Lesson 6: **Reflections**

Lesson Topic

Reflections and glide reflections

Grade

5

Lesson Length

50 minutes

NCTM Standards Addressed

- Explore congruence and similarity
- Make and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions
- Predict and describe the results of sliding, flipping, and turning two-dimensional shapes
- Describe a motion or a series of motions that will show that two shapes are congruent
- Understand such attributes as length, area, weight, volume, and size of angle and select the appropriate type of unit for measuring each attribute
- Understand that measurements are approximations and understand how differences in units affect precision
- Select and apply appropriate standard units and tools to measure length, area, volume, weight, time, temperature, and the size of angles

PA Standards Addressed

- Select and use appropriate instruments and units for measuring quantities (e.g., perimeter, volume, area, weight, time, temperature).
- Select and use standard tools to measure the size of figures with specified accuracy, including length, width, perimeter and area.
- Estimate, refine and verify specified measurements of objects.
- Construct two- and three-dimensional shapes and figures using manipulatives, geoboards and computer software.
- Represent and use the concepts of line, point and plane.
- Analyze simple transformations of geometric figures and rotations of line segments.
- Identify properties of geometric figures (e.g., parallel, perpendicular, similar, congruent, symmetrical).

Student Objectives

Students will:

- create a reflection of a polygon using a Mira™
- discover that a line connecting a vertex of a polygon and the corresponding vertex of its reflection is perpendicular to the line of reflection
- discover that the line of reflection bisects a line connecting a vertex of a polygon and the corresponding vertex of its reflection
- discover that a shape and its reflection across a line are congruent
- be able to create a glide reflection of a shape
- discover that a shape and its glide reflection are congruent
- recognize that a glide reflection is a combination of a reflection and a translation

Grouping for Instruction

- Whole class for launch and closure
- Small groups of 4 or 5 for the investigation

Overview of Lesson

Students use a Mira™ to investigate reflections and glide reflections. Students are guided to discover that these transformations are rigid transformations—a reflection or a glide reflection is congruent and the original shape are always congruent. They use measurement to discover properties of a shape and its reflection.

Background Information

Students should have been given time to play with a Mira™ prior to starting this lesson. Students need to know how to measure angles using a protractor and lengths fairly accurately using a ruler. They should be familiar with the concepts of perpendicular lines and midpoint or bisecting a line.

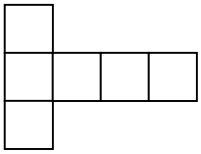
Materials and Equipment

- A classroom set of Miras™
- A full-length mirror
- A classroom set of pattern blocks
- An overhead set of pattern blocks
- An overhead projector
- Blank paper
- Rulers
- Protractors
- Transparency of a picture of footprints in the sand

Lesson 6 Procedure

A. Motivation and introduction

1. Have several students stand in front of the full-length mirror. Ask: "What do you notice about <Josh> and his reflection?" (Pause for student responses.) Ask: "How many polyhedra (the plural of polyhedron) can you list?"
2. Show a cube made from Polydrons™ and say: "For example, a cube is a polyhedron with each face being a square. Notice that the surface of squares divides space into three regions—the region inside the surface, the surface itself, and the region outside the surface."
3. Say: "Look around you. Do you see any polyhedra in this room?" Ask students to explain why they think an object qualifies as a polyhedron. Allow other students to question whether an object is a polyhedron.
4. Say: "Consider objects in your home. Are there any polyhedra in your home?" List several student responses on the overhead.
5. Help students find one net of the cube. Show them how you can create a "T" with the Polydrons™ used to create a cube.



6. Say: "This is one net of the cube. It consists of faces of the polydron where each face is connected to at least one other face. Do you think there are any other nets of the cube?"
1. Say: "Let's investigate nets of some polyhedra"

B. Development (including discussion points and feedback)

1. Place the students in heterogeneous cooperative groups of about 4 students each.
2. Assign a task to each person in a team (leader, recorder, reporter etc.)
1. Distribute the worksheets "Pattern Blocks, Mira, and Reflections."
2. Ask the teams to complete the "Pattern, Blocks, Mira, and Reflections" project.
3. Circulate among the groups, guiding them to complete the project, and observing how students work.
4. Ask each group to report on a net they found for the cube or another polyhedron.

C. Summary and closure

1. Make sure each student understands the concept of a net. Ask questions such as "What makes this a net?" and "Why is this disconnected set of squares not a net?" and "Could you have a net of the cube that contained only five squares? Explain your reasoning."
2. Fold a cloth net around a pyramid with a square base made with Polydrons™ to emphasize the relationship between a figure and its net.

D. Assignment

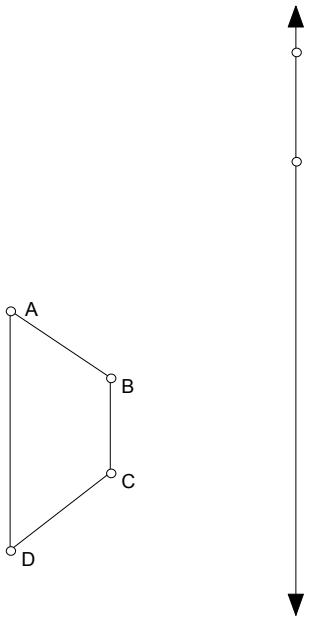
Give each student a net for a prism on a sheet of paper. Have them cut out the net and create the corresponding prism for the next day.

Assessment

- Observe the students during the group project.
- Record how each student is working in the group and whether the he or she can visualize a net from the solid and the solid from a net.
- Grade the group project, the presentations (if they are more formal than implied in the project), or the homework.

Worksheet: **Pattern Blocks, Mira, & Reflections**

Draw a line down the center of a blank sheet of paper. Place the Mira™ on the line. Place a red trapezoid on one side of the Mira™. Using a pencil draw the perimeter of the trapezoid. Make sure the trapezoid stays in this spot as you draw its reflection. Looking through the Mira™ draw the perimeter of the reflection of the trapezoid. Remove the Mira and pattern block leaving the drawing of the original figure, the line of reflection, and the drawing of the figure's reflection. Label the original figure's vertices as shown below. Label the corresponding vertices on the reflection as A', B', C', and D'.



Draw the line segment $A A'$ on your sheet. Using your protractor, measure the angle formed by the line of reflection and the line segment $A A'$. What did you discover?

Let A'' be the point of intersection of the line of reflection and the line segment $A A'$. Using your ruler, measure $A A''$ and $A''A'$. What did you discover about the lengths of these two segments?

Draw the line segment $B\,B'$. What is the angle formed by this line segment and the line of reflection?

Compare the length of $B\,B'$ and the distance from *B* to the line of reflection. What did you discover?

Does the same pattern hold for $C\,C'$? For $D\,D'$?

State the pattern in your own words.

Are the reflection of the original trapezoid and the original trapezoid **similar** (the same shape)? How do you know?

Are the original trapezoid and the reflection of the original trapezoid **congruent** (the same shape and size)? How do you know?

On the same sheet of paper create a **glide reflection** (a slide parallel to the line of reflection followed by a flip across the line of reflection) of the original trapezoid by translating the original figure up 2 inches and then reflecting the trapezoid. Is this new figure similar to the original? Justify your answer.

Are the original figure and its glide reflection congruent? Justify your answer.

Label the vertices of the trapezoid formed by the glide reflection W, X, Y, and Z with W corresponding to A in the original trapezoid, X to B, etc. Draw the line segments AW, BX, CY, and DZ. Does the line of reflection bisect each line segment? How do you know?

The reflection of a shape is often called a "flip" of the shape. Why do you think a reflection is often called a flip?

The points A', B', C', and D' are called the **images** of the points *A*, *B*, *C*, and *D*, respectively.
What will be true about a point *F* that is on the line of reflection and its image F'?

If a point *G* is 1 inch from the line of reflection, how far will its reflection be from the line of reflection?