Unit 4 Projects

Inquiry Project
Design a Light Tunnel (Student textbook page 522)

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 and planning skills. In addition, students will demonstrate an understanding of reflection and refraction of light.

Planning		
Materials	2 concave mirrors 2 diverging lenses Triangular prism Acetate, plastic wrap, or glass Foil	2 convex mirrors 2 converging lenses Light source Cardboard tubes **BLM 12-12 Design a Light Tunnel**
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 and never point the light into someone's eye.	

Background

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

Activity Notes and Troubleshooting

- Potato chip bags work well in place of foil as the reflective surface.
- Spread this project over a few days so that students have time between the planning and construction phases to gather materials.
- Encourage students to mimic the angle of the Sun at different times of day when preparing their ray diagrams.
- As a class, decide on and communicate the criteria on which products will be assessed. You may wish to use the rubric on the next page, or work together to determine the criteria for assessment.
- To assess students' process, use **BLM A-42 Design an Investigation Rubric.**

Additional Support

- DI Bodily-kinesthetic and spatial learners may benefit from simulating the path of light by tracing it with string.
- DI ELL 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 prepare ray diagrams.
- To challenge students, have groups use different lengths and diameter of tubes; assessing each other'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	Summarizes information about refraction, mirrors, and lenses as it relates to this task with limited effectiveness.	Summarizes information about refraction, mirrors, and lenses as it relates to this task with some effectiveness.	Summarizes information about refraction, mirrors, and lenses as it relates to this task with considerable effectiveness.	Summarizes information about refraction, mirrors, and lenses as it relates to this task with a high degree of effectiveness.
Thinking and Investigation	Formulates a hypothesis with limited accuracy. Creates a model of a light tunnel using appropriate materials safely and accurately, with limited effectiveness. Model designed meets the criteria with limited accuracy.	Formulates a hypothesis with some accuracy. Creates a model of a light tunnel using appropriate materials safely and accurately, with some effectiveness. Model designed meets the criteria with some accuracy.	Formulates a hypothesis with considerable accuracy. Creates a model of a light tunnel using appropriate materials safely and accurately, with considerable effectiveness. Model designed meets the criteria with considerable accuracy.	Formulates a hypothesis with a high degree of accuracy. Creates a model of a light tunnel using appropriate materials safely and accurately, with a high degree of effectiveness. Model designed meets the criteria with a high degree of accuracy.
Application	Challenges during the design of the light tunnel are described in limited detail. Identifies the most useful optics components in the light tunnel design with limited accuracy.	Challenges during the design of the light tunnel are described in some detail. Identifies the most useful optics components in the light tunnel design with some accuracy.	Challenges during the design of the light tunnel are described in considerable detail. Identifies the most useful optics components in the light tunnel design with considerable accuracy.	Challenges during the design of the light tunnel are described in thorough detail. Identifies the most useful optics components in the light tunnel design with a high degree of accuracy.
Communication	Ray diagrams for the design brief are drawn using proper scientific conventions with limited effectiveness. Communicates an explanation for the design brief using appropriate scientific terminology and for an intended audience and purpose with limited effectiveness.	Ray diagrams for the design brief are drawn using proper scientific conventions with some effectiveness. Communicates an explanation for the design brief using appropriate scientific terminology and for an intended audience and purpose with some effectiveness.	Ray diagrams for the design brief are drawn using proper scientific conventions with considerable effectiveness. Communicates an explanation for the design brief using appropriate scientific terminology and for an intended audience and purpose with considerable effectiveness.	Ray diagrams for the design brief are drawn using proper scientific conventions with a high degree of effectiveness. Communicates an explanation for the design brief using appropriate scientific terminology and for an intended audience and purpose with a high degree of effectiveness.

An Issue to Analyze
LEDs Brighten Up the Darkness (Student textbook page 523)

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 and 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 the real world.

Planning	
Materials	Sources such as newspapers, maps, magazines, and Internet
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.

Activity Notes and Troubleshooting

- The day before, have students research how LEDs produce light and what makes them so much more efficient than incandescent bulbs, and even 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 minute of winding).
- As a class, decide on the target audience.
- As a class, decide on and communicate the criteria on which products will be assessed. You may wish to use the rubric on the next page, or work together to determine the criteria for assessment.
- To assess students' presentations, use **BLM A-46 Presentation Rubric.**

Additional Support

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

Rubric

Achievement Chart Category	Level 1	Level 2	Level 3	Level 4
Knowledge and Understanding	A comparative analysis of conventional light technology and LED light technology is completed with limited accuracy.	A comparative analysis of conventional light technology and LED light technology is completed with some accuracy.	A comparative analysis of conventional light technology and LED light technology is completed with considerable accuracy.	A comparative analysis of conventional light technology and LED light technology is completed with a high degree of accuracy.
Communication	Research is organized using an appropriate format and proper academic documentation with limited effectiveness. Recommendation is presented using a format with limited appropriateness.	Research is organized using an appropriate format and proper academic documentation with some effectiveness. Recommendation is presented using a format with some appropriateness.	Research is organized using an appropriate format and proper academic documentation with considerable effectiveness. Recommendation is presented using a format with considerable appropriateness.	Research is organized using an appropriate format and proper academic documentation with a high degree of effectiveness. Recommendation is presented using a highly appropriate format.
Application	Researches the costs and benefits of LED technology from multiple perspectives with limited effectiveness.	Researches the costs and benefits of LED technology from multiple perspectives with some effectiveness.	Researches the costs and benefits of LED technology from multiple perspectives with considerable effectiveness.	Researches the costs and benefits of LED technology from multiple perspectives with a high degree of effectiveness.