

Least Time Principle Lab

Teacher's Guide

Topic:

Refraction and Lenses

The following information is provided to the student:

Question:

How do the ratios of light speed compare to the ratio of angles for light passing from one medium to another?

Purpose:

To use the least time principle and an analogy to a life guard's most efficient path in order to relate the ratio of light speeds to the ratio of angles of incidence and refraction.

A complete lab write-up includes a Title, a Purpose, a Data section, and a Conclusion. The Data section should include the provided tables and an additional table which summarizes the results of the three trials. The Conclusion section should respond to the question raised in the purpose and state an equation relating the two ratios.

URL: <http://www.physicsclassroom.com/shwave/leasttime.cfm>

Materials Required:

A page from The Shockwave Physics Studios:

<http://www.physicsclassroom.com/shwave/leasttime.cfm>

Description of Procedure:

Students navigate to the above page, read the directions and conduct the activity. Using a trial and error method, students determine the optimal entry point of a life guard into the water in order to save a drowning swimmer in the least amount of time. Two to three combinations of running speed on sand and swimming speed in water are used. Data is entered into the provided tables. Once students determine the optimal entry location into the water for a path of least time, the angle of approach and departure from the boundary are provided. Using the speeds and angles, students can answer the question posed in the Purpose of the lab.

Alternative Materials and Procedure:

A more thorough approach to this lab is provided at The Shockwave Physics Studios:

<http://www.physicsclassroom.com/shwave/leatimedirns.cfm>

The alternative exercise is a guided exercise with an extensive procedure.

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. Student *horseplay* and off-task behaviors should not be tolerated.

The Laboratory

Connections to Minds on Physics Internet Modules:

Sublevels 3 and 4 of the Refraction and Lenses module are suitable accompaniments to this lab:

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