LIGHT TRAVELS AS A GAME

Performance Standard 12C/11B.D

Students will apply the processes of technological design to compare the properties of various kinds of energy accordingly:

- *Knowledge*: Identify the ways that light can travel because it is a form of energy.
- *Application*: Design ways to demonstrate the ways that light can travel.
- *Communication*: Explain how the ways that light can travel, can apply to other kinds of energy.

Procedures

1. ***In order to know and apply concepts that describe properties of (force and) matter and energy and the interactions between them (12C), and the concepts, principles and processes of scientific inquiry (11A) and technological design, (11C),*** students should experience sufficient learning opportunities to develop the following:
   - Identifying technological design dilemma associated with testing how light travels by brainstorming possible ways to observe light using mirrors, prisms, clear and clouded materials.
   - Determine procedural sequence, success criteria and design options to 'construct' a light pathway game board prototype with obstacles to investigate how light energy is affected.
   - Display and analyze data from investigation.
   - Communicate the findings to explain how light travels.
   - Generate possible alternative designs for testing light again.
   - Generalize how other forms of energy are similar to light.

   Note to teacher: This activity relates to knowledge associated with the standard 12C, while addressing the performance descriptors for stage D within standard 11B. Applying scientific habits of mind and principles of safety noted in standard 13A are foundational.

   (Safety note: If penlight pointers are used, students should be advised of the danger of looking directly into the beam of light or pointing them at other student's eyes. Precautions for the safe use of mirrors and glass squares should be discussed.)
2. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work.
3. Introduce Patterns in Energy Using Light investigation by asking students to describe their current understandings about how a mirror works, what a prism does, how light starts and stops, what reflecting means, how lasers work, and where light goes. Then, ask where students learned what they already know about light.
4. Small groups of students should initially practice with different materials to see how light is affected: Allow them to use prisms and see how they refract regular (white) light (from a focused flashlight, etc.) into a rainbow of colors; test mirrors for their capabilities to reflect light; experiment with various materials such as colored filters, waxed paper, clear glass, translucent (clouded) glass, to see how they allow light to travel through. Encourage multiple combinations of materials.
5. The technological design component of this activity needs to focus on the design of a game board light pathway so that light (from a penlight pointer) can travel through a determined number of obstacles to get to the end of the path along a predetermined length or space. Students will need to develop their rules (success criteria) for a light pathway game board prototype which can use prisms, mirrors, transparent and translucent materials, colored filters, etc. Ideas for their success criteria could be:
   - How many light obstacles are used (or at least three obstacles are used, etc.)?
   - Does the path make a full circle or square?
   - Is the display the most colorful or have the longest path?
   - Does it display options of reflection, refraction and absorption or combinations of these options, etc.?
6. Students will need to sketch out the game board's projected light pathway and predict what will happen at each obstacle. They should test their game board with a penlight pointer to adjust locations of their obstacles, through which their final pathway must follow. Adjustments to design are allowed.
7. Students must display their final light pathway game board and determine the success of the design based on the class-determined criteria. (Require students to generate one or more proposals for how to improve their prototype. They may suggest adjustments to success criteria for additional testing.)

8. Ask students to propose their generalizations about how energy travels, based on what they have learned about light. (Do other forms of energy heat, sound, electrical, mechanical energy-travel in the same ways as light?) They should submit a written conclusion about their design, its success according to class criteria, improvement possibilities and energy generalizations.
9. Evaluate each student's work using the Science Rubric as follows and add the scores to determine the performance level:
    - *Knowledge*: Identifications of reflection, refraction, absorption and transmission were complete and correct.
    - *Application*: Demonstrations of light travel through/around different obstacles were complete and correct.
    - *Communication*: Explanations of light energy travel were thorough and accurate; generalizations to other forms of energy were logical and promoted additional interest in investigations.

Examples of Student Work not available

Time Requirements

- 20-30 minutes for introductory group demonstrations of light energy possibilities; 20-40 minutes to design and test prototype; 20-30 minutes to discuss tests and conclusions

Resources

- Game board paper to trace light pathway and placement of obstacles
- Obstacles such as prisms, mirrors (1inch square safety mirrors), waxed paper, colored gel filters, clear and frosted glass (1 inch squares of safety glass), etc.
- Penlights for individual group use
- Science Rubric