PhyzLab Springboard: Reflections I

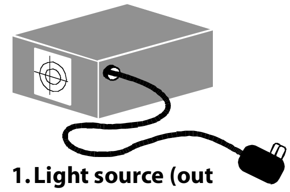
Felix

• Apparatus •

___PASCO Basic Optics System:

- __light source (out of bracket)
- __power supply (plug)
- __three-sided mirror (in blue box)
- __portion of an index card

___Lines and Angles Sheet (one per group)



1. Light source (out of bracket) with power supply firmly attached

• Set-Up •

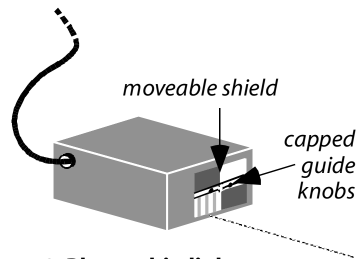
Arrange the apparatus as shown to the right.

1. Attach the power supply to the light source, then plug it in.

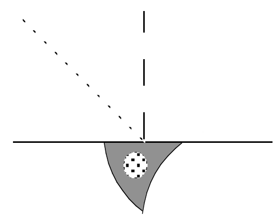
2. Arrange the light source to be a ray box and **carefully** adjust the moveable plastic shield so that a single beam is emitted. *The shield moves easily side to side: do not push the guide knobs: they will break!*

3. Place the three-sided mirror on the solid line of the Lines and Angles Sheet as shown in diagram 3 to the right.

4. Make the single beam from the light source follow the dotted diagonal line on the Lines and Angles Sheet **toward** the mirror.



2. Plugged-in light source in ray box configuration emitting a single beam

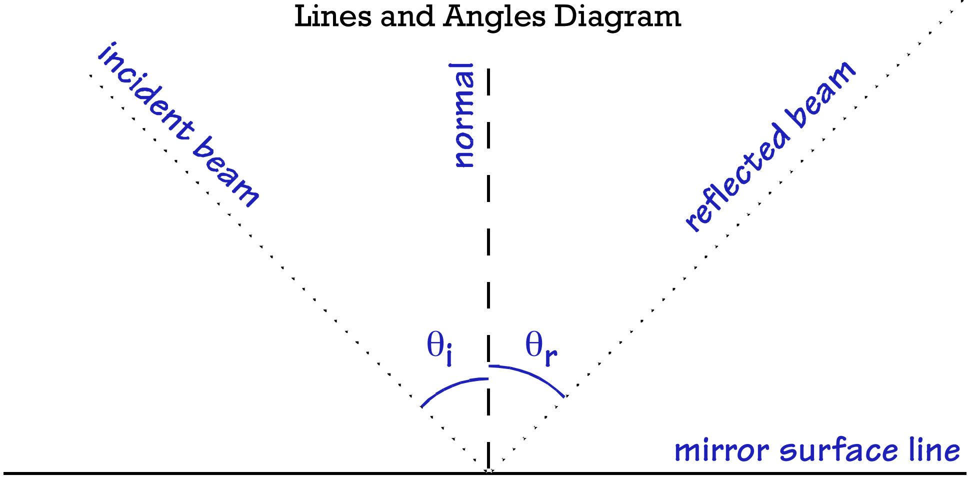


3. Three-sided mirror lying flat (like a cookie cutter) with the plane mirror on the solid line

• Procedure •

1. On the Lines and Angles Diagram below, identify the following:
   - Mirror surface line
   - N _o_ _r_ _m_ _a_ _l_ (a line perpendicular to a surface)
   - Incident ray

Lines and Angles Diagram



2. An important quantity in optical physics is the **angle of incidence.** This angle is measured from the incident ray to the normal line. Measure and record the angle of incidence and label it on the Lines and Angles Diagram.

θ_i = 45°

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3. When the lights are turned off, examine the situation. Draw two dots on the Lines and Angles Sheet along the **reflected beam** (you will use these later to construct a ray representing the reflected beam).

4. When the lights are turned on again, draw and label the reflected ray on your Lines and Angles Sheet and on the diagram above.

5. An important quantity in optical physics is the **angle of reflection.** This angle is measured from the reflected ray to the normal line. Measure and record the angle of reflection and label it on the Lines and Angles Diagram.

θ_r = 45°

6. There are at least two significant observations that can be made about the relationship between θ_i and θ_r. What are they?

$$\theta_i = \theta_r$$
$$\theta_i + \theta_r = 90°$$

7. Are both statements above always true when light is reflected? How could we test them?

[Answers may vary]
Try a different angle of incidence and observe the corresponding angle of reflection.

8. Sketch the results of this experimental test on your Lines and Angles Diagram. What did it prove?

$$\theta_i = \theta_r$$
$\theta_i + \theta_r$ is not always equal to 90°

• Further Explorations •

1. Place a small piece of an index card in front of the plane mirror.
   a. Does the white card reflect light?

Yes! It may not send a reflected beam onto the paper like the mirror does, but since you can see a bright stripe on it, you know it's reflecting.

   b. What difference—if any—is there between the mirror reflection and the white card reflection?

The mirror reflects a beam onto the paper; the card does not. The card gets a bright stripe of light on it; the mirror does not.

   c. How do the terms "specular" and "diffuse" relate to reflection?

Specular: reflection from a smooth surface (one on which the irregularities are small compared to the wavelength of light).
Diffuse: reflection from a rough surface.

2. Move the shield on the light source to allow **five** beams of light to emerge. When the lights go out, examine the reflections from the plane mirror and the two other mirrors (on the other sides of the three-sided mirror). Rotate the mirrors and observe the reflections.

More on this in a future episode...stay tuned!

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