11.9 Inquiry Investigation

INQUIRY SKILLS	
● Questioning	○ Hypothesizing
● Predicting	● Planning
● Conducting	● Recording
● Analyzing	● Evaluating
● Communicating	

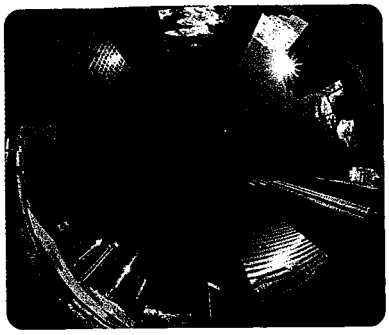

Figure 1
This image was created using a fisheye lens.

▷ **LEARNING TIP**

For help with writing a question and a prediction, see "Questioning" and "Predicting" in the Skills Handbook section **Conducting an Investigation**.

Investigating Lenses

Have you ever looked through a peephole in a door to see who is on the other side? Have you ever looked through binoculars at a ball game? Have you ever used a microscope to look at cells? Whether lenses are used to make faraway objects appear clearer or to enlarge small objects, they can produce interesting results (**Figure 1**). In this Investigation, you will use light rays to discover how different lenses produce different types of images.

Question

(a) Write a question about images and lenses that you can investigate.

Prediction

(b) Based on what you have learned, predict an answer to your question.

Experimental Design

You will use a ray box to observe images created by lenses and determine if your prediction is correct.

Look at **Figure 2** to see how you can use two rays, one at a time, to locate the top of the image of an object placed in front of a convex lens. Using two more rays, you can use a similar technique to locate the bottom of the image.

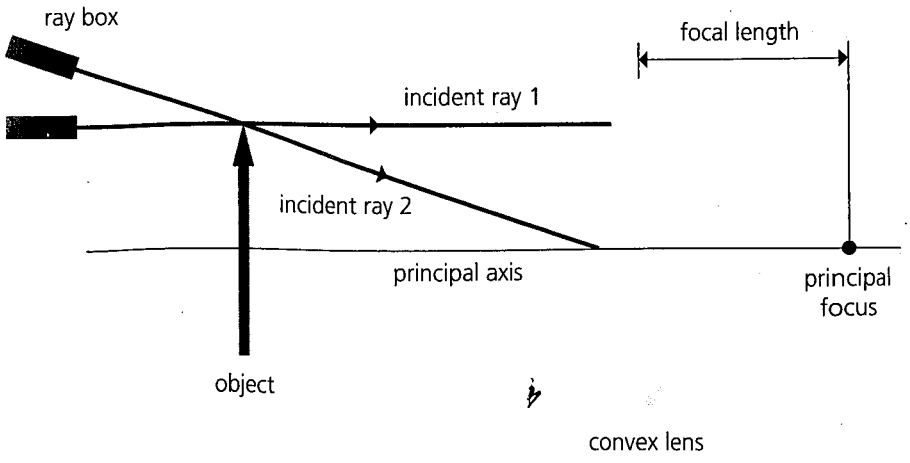

Figure 2
How to find the top of an image

(c) Design a procedure to find the image of an object in each position described below, and to decide what type of image it is.

Convex Lens

(i) an object that is 2 times the focal length from the lens

(ii) an object that is 1.5 times the focal length from the lens

(iii) an object that is exactly the focal length from the lens

(iv) an object that is half the focal length from the lens

Concave Lens

(v) an object that is 2 times the focal length from the lens

(vi) an object that is exactly the focal length from the lens

(d) Based on your design, list the steps you will take.

Materials

- ray box with multiple-slit window and single-slit window
- convex and concave lenses to use with the ray box
- plain paper
- sharp pencil
- ruler

Do not touch the light bulb in the ray box or look directly into the light. Handle the lenses carefully to avoid breakage.

Procedure

1. With your teacher's approval, carry out your procedure. For each position in step (c), draw a diagram showing what you discover. (If the rays are spreading apart, extend them with a ruler to find out where they appear to come from.)

Analysis

(e) Describe the steps you would take to determine the focal length of

(i) a convex lens

(ii) a concave lens

(f) Describe the conditions that cause a convex lens to produce

(i) a real image

(ii) a virtual image

(iii) no image

(g) Does a concave lens produce a real image or a virtual image? Explain.

Evaluation

(h) How would you improve your procedure if you were going to do this Investigation again?

PERFORMANCE TASK

Many optical devices use combinations of lenses. How many lenses are in your device? What kinds of lenses are used? What combination of different lenses is used?