**OVERALL EXPECTATIONS**

- demonstrate scientific investigation skills in the four areas of skills
- identify and describe a variety of careers related to the fields of science under study, and identify scientists, including Canadians, who have made contributions to those fields
- investigate, through inquiry, the properties of light, and predict its behaviour, particularly with respect to reflection in plane and curved mirrors and refraction in converging lenses
- demonstrate an understanding of various characteristics and properties of light, particularly with respect to reflection in mirrors and reflection and refraction in lenses

**SPECIFIC EXPECTATIONS**

**Scientific Investigation Skills**

- formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research
- conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately, and effectively, to collect observations and data
- analyze and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty

**Career Exploration**

- identify and describe a variety of careers related to the fields of science under study and the education and training necessary for those careers

**Developing Skills of Investigation and Communication**

- use appropriate terminology related to light and optics
- use an inquiry process to investigate the laws of reflection, using plane and curved mirrors, and draw ray diagrams to summarize their findings
- predict the qualitative characteristics of images formed by plane and curved mirrors, test their predictions through inquiry, and summarize their findings

**Understanding Basic Concepts**

- describe, on the basis of observation, the characteristics and positions of the images formed by plane and curved mirrors, with the aid of ray diagrams and algebraic equations, where appropriate

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**11.7 Images in Plane Mirrors**

**TIME**

45–60 min

**VOCABULARY**

- virtual image

**SKILLS**

- Questioning
- Predicting
- Performing
- Observing
- Analyzing
- Evaluating
- Communicating

**EQUIPMENT AND MATERIALS**

**per group:**
- two plane mirrors
- two mirror supports
- ruler
- protractor
- a die

**per student:**
- paper
- pencil

**ASSESSMENT RESOURCES**

Assessment Rubric 2: Thinking and Investigation
Assessment Rubric 3: Communication
Assessment Summary 2: Thinking and Investigation
Assessment Summary 3: Communication

**OTHER PROGRAM RESOURCES**

BLM 0.0-4 Two-Column Table
Skills Handbook 7. Study Skills
Science Perspectives 10
website www.nelson.com/scienceperspectives/10

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**KEY CONCEPTS**

- Images in flat mirrors are located at the point where the backward extensions of reflected rays intersect.

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**EVIDENCE OF LEARNING**

Look for evidence that students can
- describe and explain the characteristics of images formed by plane mirrors
- use the laws of reflection to make drawings of images formed by plane mirrors
POSSIBLE MISCONCEPTIONS

Identify

• Students may have the misconception that light rays actually exist “behind” a mirror or on its surface, producing the image.

Clarify

• Light rays extending behind the mirror are depicted in this section by dashed lines. Explain that these rays do not really exist. The brain interprets these rays as being behind the mirror to form a virtual image.

Ask What They Think Now

• At the end of the section, ask, Do light rays extend behind plane mirrors? (Students should note that the light rays shown behind plane mirrors in diagrams do not really exist.)
Explore and Explain

- Give students some hands-on experience with images in mirrors by having students complete the **Try This: Writing Reflectively**. They will learn how reflecting an object in a plane mirror changes the way the object appears.

**TRY THIS** WRITING REFLECTIVELY

**Skills**
- Questioning, Performing, Observing, Evaluating, Communicating

**Purpose**
- Students will examine backwards writing using a mirror.

**Equipment and Materials**
- per group: plane mirror; mirror supports (optional);
- per student: a sheet of paper; pencil

**Notes**
- Tell students that the skill of writing in a mirror (so that what is written appears correctly in the mirror) may need to be practised before it becomes easy.
- Have students work in pairs for this activity.

**Suggested Answers**

A. The name on the paper is left-to-right reversed when viewed without a mirror, but when viewed in a mirror, it appears to be normally written.

B. Answers will vary, but most students will express surprise at how difficult writing in this fashion can be.

C. Answers will vary. Students may find that it is easier to write "in the mirror" when using their non-dominant hand because normal writing motions are not so ingrained in this hand.

D. The image of an object in a plane mirror is left-to-right reversed.

E. He may have wanted to keep his ideas private, and by writing backwards, he made it difficult for others to read his ideas and perhaps steal them.

- In the next activity, students learn about how an infinite number of images can be created using a pair of plane mirrors. Have students complete the **Try This: Producing Images, and More Images, and More Images . . .**

**TRY THIS PRODUCING IMAGES, AND MORE IMAGES, AND MORE IMAGES . . .

**Skills**
- Predicting, Observing, Analyzing

**Purpose**
- Students will investigate how plane mirrors at right angles can produce multiple images.

**Equipment and Materials**
- per group: two plane mirrors; two mirror supports; ruler, protractor, a die; paper
- per student: pencil

**Notes**
- Have students work in pairs for this activity.
- The number of images formed by two plane mirrors set at an angle to each other can be determined by using the following equation:

\[
\text{Number of images} = \frac{360^\circ}{\text{angle between mirrors}} - 1.
\]

**Suggested Answers**

A. There were 3 visible images.

B. Each mirror forms one image from a single reflection of light from the object. The third image is produced by a double reflection of light from the object.

C. The angle for 4 images in theory is 72°.

D. The angle for 5 images in theory is 60°.

E. Answers will vary depending on students’ predictions.

F. Answers will vary. As the angle between the mirrors gets smaller, the number of images increases toward infinity. The images get so close together that it becomes difficult to count them all. The object may also block the view of some images.

G. (a) The multiple reflections in the mirrors make the elevator seem to have much more room inside.

(b)
• Have students look at Figures 5 and 6 on page 490. Remind students that light rays depicted with dashed lines do not actually exist. Light rays cannot actually extend behind an opaque mirror. The rays, however, give us an easy method to determine exactly where an image will appear.

• Ask a volunteer to summarize the numbered statements at the bottom of page 490 of the Student Book. For statement 1, stress that there is no actual distance from the image to the mirror, but rather a virtual distance because the image is virtual.

• Then have students examine Figures 7 and 8 on page 491 to see how the information in the numbered statements is applied. Make drawings of each figure and ask volunteers to draw in the object–image lines. Have students note that the object-image line is equally divided by the mirror. Explain that this line is always perpendicular to the mirror's surface.

• Ask students to recall some of the characteristics of images produced in plane mirrors that they explored and discussed in the Engage activity. Encourage students to employ the acronym SALT to help them remember the properties of images. Then have students describe each property of an image produced by a plane mirror. Explain that other types of mirrors produce images with other properties, so this acronym will be important as they continue through the information in this chapter.

**Extend and Assess**

• Review what students have learned in this section by asking questions such as, *What are the properties of images formed by plane mirrors?* (the same size as the object, reversed, located behind the mirror, and virtual)

• Discuss methods for locating images in plane mirrors, including the use of light rays and the use of perpendicular lines.

• Have students complete the **Check Your Learning** questions on page 493 of the Student Book.

**Suggested Answers**

1. Sample answer: A virtual image is one that appears to be in a certain location but really is not.

2. **Size** = same as original; **Attitude** = upright, reversed; **Location** = 1.8 meters directly behind the mirror; **Type** = virtual

3. The word looks reversed.

4. The image of the point source should appear to lie an equal distance on the other side of the mirror along a line perpendicular to the mirror.
5. For all images: Size = same as original; Attitude = upright, reversed; Location = an equal distance on the other side of the mirror; Type = virtual

6. (a) S = size, A = attitude, L = location, T = type
(b) Sample answer: Size is whether the image is larger, smaller, or the same size as the original object. Attitude compares the direction in which the image points to the direction in which the object points. Location is where you think the image is. Type is whether or not the image is virtual.

7. When, for example, a driver looks in the rear-view mirror of his car and sees an ambulance coming, the reversed writing of the word “ambulance” on the hood is seen in the mirror as the normally written word.

8. Backwards writing is the act of writing words that are reversed. When these words are viewed in a mirror, the reversal caused by the mirror makes the words look normal again.

9. A ray should travel from the person’s toe to the lower edge of the mirror and to the person’s eye. This shows that the toe can be seen.

10. Sample answer: A mirror creates an image that makes it seem like another room is visible through a “window.” This can make rooms seem much more spacious. Mirrors can also reflect light into dark rooms and brighten them.

11. (a) The mirrors lie at a 45° angle to the line of sight, one situated directly above the other and also parallel to it.

12. Sample answer: I knew that people’s brains can be tricked by optical illusions, but I never realized that the virtual image produced by a mirror creates the illusion of things on the other side of the mirror even though nothing is really there.
DIFFERENTIATED INSTRUCTION

- Visual/spatial learners should benefit from the creation of a SALT poster that features sketches illustrating each letter of the acronym. Invite them to design and create the poster. Students can use Figure 11 on page 492 of the Student Book as a starting point. Display the poster in some prominent location in the classroom for easy reference.

- Use Figures 5, 6, 7, and 8 on pages 490 and 491 to reinforce the information about how an image is formed by a plane mirror. Verbal/linguistic learners can describe what takes place in each figure. Bodily/kinesthetic learners can use hand and body motions to act out the production of the image in three-dimensional space. Visual/spatial learners can create a model of one of the figures using cardboard and strings to represent light rays.

ENGLISH LANGUAGE LEARNERS

- English language learners can be encouraged to compare the effects of reflection on characters in their native language and reflection of English letters. Students can use BLM 0.0-4 Two-Column Table to organize characters from their native language and English characters into two categories: characters that are affected by reflection and characters that are not.