Science Objectives

- Students will observe how objects produce images in 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 explain what an observer sees when looking at objects in a mirror.

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 the observer's position and the image of an object in the mirror.

TI-Nspire™ Navigator™

- Send out the *Plane_Mirrors.tns* file.
- Monitor student progress using Screen Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- *Plane_Mirrors.tns* document
- TI-Nspire™ Technology

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
- Plane_Mirrors_Student.doc
- Plane_Mirrors_Student.pdf

TI-Nspire document
- Plane_Mirrors.tns

Discussion Points and Possible Answers

Move to pages 1.2 and 1.3.

1. Using the **Reflection** tool, students will reflect point *X* over
    the mirror and label the point *X'*. (**Menu > Transformation >
    Reflect**). When the tool is active, click on point *X*. Then click on
    the line (representing the mirror) that you wish to reflect across.
    When the image point appears, type "*X'.*"
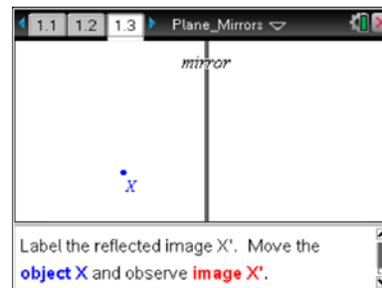
> **Tech Tip:** To reflect an object find the reflect tool (**Menu > Transform >
> Reflect**). Click on point *X* and then click on the mirror line. The point will
> appear on the opposite side. When the point appears type *X' immediately*
> and the label will be attached.

Move to pages 1.4–1.6.

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

Q1.   Describe how the image 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.

2. On page 1.5, students should measure the object distance between *X* and the mirror and the image
    distance between *X'* and the mirror by using the **Length** tool (**Menu > Measure > Length**).

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. 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 the questions 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
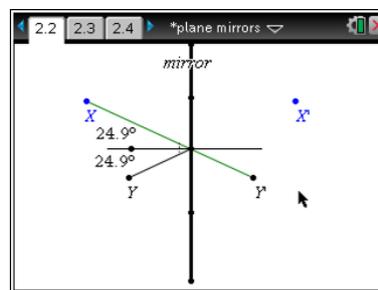   move the object?

       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. Students draw the segment *XY′*, create a perpendicular line to the
    mirror at the intersection of the mirror and the *XY′* segment (the
    "normal"). They then measure the angle of reflection formed
    between the *XY′* segment and the normal.
5. Students construct a segment from *Y* to the intersection of the
    mirror and the *XY′* segment. They measure the angle between
    this segment and the normal.

Move to pages 2.4 and 2.5.

Have students answer the questions 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 a description the scenario shown on page 3.2.
    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′*.
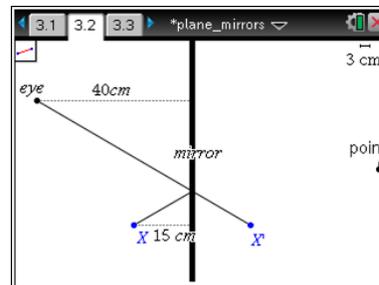
Move to pages 3.3 and 3.4.

Have students answer the questions 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
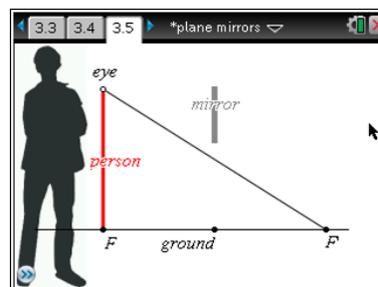   from the mirror.

> **Tech 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 the questions
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. Have students use the simulation to test their prediction. They should move the dot labeled "eye"
   toward or away from the mirror. 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'*.

Move to pages 4.1 and 4.2.

9. The students will reflect points *A*, *B,* and *C* over the mirror line and then create paths from *P* to *A'*, *B'*, and *C'*. Then they can move *P* until all three paths intersect the mirror as shown to the right.
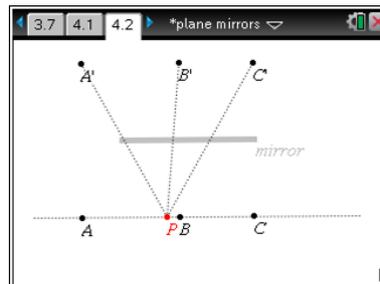
Move to pages 4.3 and 4.4.

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

Q11. Is it possible for the photographer to take a photograph of the reflections so that everyone appears in the mirror without anyone (except the photographer) having to move? Explain your answer.

   Answer: Yes. The photographer just has to get at the proper position to get all three of the peoples' reflections (images).

Q12. Where could the photographer stand (along the line) so that he or she does not appear in the photograph? Will all three other people still be visible in the photograph? If not, who will be left out?

   Answer: The photographer could stand just outside of person *C* and still get a picture where all three would appear in the photograph.

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.