LESSON PLAN

Light, Reflection & Refraction

Teacher Notes:

SC State Standards:

8-6.6-- Explain sight in terms of the relationship between the eye and the light waves emitted or reflected by an object
8-6.7-- Explain how the absorption and reflection of light waves by various materials result in the human perception of color

PS-7.1-- Illustrate ways that the energy of waves is transferred by interaction with matter (including transverse and longitudinal/compressional waves)

Common Core Literacy Standards:

CCSS.ELA-Literacy.RST.6-8.1-- Cite specific textual evidence to support analysis of science and technical texts.
CCSS.ELA-Literacy.RST.6-8.2-- Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
CCSS.ELA-Literacy.RST.6-8.3-- Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
CCSS.ELA-Literacy.RST.6-8.4-- Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 6–8 texts and topics*.
CCSS.ELA-Literacy.RST.6-8.7-- Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
CCSS.ELA-Literacy.RST.6-8.8-- Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
CCSS.ELA-Literacy.RST.6-8.9-- Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

CCSS.ELA-Literacy.RST.9-10.1-- Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

Common Core Mathematics Standards:

CCSS.Math.Content.HSS-IC.B.6-- Evaluate reports based on data.

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Target Classes:

- Middle School Physical Science
- Middle School Integrated Science
- High School Physical Science

Summary of the Activity:

This worksheet covers the topics of reflection and refraction as well as the color spectrum of light, utilizing the following exhibits at ***WonderWorks***: two sets of carnival mirrors and a bubble station with three bubble blowing stations. The worksheet can be used as a guided inquiry lesson or as a review. It begins by addressing the nature of light and its behavior as it travels through air. The concept of reflection on planar mirrors is then introduced. Students are then asked to draw a simple ray diagram for an object in front of planar mirror. These activities could be performed in class before visiting ***WonderWorks***, as homework before visiting ***WonderWorks***, or as students wait to use an exhibit.

Students are then asked to make observations based on their reflection in the carnival mirror. They are asked to observe the shape of the carnival mirror, and the vocabulary words “convex” and “concave” mirrors are introduced briefly. Ultimately, the students are asked to draw a relationship between their distorted image and the shape of the carnival mirror.

Students then move to the bubble station. Here, students learn about refraction and the colors present in light. Students are asked to make observations about the colors of bubbles and images seen through bubbles.

Timing:

Approximately 1 hour of data collection at ***WonderWorks***.

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Pre-Field Trip Activities:

The following worksheet is intended to be used as an inquiry worksheet. Concepts covered include reflection, refraction, and the movement of light.

Post-Field Trip Activities:

Discussion questions stemming from this include:

- What are some reflective surfaces you see every day? Do they distort your image?
- Why are some surfaces reflective, but not others? (Absorbance of light)
- What are good properties of a mirror?
- How do objects look when they are submerged in water?

<u>Individual projects could revolve around:</u>

- History of Mirrors
- Prisms, Mirrors, Gratings
- Colors of the Rainbow

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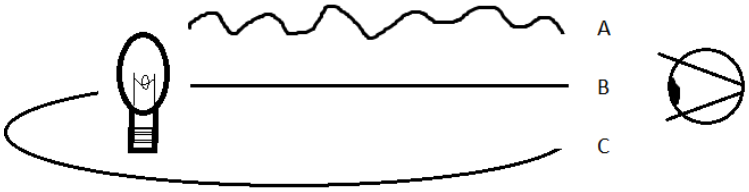
Light, Reflection & Refraction

Student Worksheet

Properties of Light

When light moves through an area, there are very specific rules that determine its path. First, light always travels in a straight line. Second, light always travels through the shortest path possible. These rules were developed by Pierre Fermat in 1605, and are called Fermat's Theorem.

In the picture below, circle the path of light that best follows Fermat's Theorem. Then, explain what is wrong with the other two paths.



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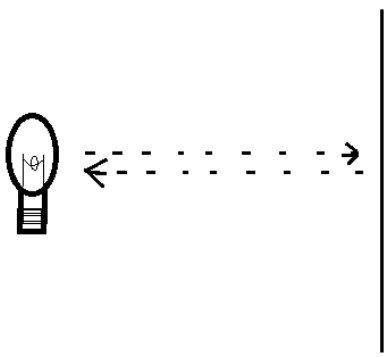
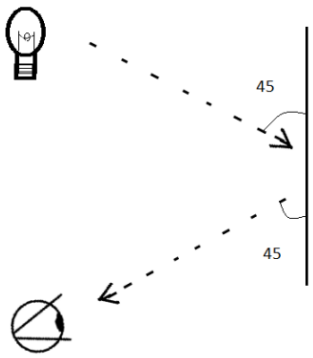
Reflection

Exhibit: Carnival Mirrors (4th level)

When light hits a shiny surface, like a mirror, we say it is reflected. Reflected light bounces back at the same angle that it hits the mirror. In the pictures below, connect the dotted lines to show how light from a mirror hits a mirror and how it bounces back.





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The light that hits the mirror is called “incident light.” The light that bounces off the mirror is called “reflected light.” When the reflected light hits your eye, you see the image in the mirror. Label each arrow that hits the mirror as “incident” and each arrow that comes out of the mirror as “reflected.”

Notice that the lines that we are drawing to represent the mirror are straight. We call these planar mirrors. You usually see planar mirrors in your house, in bathrooms, or in dressing rooms at the mall.

Stand to the side of the fun house mirror. Is it a straight line? Is the fun house mirror a planar mirror?

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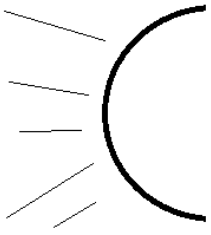
In the box below, draw one of the fun house mirrors as it looks from the side. Be careful to note each of the curves.

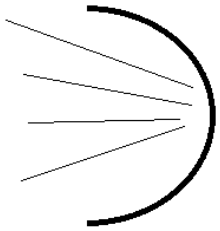
There are two types of mirrors: concave and convex.

Convex mirrors curve outward.



CONVEX MIRROR

Concave mirrors curve inward.



CONCAVE MIRROR

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The funhouse mirror has both convex and concave parts. In the representation that you drew in the box, label the convex and concave parts.

Because the mirror is not straight, the convex and concave parts distort your image.

Look at the part of the mirror that is convex. How does your image in that part of the mirror look?

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Look at the part of the mirror that is concave. How does your image in this part of the mirror look?

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Draw a representation of your image as seen in the funhouse mirror in the box below.

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Refraction **Exhibit: Bubble Lab (3rd level)**

Light moves very differently depending on the material (or medium) through which it travels. Imagine trying to walk through air, water, and through quicksand. How would your movement differ?

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When light travels through water, it moves much slower than it does in air. We call the differences in speed "refraction." We say that light is refracted when it travels through water.

Even though we sometimes think light is "white," it is actually made up of all the colors in the rainbow. You may have heard the acronym ROYG. BIV to represent the colors from which light is comprised. Write the colors which ROY G. BIV represents below:

R- O- Y- G-

B- I- V-

Sometimes when light travels through a different medium, light splits up and its colors are more visible. When it rains, light has to travel through rain drops before it reaches your eyes. The light is refracted, and you see the different colors as a rainbow.

Examine the bubble solutions. What evidence do you see that light is being refracted?

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Use one of the large bubble wands and slowly try to cover someone with a bubble. As you do so, carefully observe how the person looks from behind the bubble solution. What do you see? How does this differ from the image you saw in the fun house mirrors?

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The colors you see on the bubble actually show the thickness or thinness of the bubble wall. Compare bubbles you make with a large wand to bubbles you make with a smaller wand. How do the colors differ?

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What color is the bubble just before it bursts?

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