect and between fact and opinion.
 - i) Identify new information gained from reading.
- 4.6 The student will demonstrate comprehension of information resources to research a topic.
- a) Construct questions about a topic.
 - b) Collect information using the resources of the media center including online, print, and media resources.
 - c) Evaluate and synthesize information.

Science (2003)

Scientific Investigation, Reasoning, and Logic

- 4.1 The student will plan and conduct investigations in which
- distinctions are made among observations, conclusions, inferences, and predictions;
 - hypotheses are formulated based on cause and effect relationships;
 - variables that must be held constant in an experimental situation are defined;
 - appropriate instruments are selected to measure linear distance, volume, mass, and temperature;
 - appropriate metric measures are used to collect, record, and report data;
 - data are displayed using bar and basic line graphs;
 - numerical data that are contradictory or unusual in experimental results are recognized; and
 - predictions are made based on data from picture graphs, bar graphs, and basic line graphs;

Force, Motion, and Energy

- 4.3 The student will investigate and understand the characteristics of electricity. Key concepts include
- conductors and insulators;
 - basic circuits (open/closed, parallel/series);
 - static electricity ;
 - the ability of electrical energy to be transformed into heat, light, and mechanical energy;
 - simple electromagnets and magnetism; and
 - historical contributions in understanding electricity.

Mathematics (2001)

Measurement

- 4.11 The student will
- estimate and measure length, using actual measuring devices, and describe the results in both metric and U.S. Customary units, including part of an inch ($1/2$, $1/4$, and $1/8$), inches, feet, yards, millimeters, centimeters, and meters;
 - identify equivalent measurements between units within the U.S. Customary system (inches and feet; feet and yards; inches and yards) and between units within the metric system (millimeters and centimeters; centimeters and meters; and millimeters and meters); and
 - estimate the conversion of inches and centimeters, yards and meters, and miles and kilometers, using approximate comparisons (1 inch is about 2.5 centimeters, 1 meter is a little longer than 1 yard, 1 mile is slightly farther than 1.5 kilometers, or 1 kilometer is slightly farther than half a mile). *
- * *The intent of this standard is for students to make ballpark comparisons and not to memorize conversion factors between U.S. Customary and metric units.*

Standards for Technological Literacy

Standard 8: Students will develop an understanding of the attributes of design.

Standard 9: Students will develop an understanding of engineering design.

Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Standard 11: Students will develop the abilities to apply the design process.