

## The Laboratory

# R and R Lab

## Teacher's Guide

### Topic:

Refraction and Lenses

### The following information is provided to the student:

**Question:**

What is the effect of increasing the angle of incidence upon the amount of reflection and refraction which occurs for light when it reaches a boundary?

**Purpose:**

To determine the effect of increasing the angle of incidence upon the relative amount of light which undergoes reflection and refraction at a boundary between Lucite and air.

A complete lab write-up includes a Title, a Purpose, a Data section and a Conclusion/Discussion section. The Data section should include an outline of the hemi-cylindrical Lucite disk and should somehow document the results of your investigation. This section should be labeled, visual and purpose-related (*purposeful*). The Conclusion/Discussion section should use organized and complete sentences to respond to the question raised in the Purpose of the lab. Conclusion should be supported by making specific reference to observations in the Data section.

### Materials Required:

Laser; hemicylindrical Lucite block.

### Description of Procedure:

The hemicylindrical Lucite block is placed on top of a sheet of paper. A leveling laser is set to LINE setting and placed with its flattest edge on the paper. The light path is directed at the curved side of the hemicylindrical Lucite block, entering the Lucite at the midpoint of the curved edge and approaching the boundary with the flat side at an angle of incidence of  $0^\circ$ . Gradually the laser path is altered so that the angle of incidence at the flat side increases. For each angle, the laser is set to exit the hemicylindrical block at the midpoint of the flat side. As the angle of incidence is increased, observations are made of how the brightness of the refracted ray changes. The reflected ray at the flat side of the Lucite is also observed; observations are made of how the brightness of the reflected ray changes. These observations are organized and documented in the Data section of the lab. A sufficient number of observations are documented in order to answer the question raised in the Purpose of the lab.

### Alternative Materials and Procedure:

Alternative materials and procedures are not recommended.

### Safety Concern:

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that the working environment is as safe as possible. Light from lasers should never be pointed into a person's eye. Caution should be taken to avoid such mishaps. Student *horseplay* and off-task behaviors should not be tolerated.

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### Suggestions, Precautions, Notes:

1. Inexpensive leveling lasers can be purchased at a home store. They often go on sale for \$5 during the Christmas season. They possess the capability of projecting the laser as a line or a beam. If the price is right, consider picking up a class set for use in both reflection and refraction activities.
2. Emphasize to students the need to document. As you find lab groups and students are doing a great job of documenting, interrupt the class and use their notebooks to demonstrate effective means of communicating the observations.
3. Warn students in advance of the lab of the need to never direct laser light at another person's eye. Students who do not heed your warning should immediately be dismissed from the lab.
4. This activity is a quick experience which provides students a good preparation for a lesson on total internal reflection.

### Auxiliary Materials:

None

### Scoring Rubric:

<b>RL6. R and R Lab</b>	<b>Score</b>
____ Included, labeled and organized all parts of the lab report.	____/____
____ Data section includes observations of how the angle of incidence effects the amount of light which is reflected and the amount of light which is refracted. Observations are organized, accurate, clear and thorough.	
____ Conclusion/Discussion uses complete sentences to intelligently and thoroughly describe the trend of how an increasing angle of incidence effects the amount of light reflected and refracted at a boundary. Clear and explicit reference is made to the Data section in support of the conclusion.	

### Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/refrn/u14l3a.cfm>

<http://www.physicsclassroom.com/Class/refrn/u14l3b.cfm>

### Connections to Minds on Physics Internet Modules:

Sublevel 5 of the Refraction and Lenses module is a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/mop/module.cfm>