

Name: \_\_\_\_\_ Date: \_\_\_\_\_

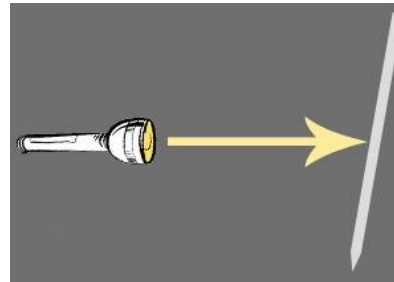
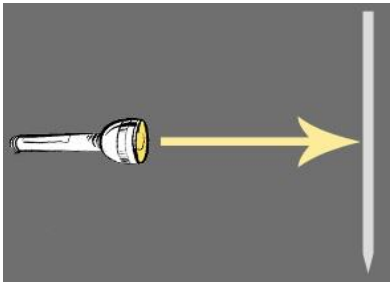
## Student Exploration: Laser Reflection

**Vocabulary:** angle of incidence, angle of reflection, laser, law of reflection, plane mirror, reflection

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

Imagine you shine a flashlight directly at a mirror, as shown below.

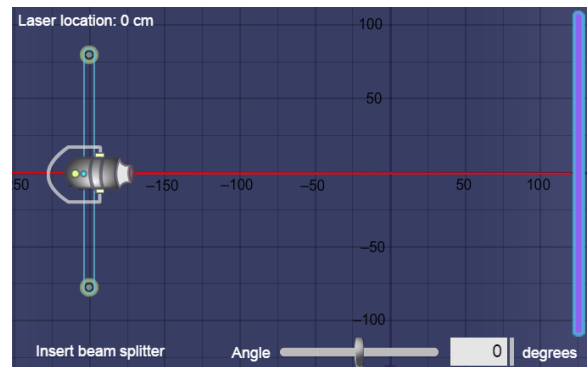
1. Draw an arrow showing the direction you think the beam of light will most likely reflect off the mirror.
2. Suppose you tilt the mirror. Draw an arrow showing the direction the beam will most likely reflect off the mirror now.



### Gizmo Warm-up

Flashlights produce wide beams of light that have various wavelengths. A **laser**, on the other hand, is a narrow beam of light with only one wavelength. All the waves in a laser beam are parallel to one another. As a result, lasers are ideal for studying **reflection**, or how waves bounce off a surface.

Using the *Laser Reflection Gizmo™*, you can adjust the position of a laser beam and mirror to study how light behaves when it is reflected.



1. Drag the **Angle** slider back and forth. Describe what happens to the reflected laser beam:

---



---

2. Drag the laser up and down. Describe what happens to the reflected laser beam: \_\_\_\_\_

---



<b>Activity A:</b> <b>Reflection from a plane mirror</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Set the <b>Laser location</b> to 0 cm.</li> <li>• Set the <b>Angle</b> to 25 degrees.</li> <li>• Make sure <b>Plane mirror</b> is selected.</li> </ul>	
---	---	--

**Introduction:** A **plane mirror** is a perfectly flat, smooth surface. In this activity, you will study how plane mirrors reflect light.

**Question:** How does the angle of a mirror determine the angle of the reflected light?

1. **Observe:** Turn on **Show normal**. The normal is the dotted line perpendicular to the mirror. The **angle of incidence** ( $\theta_i$ ) is the angle between the incoming laser beam and the normal. The **angle of reflection** ( $\theta_r$ ) is the angle between the reflected laser beam and the normal.

Move the **Angle** slider back and forth. What do you notice about the sizes of  $\theta_i$  and  $\theta_r$ ?

---

2. **Measure:** Set the **Angle** to 40 degrees and turn on **Show protractor**. Each marking on the protractor represents 10 degrees.

What do  $\theta_i$  and  $\theta_r$  equal?       $\theta_i =$  \_\_\_\_\_       $\theta_r =$  \_\_\_\_\_

3. **Make a rule:** What is the relationship between  $\theta_i$  and  $\theta_r$ ? \_\_\_\_\_

---

Turn on **Show angles** and move the **Angle** slider back and forth. Was your rule correct?

---

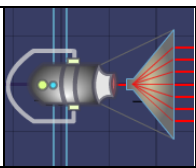
The **law of reflection** states that the angle of incidence is equal to the angle of reflection.

4. **Gather data:** Use the Gizmo to complete the table below.

Mirror angle	Angle of incidence ( $\theta_i$ )	Angle of reflection ( $\theta_r$ )
0°		
25°		
50°		

5. **Make a rule:** How is the mirror angle related to the angles of incidence and reflection?

---

<b>Activity B:</b> <b>Reflection from non-planar mirrors</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Turn off <b>Show normal</b> and <b>Show protractor</b>.</li> <li>• Set the mirror Angle to 50°.</li> </ul>	
---	---	---

**Question: How can you use the angle of reflection to determine the shape of a non-planar mirror's surface?**

1. **Observe:** Turn on **Insert beam splitter**. How do the seven incoming beams compare with one another? How do the reflected beams compare with one another?

---



---

2. **Observe:** From the dropdown menu at lower right, select **Mirror 1**. Unlike the plane mirror, mirror 1 is not flat.

A. Describe how the laser beams changed: \_\_\_\_\_

---

B. Why do you think this happened? \_\_\_\_\_

---



---

3. **Solve:** Turn off **Insert beam splitter**. Set the mirror's **Angle** to 0 degrees and the **Laser location** to 35 cm. Check that **Show angles** is on.

A. What are the angle of incidence and angle of reflection ( $\theta_i$  and  $\theta_r$ )? \_\_\_\_\_

B. What does this tell you about the surface of the mirror in this location? \_\_\_\_\_

---

C. Move the **Laser location** to 14 cm. How did the orientation of the beam change?

---

D. What does this tell you about the surface of the mirror in this location? \_\_\_\_\_

---

**(Activity B continued on next page)**

