

<b>Main Topic</b>	Light & Color
<b>Subtopic</b>	Refraction
<b>Learning Level</b>	Middle
<b>Technology Level</b>	Low
<b>Activity Type</b>	Student

Description: Investigate images formed by converging lenses using the Light Box & Optical Set

Required Equipment	Light Box and Optical Set
Optional Equipment	

This lab is excerpted from *Light and Color Teacher's Guide* (Arbor Scientific P2-9560). The diagrams allow students to use the Light Box and Optical Set (Arbor Scientific P2-9561) directly on their lab pages.

## Refraction—B6—How is Light Refracted Through a Thick Lens?

### Teacher's Notes

#### Educational Objectives

- Students will demonstrate using the light box and plastic lenses that lenses have focal points and focal lengths.
- Students will be able to use ray tracing techniques to describe the path of light rays from before the light enters the lens until after it has exited the lens.
- Students will be able to apply their understanding of refraction to predict the path light will take as it interacts with each of the objects in the activity.

#### Key Questions

- What happens to the path of parallel rays of light as they enter and exit a lens?

#### Concept Overview

Students are introduced to how lens function with a progression of four carefully crafted activities. The first three activities use different converging lenses and the fourth activity uses a diverging lens. The series of activities is started with the half round element. The students observe and establish that a focal point exists when a beam of parallel light rays light enters both the curved and flat surfaces of the lens. The second activity has the students repeating the process using a thick lens. The third activity students make use a thin converging lens to repeat these same observations. The first three activities are designed to let the student identify that lens have a focal point and changing the curvature and thickness of the lens can change position of the focal point. The fourth activity uses a concave lens that spreads (diverges) the parallel light rays and no real focal point can be found however by extending the refracted ray back through the lens a virtual focus may be obtained.

**Techniques**

See Refraction 1 Teacher's Notes for information on eliminating "Ghost Rays."

## How is light refracted through a thick lens?

### Goal

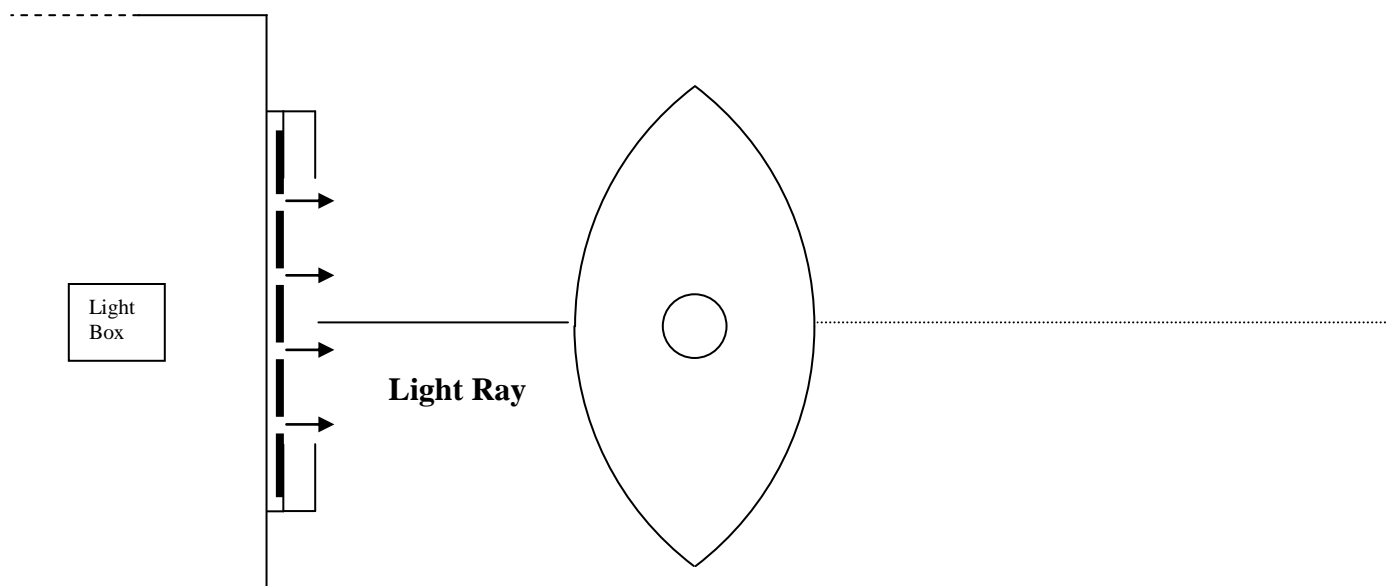
- To learn how light is bent when it passes through a thick lens.

### Materials

Light box  
Thick lens

mask with four slit opening

- Predict the path that the light rays below will take as they travel through the lens and exit the lens below. Use a dashed line for your prediction. Drawing a normal line at the point where the light enters and exits the half round lens may be helpful.



- Cite evidence from previous activities that support your proposed light path.

\_\_\_\_\_

\_\_\_\_\_

- Using a four slit mask on the light box, shine a rays parallel to the “light ray direction” line. Use a solid line to show the light ray path as it moves to the right side of the paper.

- What do you observe about the refracted rays as they exit the lens?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_