

## Direction of Bending Lab

### Teacher's Guide

**Topic:**

Refraction and Lenses

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

**Question:**

What rule could be developed to describe the direction of bending of a light ray as it crosses the boundary between two transparent media?

**Purpose:**

To determine the principle which would predict the relative direction of bending of a light ray as it crosses the boundary between two media (in either of the two directions).

A complete lab write-up includes a Title, a Purpose, a Data section, a Conclusion and a Discussion of Results. The Data section should include a trace of two or more prisms (rectangular or triangular) and the path of laser light from air, into, through and out of the prism. Normal lines should be constructed and the relative direction of bending with respect to the normal line should be discussed. The Conclusion should include a statement of the rule(s). The Discussion of Results section should make explicit reference to the diagrams in the Data section and discuss the logical connection between the evidence and the conclusion.

**Materials Required:**

Laser; transparent Lucite block; transparent glass square; transparent glass triangle.

**Description of Procedure:**

A refraction block (Lucite block, glass square, or glass triangle) is placed on a sheet of paper and outlined using a pencil or pen. A leveling laser is set to LINE setting and placed with its flattest edge on the sheet of paper such that the light path is projected onto the paper. The laser line is directed such that it passes into one side of the refraction block at an angle to the normal line and out the other side. The path of the laser is traced on the paper; arrowheads are placed on the path to indicate the direction of the rays. The process is repeated for a second block. Students analyze the diagrams by drawing normal lines for each boundary (two per diagram) and indicate on the diagram for each boundary whether the bending of the light path was toward or away from the normal line. Students then answer the question posed in the Purpose of the lab.

**Alternative Materials and Procedure:**

If lasers are not available, a cardboard platform and four pins can be used as a replacement. A sheet of paper is placed upon the cardboard. The prism or block is placed upon the paper; a trace of the prism or block is made using a pencil. Two pins are pushed through the paper into the cardboard on one side of the block so that they are upright. Students look through the prism or block from the opposite side at the pins. With one eye closed, they change their sighting location until the pins are aligned one behind the other. Holding their line of sight steady at this location, the students place two more pins along the same line of sight such that all four pins are optically aligned along the same line. The two sets of two pins represent an incident ray entering the prism or block and a refracted ray exiting the prism or block. The entire path of light can be traced and the question raised in the Purpose of the lab can be answered.

## The Laboratory

### 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.

### 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. Refraction blocks and prisms can be purchased from most science supply houses.
3. Emphasize to students that there are two boundaries - one for laser light entering and one for light exiting the block. They should analyze the behavior of light at each boundary individually. Labeling the media as *fast* and *slow* helps. Drawing the normal line and labeling it as **normal line** or **N** also helps.
4. 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.

### Auxiliary Materials:

None

### Scoring Rubric:

<b>RL2. Direction of Bending Lab</b>	<b>Score</b>
<p>___ Included, labeled and organized all parts of the lab report.</p> <p>___ Data section includes an outline of a prism with the laser light path traced into, through and out of the prism; arrowheads are included on the diagram. Normal lines are drawn and the relative direction of bending with respect to the normal line is indicated for each of the two boundaries.</p> <p>___ Conclusion states the rule(s) for the direction of bending for a slow to fast and for a fast to slow situation; rules are correctly stated.</p> <p>___ Discussion of Results relates the evidence of the Data section to the rules of the Conclusion. Specific references are made to the diagrams in the Data section to logically support the direction which light bends when moving from a <i>slow</i> medium to a <i>fast</i> medium. Writing is clear and thorough.</p>	___/___

### Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/refrn/u14l1c.cfm>

<http://www.physicsclassroom.com/Class/refrn/u14l1d.cfm>

<http://www.physicsclassroom.com/Class/refrn/u14l1e.cfm>

### Connections to Minds on Physics Internet Modules:

Sublevel 2 of the Refraction and Lenses module is a suitable accompaniment to this lab:

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