Drexel-SDP GK-12 LESSON

- ***Understanding Light***

- *Wireless Communication*

- Subject Area (Unit): ***Engineering***

- Concept: Wireless Communication, Optics

- Objectives: This section is a basic introduction to the behavior of light, particularly in relation to communications. The students are guided on an exploration of lights behavior as a wave that reflects or is absorbed, can be shaped and focused and has a finite amount of power from a source. Using provided materials students first explore the interaction of light with different optical and everyday materials. After the initial exploration they are directed to create a guide a laser through a maze to a specified target.

    - Students will be able to….
      understand the behavior of light and its interactions with different materials
      understand how light can be focused, shaped and distributed depending on materials and the nature of the source
      understand how power propagates and that the power emitted by a light source is finite
      use geometry to understand the propagation of different sources
      design a method to guide a laser light through a maze and explore why other sources of light may be guided in the same manner
      identify how different light sources can be used to communicate under different circumstances depending on the need of the user

- PA Academic Standards: *3.1.7ABC, 3.2.7BCD, 3.4.7AB*

- Grade Level: ***6***

- Setting/Group Size: Classroom split into small groups of 3-4.

- Duration/Time Required: ***2 60 minute sessions***

- **Materials**: Various lenses, microscope objectives, magnifying glasses, small mirrors, aluminum foil, wax paper, material with a rough surface, cardboard and other items with interesting optical properties, A laser pointer, A flashlight, LEDs attached to 1.5V batteries (Can easily be taped together), Tape, Worksheet "Understanding Light"

- **Context**: Understanding the behavior of light is key to understanding wireless communication. In this exercise the students are first given a set of materials including mirrors, lenses, magnifying glasses and different surfaces and asked to answer several questions on their interaction with several sources of light, including a laser pointer, a flashlight and LEDs. The instructor can lead the exploration in different directions depending on the questions asked by students and the interest of the group. Light through a lens becomes bigger, what is the relationship between the positions of the source, lens and surface? After this initial investigation the instructor sets up a maze with complexity depending on the aptitude of the students involved. The students are then asked to design a guide for the laser to hit the specified target using the materials they have investigated previously.

- **Methods and Procedure:**

  There is no set procedure for this lesson, aside from the setting up of the maze itself. Students should be given the material and engaged according to their interest. Small groups are best for this lesson.

  The maze can easily be constructed using cardboard and tape on a table. The laser point should also be secured with tape, allowing for the "on" button to be accessible from the top. A small sheet of paper can serve as the target.

  Start them with the provided worksheet and expand the discussion/lesson from their discoveries there.

  There are many additional possible areas of discussion such as using the LEDs to discover how intensity changes according to the number of batteries attached to the LEDS. The directionality of the light sources can also be discussed in particular in relation to communication. Where does the light go from each source, how far does it go? Are there

different situations in which one source would be better to communicate with than another? From what angles and distances can each source be seen? Use of geometry is appropriate here to model light propagation and investigate how the circumference of a circle grows with distance (LED power) and how unequal side of an isosceles triangle grows with distance (flashlight power).

Does the flashlight or LED work in the maze? Why not?

After 30 to 45 minutes ask the students to record their observations in their science notebooks. What additional questions do they have, what experiments might they consider to discover the answer. Ask some specific questions to see that the basics have been learned and relate them specifically to wireless communication.

- Assessment: *A short discussion on what was learned after they complete their notebook entries followed perhaps by an expanded discussion into questions that they may have asked.*

  Presentation – Poster and Oral

  Science Journal Entry

  Teacher Observation Checklist

- Keywords: Engineering

- Author: Eric Gallo

Understanding Light-What Did we learn from the laser maze and our experiments with LED's

How did the laser react to different materials?

Material	What happened to the light?	How did the shape change?
Mirrors		
Cardboard		
Magnifying Glass		
Microscope Lens		
Glass Bottle		

Draw a diagram of the light that came out of the laser, flashlights and LEDs. How is the light different, what is different about the shape, brightness and direction?

If I shine the laser at an angle to a mirror where will it hit? How do you know?

What different problems did you encounter when you were guiding the laser through the maze? What happened, why did it happen?

What other observations did you make about light? What did you notice that you didn't know before? What experiments could you do to learn more about the different sources of light?

Why do you think understanding light might be important to an engineering designing a wireless communication system?

Where do you find different sources of light in your home? Which type are they and why do you think they are used there?