Objective: To guide exploration of the connection between reflections and line symmetry.

Key Concepts and Skills
- Identify polygons and describe properties of regular polygons. [Geometry Goal 2]
- Identify and draw lines of symmetry. [Geometry Goal 3]
- Explore the connection between reflections and line symmetry. [Geometry Goal 3]
- Solve problems involving spatial visualization. [Geometry Goal 3]
- Describe rules for patterns and use them to solve problems. [Patterns, Functions, and Algebra Goal 1]

Key Activities
Students use a transparent mirror to complete symmetric pictures and to find lines of symmetry in symmetric objects. They fold paper to sort polygons by the number of lines of symmetry.

Ongoing Assessment: Informing Instruction
See page 812.

Ongoing Assessment: Recognizing Student Achievement
Use an Exit Slip (Math Masters, p. 389). [Patterns, Functions, and Algebra Goal 1]

Key Vocabulary
line of symmetry, symmetric, rotation (turn), symmetry

Materials
Math Journal 2, p. 279
Student Reference Book, p. 109 (optional)
Study Link 10-3
Math Masters, pp. 311–314; p. 389 (optional)
per partnership: 1 transparent mirror, scissors, slate

Multiplying a Fraction by a Whole Number
Math Journal 2, pp. 280A and 280B
Students practice multiplying fractions by whole numbers.

Math Boxes 10-4
Math Journal 2, p. 280
Students practice and maintain skills through Math Box problems.

Study Link 10-4
Math Masters, p. 315
Students practice and maintain skills through Study Link activities.

ENRICHMENT
Interpreting a Cartoon
Math Masters, p. 316
Students interpret a cartoon involving line symmetry.

ENRICHMENT
Exploring Rotation or Turn Symmetry
Geometry Template, pattern blocks, tape
Students explore turn or rotation symmetry.

EXTRA PRACTICE
Exploring Line Symmetry
Math Masters, p. 317
Geometry Template, pattern blocks
Students use pattern blocks to create shapes with line symmetry.

ELL SUPPORT
Creating a Line Symmetry Museum
magazines and newspapers, scissors, tape
Students create a Line Symmetry Museum.

Advance Preparation
Math Message Follow-Up

Ask students to share what they know about symmetry. Tell them to indicate “thumbs-up” if they have a similar answer. Then ask students to explain how they know the classroom object that they chose has line symmetry.

Tell students that in this lesson they will investigate how symmetry and reflections are related.

Completing Symmetric Pictures

*(Math Journal 2, p. 279; Math Masters, p. 311)*

Ask students to turn to journal page 279. Partners share a transparent mirror while working on the activities.

Tell the class that each drawing on *Math Masters*, page 311 is only half of a picture. Students are to figure out what each picture would look like if it were complete and then use their transparent mirrors to complete each picture. Remind them to use the recessed edge to draw the line of reflection. Bring the class together to discuss results. Ask the following questions:

- How are these drawings like the dog picture in Lesson 10-3? How are they different? *As in the dog picture, there are two sides that look exactly alike (congruent) but are facing in opposite directions. Here, however, the end results are single drawings instead of pairs of drawings.*

Point out that here the lines of reflection are in the middle of the pictures or objects—not outside, as in the dog picture. When a line of reflection is in the middle of a picture or object, it is called a **line of symmetry**. In this case, the pictures or objects are said to be **symmetric**.

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<th>Polygon</th>
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|     | 5 lines                     |
|     | 6 lines                     |
|     | 8 lines                     |

Math Journal 2, p. 279
Students may be familiar with line symmetry from previous work but may not have made a connection between line symmetry and reflections. Thinking about line symmetry in terms of reflections is a more powerful approach because it can be generalized to other kinds of symmetry. Rotation (turn) symmetry, for example, can be thought of in terms of turns.

### Finding Lines of Symmetry

(Math Journal 2, p. 279; Math Masters, p. 312)

Students use their transparent mirrors to draw lines of symmetry in the pictures of a bat and a turtle on Math Masters, page 312. Then they cut out the other three pictures on the page and find their lines of symmetry by folding. Point out that a picture may have more than one line of symmetry. Have students answer the question in Problem 2c on page 279.

Bring the class together to discuss results. Ask: Which picture has more than one line of symmetry? The bow

### Exploring Lines of Symmetry of Polygons

(Math Journal 2, p. 279; Math Masters, pp. 313 and 314)

Students cut out the polygons on Math Masters, pages 313 and 314. They find all lines of symmetry for each polygon by folding, and then they record the results in the tables and answer the related questions on journal page 279.

### Ongoing Assessment: Informing Instruction

Watch for students who think that Polygon F, the parallelogram, has line symmetry. Many people think this is true because Polygon F does have symmetry; however, it is turn or rotation symmetry, rather than line symmetry. Polygon F cannot be folded (or reflected) so that the two halves match, but it can be turned to match its original shape.

Bring the class together to share results. Students should have found that a regular polygon has the same number of lines of symmetry as it has sides. For example, a regular octagon has 8 sides and 8 lines of symmetry.

### Exit Slip

Use an Exit Slip (Math Masters, page 389) to assess students’ ability to describe a pattern and use it to solve problems. Have students describe patterns they see in Problems 3 and 4 on journal page 279. Students are making adequate progress if they state that a regular polygon has the same number of lines of symmetry as it has sides. Some students may extend the pattern by stating the number of lines of symmetry in additional regular polygons.

[Patterns, Functions, and Algebra Goal 1]
Multiplying a Fraction by a Whole Number

*INDEPENDENT ACTIVITY*

(Math Journal 2, pp. 280A and 280B)

Students practice multiplying fractions by whole numbers.

**Math Boxes 10-4**

*INDEPENDENT ACTIVITY*

(Math Journal 2, p. 280)

**Mixed Practice** Math Boxes in this lesson are paired with Math Boxes in Lesson 10-1. The skill in Problem 6 previews Unit 11 content.

**Study Link 10-4**

(Math Masters, p. 315)

**Home Connection** Students complete a Venn diagram to identify capital letters of the alphabet that have horizontal and/or vertical line symmetry. They list words with horizontal or vertical line symmetry.

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**Lesson 10-4**

Write an equation to describe each number line.

1. $\frac{3}{5} \times 4 = \frac{12}{5}$
2. $\frac{2}{3} \times 9 = 6$
3. $3 \times \frac{1}{8} = \frac{3}{8}$

Use the number lines to help you solve the problems.

4. $\frac{2}{5} \times \frac{8}{10} = \frac{16}{50}$
5. $\frac{3}{4} \times \frac{2}{3} = \frac{6}{12}$

Solve. You may draw a visual fraction model such as a number line if you wish.

6. $\frac{5}{6} \times \frac{6}{10} = \frac{5}{10}$
7. $\frac{4}{5} \times \frac{2}{5} = \frac{8}{25}$

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**Math Journal 2, p. 280A**

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A manufacturer of dry puppy food has the following feeding guidelines. All measurements are given in cups per day. Use the information in the table to answer the questions below. Write an equation to show what you did.

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Math Journal 2, p. 280B

**ENRICHMENT**

Interpreting a Cartoon

(Math Masters, p. 316)

To apply students’ understanding of line symmetry, have them interpret a cartoon.

Exploring Rotation or Turn Symmetry

To further explore symmetry, have students use combinations of pattern blocks to perform and analyze transformations. Ask students to tape together a trapezoid and an equilateral triangle pattern block to form a parallelogram.

Ask the following questions:

- Will the parallelogram look exactly the same if it is flipped over? No. If it slanted to the right before the flip, then it will slant to the left after the flip.
- Does the parallelogram have line symmetry? No. Students have already tried folding a parallelogram to find a line of symmetry, and they know that it does not have one.
- Will the parallelogram look exactly the same if it is turned through a \( \frac{1}{2} \)-turn? Yes. Have students trace the parallelogram and show that after a \( \frac{1}{2} \)-turn, the tracing matches the original figure.

Shapes that look the same after they have been turned less than a full turn have rotation or turn symmetry. Have students use pattern blocks and tape to make their own turn-symmetric shapes. Have them use their Geometry Templates to record the shapes they make.

Sample answers:

- \( \frac{1}{2} \)-turn symmetry
- \( \frac{1}{3} \)-turn symmetry
- \( \frac{1}{4} \)-turn symmetry
**Exploring Line Symmetry**  
*(Math Masters, p. 317)*

To practice identifying lines of symmetry using a concrete model, have students use combinations of pattern blocks to create figures with a specified number of lines of symmetry.

**Creating a Line Symmetry Museum**

To provide language support for symmetry, have students bring in pictures of objects with line symmetry to create a Line Symmetry Museum. Have students describe the objects in the pictures and the lines of symmetry they see. They may even draw the lines of symmetry on the pictures. If some of the pictured objects are not perfectly symmetric, consider setting up a section of the museum called Almost Symmetric.