Unit 4 Projects

Inquiry Investigation

Design a Light Tunnel (Student textbook page 360)

Pedagogical Purpose

This investigation requires students to design and test the optical requirements necessary to build a light tunnel from the roof to a room in their house. The project provides an opportunity for students to demonstrate design, planning, and communication skills. In addition, students will demonstrate an understanding of reflection and refraction of light.

Planning	
Materials	Per group: 2 concave mirrors 2 convex mirrors 2 diverging lenses 2 converging lenses triangular prism light source acetate, plastic wrap, or glass cardboard tubes foil **BLM A-53 Unit 4 Inquiry Investigation Rubric**
Time	30 min to plan (could be homework) 30 min to construct 20 to 30 min to draw ray diagrams 1 class period for presentations
Safety	Students should use caution when testing their design. Remind students not to shine light in their eyes or their classmates' eyes.

Background

Light tunnels use a reflective inner surface to focus and direct natural light in places unsuitable for windows (e.g., through several floors of a building). Diverging lenses may be used to gather more light from the top and to disperse it more widely at the bottom.

Skills Focus

- select appropriate instruments and materials and use them safely
- select, organize, record, and interpret relevant information
- communicate ideas, plans, and procedures using appropriate language
- use appropriate numeric, symbolic, and graphic modes of communication

Activity Notes and Troubleshooting

- Introduce the project early in the unit, so that students can incorporate relevant information and skills from the topics into their project.
- Establish interim checkpoints to keep students on track. For example, require that students show you their plan before they begin gathering materials for their model.
- As a class, decide on and communicate the criteria on which products will be assessed. You may wish to use the rubric provided here, use the Assessment Criteria on page 360 of the student textbook, or work together to determine the criteria for assessment. Review the assessment criteria with students before they begin so that they know what to expect.
- Spread this project over a few days so that students have time between the planning and construction phases to gather materials.
- Potato chip bags work well in place of foil as the reflective surface.
- Encourage students to mimic the angle of the Sun at different times of day when preparing their ray diagrams.

Additional Support

- DI Bodily-kinesthetic and spatial learners may benefit from simulating the path of light by tracing it with string.
- DI Intrapersonal and English language learners may feel uncomfortable presenting their findings to the class. Provide the option of presenting the project to smaller groups or in static displays.
- DI Logical-mathematical learners may benefit from using a protractor to draw detailed ray diagrams during the planning phase.
- A laser pointer aimed into the tube may help students refine designs and prepare ray diagrams.
- To challenge students, have groups use different lengths and diameter of tubes, assessing one another's success (for example, a wrapping paper roll vs. a paper towel roll). Or challenge a particularly keen group to make the tunnel turn a corner or go a particularly long way.

Rubric

ACHIEVEMENT CHART CATEGORY	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	Information necessary for task about reflection, refraction, mirrors, and lenses was described with little detail.	Information necessary for task about reflection, refraction, mirrors, and lenses was described with some detail.	Information necessary for task about reflection, refraction, mirrors, and lenses was described in detail.	Information necessary for task about reflection, refraction, mirrors, and lenses was accurately and thoroughly described.
Thinking and Investigation	Few materials were selected to create a model of the light tunnel.	Materials were selected and gathered to create a model of the light tunnel.	Appropriate materials were selected and gathered to create a model of the light tunnel.	Appropriate materials were quickly selected and gathered to create a model of the light tunnel.
	Materials were sometimes used effectively.	Materials were usually used safely and effectively.	Materials were used in a safe and effective way.	Materials were used in a very safe and effective way.
	Design of model meets few of the criteria listed.	Design of model meets some of the criteria listed.	Design of model meets the criteria listed.	Design of model goes beyond the criteria listed.
Communication	Little effectiveness in using a ruler and protractor to draw ray diagrams was used.	Some effectiveness in using a ruler and protractor to draw ray diagrams was used.	Ruler and protractor were used to draw ray diagrams.	Ruler and protractor were used effectively to draw ray diagrams.
	Little scientific terminology was used to communicate purpose to intended audience.	Some scientific terminology was used to communicate purpose to intended audience.	Appropriate scientific terminology was used to communicate purpose to intended audience.	Appropriate scientific terminology was very effectively used to communicate purpose to intended audience.
	Design plans were done with few ray diagrams and little explanation of how light will be directed through tunnel.	Design plans were done with ray diagrams and some explanation of how light will be directed through tunnel.	Design plans were well done with complete ray diagrams and explanation of how light will be directed through tunnel.	Design plans were very well done with complete ray diagrams and explanation of how light will be directed through tunnel.
Application	Provides little description of challenges faced when designing the light tunnel.	Provides some description of challenges faced when designing the light tunnel.	Provides description of challenges faced when designing the light tunnel.	Provides a detailed description of challenges faced when designing the light tunnel.

Please also see **BLM A-53 Unit 4 Inquiry Investigation Rubric**.

An Issue to Analyze

LEDs Brighten Up the Darkness (Student textbook page 361)

Pedagogical Purpose

In the process of becoming scientifically literate, students are asked to use their scientific skills and knowledge to assist them in decision-making. Scientifically literate students reflect on what they have learned and apply that knowledge when considering the costs, benefits, and use of new technologies. This analysis is an opportunity for students to demonstrate knowledge and understanding from this unit and apply it to make decisions about a real world issue.

Planning	
Materials	Sources such as newspapers, maps, magazines, and the Internet. **BLM A-54 Unit 4 An Issue to Analyze Rubric** (optional) **BLM G-13 How To Do a Research Based Project** (optional) **BLM G-16 Scientific Research Planner** (optional) **BLM G-17 Research Worksheet** (optional) **BLM G-18 Internet Research Tips** (optional)
Time	2 weeks (in and out of class) for research 1 or 2 periods for presentations

Background

LEDs produce artificial light but consume much less electricity than incandescent bulbs. In many parts of the world, including remote areas in Canada, people have no access to the power grid. The high efficiency of LED technology makes lighting more practical for locally produced electricity from solar panels and dynamos.

Skills Focus

- select, organize, record, and interpret relevant information
- communicate ideas, plans, and procedures using appropriate language

Activity Notes and Troubleshooting

- Introduce the project early in the unit, so that students can incorporate relevant information and skills from the topics into their project.
- Before students begin targeted research, have them research how LEDs produce light and what makes them so much more efficient than incandescent bulbs, and even compact fluorescent lights (CFLs).
- Bring examples of LEDs to class such as flashlights and wind-up emergency lights. Note the manufacturer's stated lifespan for both the bulbs and the power source (i.e., per set of batteries or per minute of winding).
- As a class, decide on and communicate the criteria on which products will be assessed. You may wish to use the rubric provided here, the Assessment criteria on page 361 of the student textbook, or work together to determine the criteria for assessment. Review the assessment criteria with students before they begin so that they know what to expect.
- As a class, decide on the audience students will target in advance.
- Students could use **BLM G-13 How To Do a Research Based Project, BLM G-16 Scientific Research Planner, BLM G-17 Research Worksheet,** and/or **BLM G-18 Internet Research Tips,** to help plan and organize their research.
- To assess students' presentations, use **BLM A-54 Unit 4 An Issue to Analyze Rubric.**

Additional Support

- DI ELL Allow students to select from a wide range of presentation formats. Encourage English language learners and intrapersonal learners to either present to smaller groups, or to select an alternative format such as video recording or multimedia display.

Rubric

ACHIEVEMENT CHART CATEGORY	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	Little detail was provided in the comparison of light generated by conventional technologies and light generated by LEDs.	Some comparison was made between light generated by conventional technologies and light generated by LEDs.	Good comparison was made between light generated by conventional technologies and light generated by LEDs.	Detailed comparison was made between light generated by conventional technologies and light generated by LEDs.
Thinking and Investigation	Used few resources to research LED technology from economic, scientific, and social points of view.	Used some resources to research LED technology from economic, scientific, and social points of view.	Used a variety of resources to research LED technology from economic, scientific, and social points of view.	Used numerous resources to research LED technology from economic, scientific, and social points of view.
Communication	Includes information from a variety of sources using an accepted form of academic documentation with limited effectiveness.	Includes information from a variety of sources using an accepted form of academic documentation with some effectiveness.	Includes information from a variety of sources using an accepted form of academic documentation with considerable effectiveness.	Includes information from a variety of sources using an accepted form of academic documentation with a high degree of effectiveness.
	Uses scientific vocabulary with limited effectiveness.	Uses scientific vocabulary with some effectiveness.	Uses scientific vocabulary with considerable effectiveness.	Uses scientific vocabulary with a high degree of effectiveness.
	Selected a format for presenting the recommendation that gave little consideration to the purpose and audience.	Selected a format for presenting the recommendation that gave some consideration to the purpose and audience.	Selected an appropriate format for presenting the recommendation that considered purpose and audience.	Selected a very appropriate format for presenting the recommendation that considered purpose and audience.
Application	Little research into costs and benefits of LED technology was demonstrated with little consideration given to multiple perspectives.	Some research into costs and benefits of LED technology was demonstrated with some consideration given to multiple perspectives.	Costs and benefits of LED technology was researched and examined from multiple perspectives.	Costs and benefits of LED technology were well-researched and examined from multiple perspectives.

Please also see **BLM A-54 Unit 4 An Issue to Analyze Rubric**.