

## Reflection Lab

### Teacher's Guide

**Topic:**

Reflection and Mirrors

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

**Question:**

What general principle could be made to describe how light reflects off a plane mirror surface?

**Purpose:**

To determine a general principle which describes the manner in which light reflects off a plane mirror surface.

A complete lab write-up includes a Title, a Purpose, a Data section (with provided graphic and several labeled laser light paths), a Conclusion and a Discussion of Results. The Conclusion should include a generalized statement expressed in your own words which describes how light reflects off a mirror. The Discussion of Results should describe how the findings reported in the Data section logically lead to the conclusion which you have made. Specific trials that justify your conclusion should be identified.

**Materials Required:**

Plane mirror with a vertical mount; protractor (or photocopy of a protractor); laser light.

**Description of Procedure:**

A plane mirror is placed in an upright orientation on a photocopy of a protractor. It is carefully aligned so that its reflecting surface is flush with the line on the bottom of the protractor. A leveling laser is set to LINE setting and placed with its flattest edge on the sheet of paper. The laser line is directed at the origin of the protractor and reflects off the mirror. The path of the light is clearly evident on the paper since the LINE setting is being used. Students somehow document the path of the laser on their paper. The process is repeated for other angles of approach until sufficient evidence has been accumulated in order to answer the question posed in the Purpose of the lab.

**Alternative Materials and Procedure:**

If lasers are not available, a cardboard platform and three pins can be used as a replacement. Students place a photocopy of the protractor on top of the cardboard. Students rest their mirror with a upright orientation on the protractor. A pin is placed at the origin of the protractor; the mirror is nudged up next to it. A second pin is placed anywhere else on the protractor - for instance, 50 degrees from the normal line. Students sight with one eye from the other side of the normal line at the two pins along an orientation which aligns the two pins. Once aligned, they place a third pin down such that is aligned with the other two. They can then draw the path of light from the first pin to the origin pin to the third pin. The process can be repeated for a couple of other angles until a pattern emerges and a conclusion can be drawn.

**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

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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. Here are two methods for vertically mounting a plane mirror so that it stands upright on a sheet of paper. First, 1-inch thick strips of wood with the same dimensions as the mirrors can be cut and glued to the back of the mirrors. The wood must be perfectly flat along one of its edges. Second, large binder clips could be purchased and clipped to the bottom sides of your mirrors to provide a base of support.
2. 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.
3. Most inexpensive mirrors are coated with a reflective material on the back surface of a thin pane of glass. This does cause difficulties for many optics labs (especially this one) since the reflecting surface is actually behind the glass and not on the glass. A quick fix is to use a so-called two-way mirror which has its reflective coating on the front of the glass (actually, on both sides of the acrylic). An acrylic sheet can be purchased and cut into 3"x5" strips for a cost of approximately \$2 per mirror. Avoid scratching the mirror during the cutting process.
4. A photocopy of a protractor serves as a useful accompaniment for this lab. Students can position the mirror in an upright orientation on the paper and align it along the edge of the protractor. Visit <http://www.ossmann.com/protractor/conventional-protractor.pdf> for a free downloadable protractor.
5. 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:

The downloadable protractor listed at the above web page is provided to students for inclusion in the Data section of their lab notebook.

### Scoring Rubric:

RM1. Reflection Lab	Score
___ Included, labeled and organized all parts of the lab report.	
___ Data section includes provided graphic with incident and reflected rays for several paths (at least two); rays are clearly labeled or color-coded to indicate which reflected ray corresponds to which incident ray.	___/___
___ Conclusion provides a clear statement of how light reflects; written in own words; general enough to be applied to any angle of incidence.	
___ Discussion of Results explains how the data logically support the conclusion. Specific results are referenced in the discussion. Reasons are given for why any results inconsistent with the conclusion can be <i>ignored</i> .	

### Connections to The Physics Classroom Tutorial:

The following reading is a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/refln/u13l1c.cfm>

### Connections to Minds on Physics Internet Modules:

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Sublevel 1 of the Reflection and Mirrors module is a suitable accompaniment to this lab:

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