Reflection Lab

In the following experiment, we will determine the location of an object and its image by a technique called ***ray tracing***. This technique is based on our model for the behavior of light in which we envision light as being either emitted or reflected in the form of waves.

Part A

1. Stick a pin into a sheet of paper secured to a piece of cardboard. This will be the object pin. Place a mirror about 5 cm behind the pin.
   a. Mark the location of the mirror and the object pin on the paper. Draw a straight line connecting the object location to any point on the mirror. Draw an arrowhead in the middle of this line pointing to the mirror. This is the incident ray of light.
   b. Draw a line perpendicular to the mirror at the point where the incident ray meets the mirror. This is also called a normal to the mirror.
   c. Place your eyes near the surface of the table so that you can see the image of the pin and the image of the incident ray in a straight line (using only one eye).
   d. Place a second pin in a position that blocks your view of the object pin. Mark its location.
   e. Remove the mirror and both pins. Now draw a straight line connecting the location of the second pin and the same point on the mirror as above. What does this line represent? Draw an appropriate arrowhead on this line to indicate its direction of propagation.

2. Consider the angle formed by the incident ray and the normal to the mirror (the angle of incidence) and the angle formed by the second ray and the normal (the angle of reflection).
   a. Predict how these angles will compare.

   b. Now measure the angles and test your prediction.

3. Extend the path of the second ray back behind the mirror as a ***dotted*** line.
   a. What does the dotted line that you just drew represent?

   b. Why wouldn't it be appropriate to include an arrowhead on this line?

Part B

1. Repeat the procedure in part A for at least two more incident rays (two more points on the mirror).
   a. Predict how the angles of incidence and angles of reflection will compare for each case.

   b. Measure the angles and test your predictions.

2. Extend the path of the reflected rays back behind the mirror with a dotted line as before.
   a. Do these dotted lines intersect behind the mirror? If they do, explain why. If they don't, explain why not.

   b. What is the least number of rays required to determine the location of an object using a ray diagram?

3. Place a pin in the location of the image marked on the paper.
    a. Draw a perpendicular ray directly from the object to the mirror. Extend this line back behind the mirror so that it meets the location of the image.
    b. How does the distance of the object from the mirror compare to the distance of the image from the mirror?
    c. Is the image of the object seen in the mirror larger, smaller, or the same size?
    d. Is the image of the object seen in the mirror right side up or upside down? Is this always true?

Wrap-up Activity

1. Imagine you are looking at yourself in a mirror mounted on a wall. From where you stand, you see your head and the top of your shoulders.
    a. Is there anything you can do, while still standing vertically upright, to enable you to see more of yourself in the mirror?
    b. Draw a ray diagram of this situation.
2. What is the minimum size mirror needed by someone who is six feet tall to view herself or himself completely?
    a. How does the person's distance from the mirror affect the image? Draw a ray diagram to justify your conclusions.
    b. Does your answer depend on whether the person's eyes are at the very top of the head or somewhere lower down?