Name: _____ **Class:** _____ **Date:** _____

Illuminating the Properties of Light!

Learner Outcomes:

- Investigate light beams and optical devices, and identify phenomena that provide evidence of the nature of light (*e.g., evidence provided by viewing the passage of light through dusty air or cloudy water*)

Key Terms:

Absorption	Emission	Refraction
Collimated	Reflection	Scattering

Background Information:

Light is as important to humans and other living things as the air we breathe. Because of this, people have been trying to understand light for thousands of years, however light is difficult to study, because it cannot be observed directly. We can only observe the effect light has when it interacts with objects. Studying these effects however, help us to illuminate the nature of light.

Materials:

small flashlight	cocoa powder	white card
penlight laser pointer	clear gelatin	black card
	red gelatin	ruler
1 square bottle	green gelatin	thermometer
1 round bottle	petri dish	spectroscope
water	2 sheets of paper	

Research Question: How can studying how light interacts with objects help us to understand the properties and characteristics of light?

WARNING:

Be sure that you NEVER point the laser beam directly at your or any of your classmates eyes. Be careful not to bounce the beam off a shiny object into your classmate s eyes. Exposure to direct laser light can cause blindness, even if it is reflected light. The laser beam should point horizontally, well below eye level.

This activity was adapted from:
http://www.esrl.noaa.gov/psd/outreach/education/activities/light_beams.html

Procedure:

Part 1: The flashlight versus the laser.

1. Test the function of the reflector (silvery bowl) in the flashlight by shining the flashlight at the white card with and without the reflector in place. Record your observations.
2. Move a white card forward and back along the path of both the flashlight beam and the laser pointer light beam. Describe what happens to each beams diameter as it gets farther away from the light source. We say that a light beam is collimated if its diameter remains constant as you go to further distances.
3. Lay the flashlight on a table so that its beam travels parallel to the table; raise the back end if needed. Fold a piece of paper in half and lay it on the table with the creased edge against the flashlight. Slowly raise the paper and see cross-sections of the beam. Hold the paper parallel to the table with the creased edge slightly below the center of the flashlight. Draw two lines which trace the diverging outside edges of the flashlight beam. Now, unfold the paper and with a ruler, extend the lines until they cross. Mark and measure the distance between the flashlight and the point that the lines intersect. Record your observations.
4. Place a thermometer on a piece of black paper and record the temperature. Shine a beam of light from the flashlight on the bulb of the thermometer for 3 minutes and record the temperature again. Repeat using the laser beam.
5. Observe the flashlight beam and the laser beam through the spectroscope. Record your observations.

Part II: Absorption, scattering and refraction.

1. Put some tap water in the square bottle. Shine the flashlight straight through the water. Set the white card behind the container to view the beam. Repeat by shining the flashlight at an angle through the bottle. Record your observations.
2. Stir a pinch of cocoa powder (or a drop of milk) into the water. Shine the flashlight beam through the water. Repeat the process with the laser beam. Try other liquids and materials. Record your observations.

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3. Place a small sample of each color of gelatin in a square bottle and shine the flashlight and the laser pointer through each. Record which of the colors of gelatin the flashlight and laser light can be seen best.
4. Hold the white card and then the black card in the laser beam. Record which paper color makes a brighter spot.
5. Put some tap water in a round bottle. Shine the flashlight straight through the water. Set the white card behind the container to view the beam. Record your observations.
6. Try shining the laser through the round bottle filled with water and a little cocoa powder. Record your observations.
7. Shine the laser through the curved side of the petri dish or round bottle filled with red gelatin. Record how the laser beam appears in the gelatin and on the card as you move the laser from the outside edge to the center. Shine the laser beam at through the base of the petri dish. Record your observations.

Observations:

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Analysis:

1. What was the function of the reflector (silvery bowl) on the flashlight?

2. How did the light beams of the laser pointer and the flashlight compare? Explain.

3. What happened to the temperature when you shone the flashlight on the bulb of the thermometer? What happened with the laser beam? What does this mean with respect to the properties of light?

4. How did the flashlight beam travel through the square bottle, compared to the round bottle? What does this tell us about the properties of light?

5. What effect did adding cocoa powder have on how the light from the flashlight and light from the laser beam, travelled. What does this tell us about the properties of light?

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6. What impact did the gelatin have on how light travelled through this medium? What role did the gelatin color play?

7. What does the way light reacts when passed through a spectroscope tell us about the nature of light?

Conclusion: What conclusions can we draw about the nature and properties of light? Which observations confirm the nature of light as a particle and which confirm the nature of light as a wave?

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Extension:

1. Investigate and report upon how sunglasses work?
2. Design an experiment to test how light travels through different gaseous media.
3. Research how an LED light differs from a regular filament bulb.
4. Create a safety poster for using laser pointers.
5. Make your own spectroscope! Go to:

http://coolcosmos.ipac.caltech.edu/cosmic_games/spectra/makeGrating.htm

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