



### Science Objectives

- Students will draw diagrams showing how an object's reflection can be seen through a mirror.
- Students will explore the relationship between the distance of the object from a mirror and the image distance from the mirror.
- Students will measure angles of reflection to see the relationship between an object and its reflection.

### Vocabulary

- angle of incidence
- image
- light path
- object
- plane mirror
- reflection

### About the Lesson

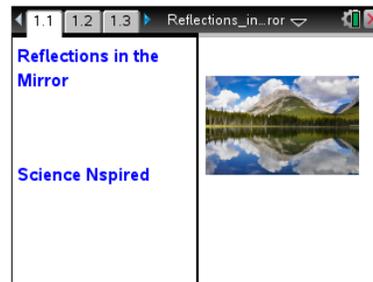
- This lesson has students reflect objects over a mirror line to determine the position of the image.
- As a result, students will:
  - Develop the understanding that the image appears the same distance behind the mirror as the object is in front of the mirror.
  - Be able to explain the relationship between an object's angle of reflection and how it appears in a mirror.

### TI-Nspire™ Navigator™

- Send out the *Reflections\_in\_the\_Mirror.tns* file.
- Monitor student progress using Screen Capture.
- Use Live Presenter to spotlight student answers.

### Activity Materials

- *Reflections\_in\_the\_Mirror.tns* document
- TI-Nspire™ Technology
- *Reflections\_in\_the\_Mirror\_Student* Activity Handout



### TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and move a point

### Tech Tips:

Make sure that students understand how to drag points, construct line segments, and construct a perpendicular.

### Lesson Materials:

#### *Student Activity*

- *Reflections\_in\_the\_Mirror\_Student.doc*
- *Reflections\_in\_the\_Mirror\_Student.pdf*

#### *TI-Nspire document*

- *Reflections\_in\_the\_Mirror.tns*

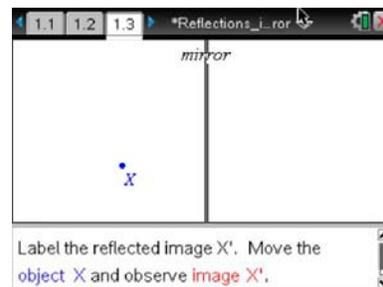


### Discussion Points and Possible Answers

Have students read the background information stated on their activity sheet.

**Move to pages 1.2 and 1.3.**

- On page 1.3, using the **Reflection** tool, students will reflect point  $X$  over the mirror and label the point  $X'$ .
  - Click on **Menu** and under **Geometry** select **Transformation** and under that select **Reflection**.
  - When the tool is active, click point  $X$ .
  - Then click on the line (representing the mirror) that you wish to reflect across.
  - When the image point appears, create a text label and input " $X'$ ."



**Tech Tip:** To reflect an object find the reflect tool (**Menu** and under **Geometry** select **Transformation** and under that select **Reflection**). Click on point  $X$  and then click on the mirror line. The point will appear on the opposite side. When the point appears type  $X'$  *immediately* and the label will be attached.

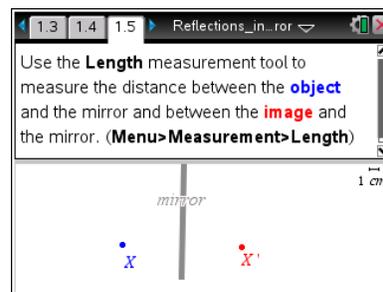
**Move to pages 1.4–1.6.**

Have students answer questions 1 and 2 on either the handheld, on their activity sheet, or both.

- Q1. Move the point  $X$  around the screen. Describe how the image,  $X'$ , moves as you move the object.

**Answer:** The image moves to the same corresponding position at and the same distance from the mirror on the opposite side.

- On page 1.5, students will use the Length measurement tool to measure the distance between the object and the mirror and between the image and the mirror.
  - Make sure the Geometry window is active. If it isn't, press **ctrl** **tab**.
  - Measure the distance from  $X$  to the mirror using the **Length** tool (**Menu > Measurement > Length**).
  - Click on point  $X$  and then click on the line representing the mirror.
  - They'll see the object distance.
  - Repeat by measuring the image distance from  $X'$  to the mirror.





- Q2. How is the object distance related to the image distance? Does this relationship stay the same when you move the object?

**Answer:** The distances are equal and they remain equal to each other when you move the object.

**Tech Tip:** When measuring an angle students need to click on three points. The first point on one segment, the second point on the vertex and the third on the other side or segment of the angle.

Move to pages 1.7 and 1.8.

3. Have students read the directions on page 1.7. On page 1.8, they should first construct a line segment from point  $X$  to point  $X'$ , and then measure the angle between the mirror and the segment.

Move to pages 1.9 and 1.10.

Have students answer questions 3 and 4 on either the handheld, on the activity sheet, or both.

- Q3. What angle does the connecting segment make with the mirror? Does this angle change when you move the object?

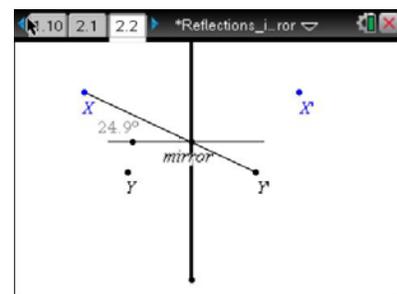
**Answer:** 90 degrees; The angle does not change when the object is moved.

- Q4. Suppose  $XY$  is the length of an object. How does the length of the image,  $X'Y'$ , compare to  $XY$ ?

**Answer:** The length of the image is the same as the length of the object.

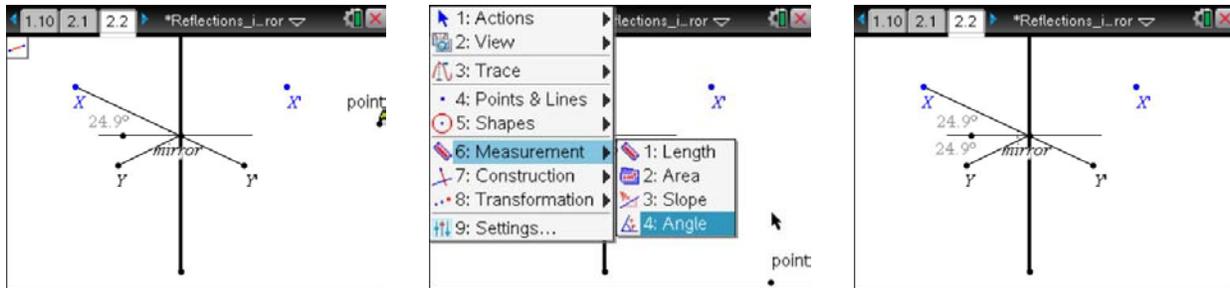
Move to pages 2.1–2.3.

4. How does an observer at point  $X$  see the image at point  $Y$ ?
- On page 2.2, students draw a line segment from point  $X$  to image  $Y'$ .
  - To measure the angle of reflection, students must first construct a perpendicular line to the mirror at the point where segment  $XY'$  intersects the mirror (the “normal”).
  - They then will measure the angle of reflection formed between the  $XY'$  segment and the normal.





5. Students draw a segment from  $Y$  to the point where segment  $XY'$  intersects the mirror. They then measure the angle between this segment and the normal. Students can follow the sequence of screens shown below.



**Move to pages 2.4 and 2.5.**

Have students answer questions 5 and 6 on either the handheld, on the activity sheet, or both.

- Q5. What angle does the connecting segment make with the normal to the mirror? Does this angle change when you move the object?

**Answer:** Answers will vary; the angle of reflection equals the angle of incidence.

**Teaching Tip:** This is a great time to talk about angle of incidence and angle of reflection.

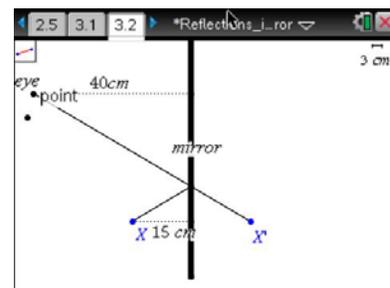
- Q6. If  $X$  or  $Y$  is moved away from the mirror, does it change your answer for the last question?

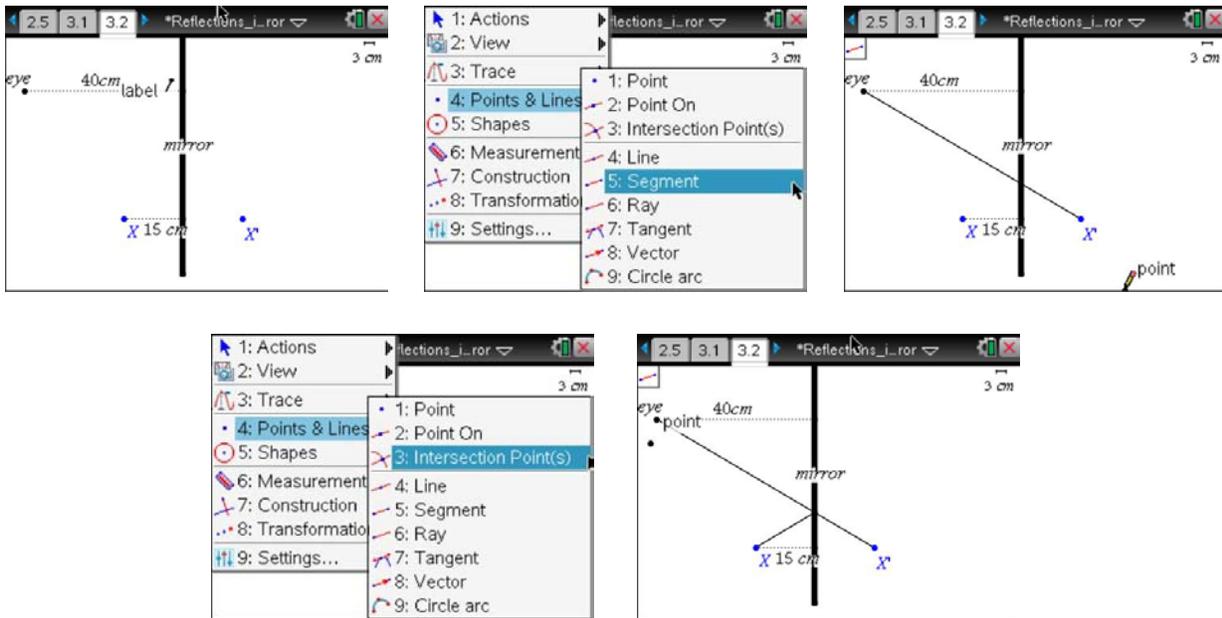
**Answer:** The angles do change but they stay equal to each other.

**Move to pages 3.1 and 3.2.**

6. Students will read the scenario shown on page 3.1. Page 3.2 simulates the scenario.

**Teacher Tip:**  $X'$  will appear slightly further back because the path of light from the object to the eye is slightly longer than the path from  $X$  to  $X'$ . If students construct the light paths between the eye and  $X$  they can see the distance between the eye and the  $X'$ .





Move to pages 3.3 and 3.4.

Have students answer questions 7 and 8 on either the handheld, on the activity sheet, or both.

Q7. How far behind the mirror will the image appear to the observer?

**Answer:** The image should still appear 15 cm behind the mirror but answers will vary from the students.

Q8. Will this distance change if the observer moves closer to the mirror? Explain your answer.

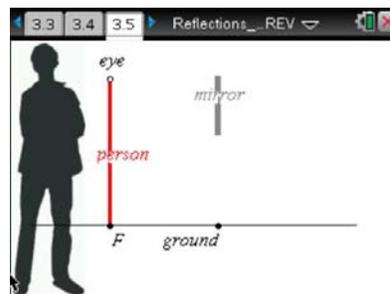
**Answer:** Yes, the closer you move to the mirror the farther it will seem the object is from the mirror.

**Teacher Tip:** Students will need to use knowledge from previous explorations in this activity to construct the path of light. Little instruction is given in the student document to allow them to use this prior knowledge and to explore on their own.



Move to pages 3.5–3.7.

Have students use the diagram on page 3.5 to answer questions 9 and 10 on either the handheld, on the activity sheet, or both.



Q9. Will the person be able to see his or her feet if he or she moves farther from the mirror? Make a prediction.

**Answer:** Answers may vary. Students should note that the path of light from the eye to the image would not touch the mirror as shown in the screen capture to the right. Discuss the need for the light to hit the mirror for a person to see the image.

8. Now, use the simulation to test your prediction. Move the dot at eye level to get closer or further away. The man will not move.

Q10. Was your prediction correct? If not, explain any errors in your reasoning.

**Answer:** Answers may vary.

**Teaching Tip:** If students haven't reflected  $F$  and produced  $F'$ , discuss the need for these steps. Have them draw the path from the eye to  $F'$  also.

### TI-Nspire Navigator Opportunities

Use TI-Nspire Navigator to do screen captures to see if students are reflecting  $F$  and drawing a path from the eye to  $F'$ .



**TI-Nspire Navigator Opportunities**

Use Navigator to capture screen shots of student progress and to retrieve the file from each student at the end of the class period. The student questions can be electronically graded and added to the student portfolio.

**Wrap Up**

When students are finished with the activity, pull back the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

**Assessment**

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment will consist of questions/problems on the chapter test.