

What Portion ... ? Lab

Teacher's Guide

Topic:

Reflection and Mirrors

The following information is provided to the student:

Question:

How does the amount of mirror required to view an image of yourself compare to your height? Does the distance from the mirror affect your answer?

Purpose:

To use laser light in order to compare the portion of a mirror required for a person to view him/herself to the height of the person.

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 the provided diagram with laser-guided incident and reflected rays showing the path of light from the head and toe to the eye for two different object locations; measurements should be clearly made and labeled on the diagrams. Class data should be included in the Data section. The Discussion of Results should include a discussion of how the collected data lead logically to the stated conclusion. The Discussion section should also include an error analysis comparing the experimental results to the expected results; a percent error analysis might be included.

Materials Required:

Plane mirror with a vertical mount; metric ruler; laser light; provided diagram (see Auxiliary Materials section).

Description of Procedure:

Students use a diagram which includes an *arrow object* and a mirror line diagram (see Auxiliary Materials section). The *arrow object* represents a person standing in front of a plane mirror. A laser is set on the LINE setting and placed on the table with its flattest side down. A mirror is placed in an upright orientation on the paper such that its reflecting surface is aligned with the mirror line. The laser line is manipulated until it stretches from the head of the person (top of arrow) to the mirror and back to the eye of the person. The path of the laser is marked on the diagram; its intersection with the mirror line is marked. The laser line is then manipulated until it stretches from the feet of the person (bottom of arrow) to the mirror and back to the eye of the person. The path of the laser is marked on the diagram; its intersection with the mirror line is marked. Measurements are made of the distance between markings on the mirror and of the height of the person (*arrow object*). The procedure is repeated with the person (*arrow object*) located a different distance from the mirror. Students analyze all measurements and answer the question posed in the Purpose of the lab.

Alternative Materials and Procedure:

This lab could be done using a four foot plane mirror and an actual person. The mirror is mounted on the wall in a perfectly vertical orientation. The person gazes at the top of his/her head. A teacher moves a marker from the top of the mirror downward until it becomes located at the person's line of sight to the top of his/her head. Once the location is found, it is marked on the mirror with the marker. This procedure is repeated as the student sights at his/her feet. The sighting location is marked. The

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distance between markings is measured and the height of the person is measured. The procedure can be repeated for a different distance from the mirror.

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:

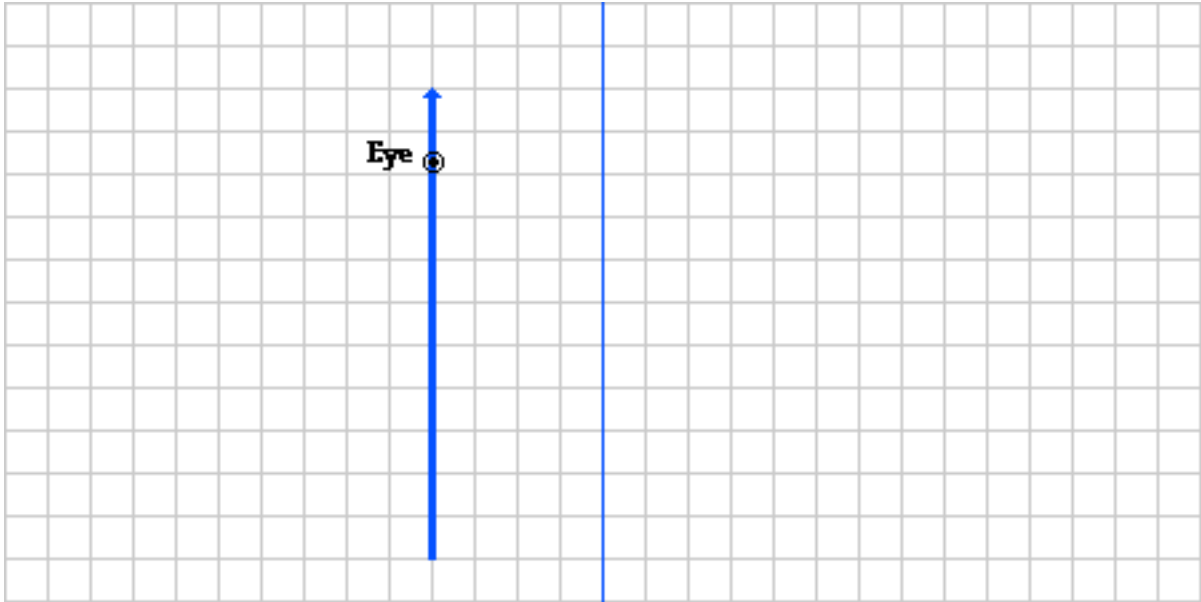
1. Here are two methods for vertically mounting a plane mirror so that it stands upright on a sheet of paper. First, 1-inch thick strips of wood with the same dimensions as the mirrors can be cut and glued to the back of the mirrors. The wood must be perfectly flat along one of its edges. Second, large 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 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. There is a subtle principle which forms the basis of the procedure. Students often miss the principle and fail to understand the procedure. The principle is: for a person to see something, he/she must sight at the thing. To see the top of one's head, one must sight along a line at the top of the head and light rays will then travel along from the top of the head to the eye (reflecting off the mirror in the in between time). Thus, the procedure is based on determining the path along which light travels from the top of the head to the mirror to the eye.
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:

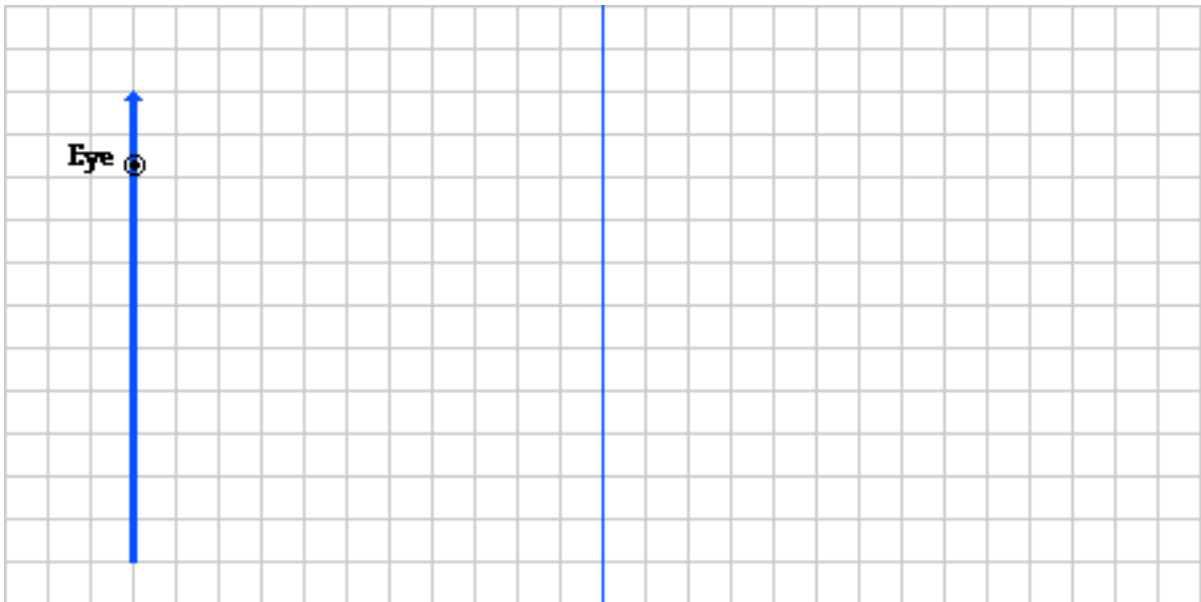
The following page is provided to the student for completion and inclusion in their lab notebook.

Situation A:

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Situation B:



Scoring Rubric:

RM4. What Portion ...? Lab	Score
___ Included, labeled and organized all parts of the lab report.	
___ Data section includes the provided diagrams; both diagrams accurately show light paths from the feet and the head to the eye; arrowheads are included on the rays. Relevant measurements are included on the diagram. Class data is included and labeled.	___/___
___ Conclusion states the relationship between the person's height and the amount of mirror needed to view his/her image.	
___ Discussion of Results uses the experimental evidence and logic to support	

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the conclusion which is drawn. Reasoning is thorough and accurate. Accuracy of individual results are evaluated; some form of percent error or percent difference calculation is used in the evaluation.	
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Connections to The Physics Classroom Tutorial:

The following reading is a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/refln/u13l2c.cfm>

<http://www.physicsclassroom.com/Class/refln/u13l2d.cfm>

Connections to Minds on Physics Internet Modules:

Sublevel 3 of the Reflection and Mirrors module is a suitable accompaniment to this lab:

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