Objective To extend children’s familiarity with polygons.

Key Concepts and Skills
- Count the sides and corners on plane shapes. [Number and Numeration Goal 2]
- Model polygons, identifying their sides and corners; compare polygon models. [Geometry Goal 1]
- Compose plane shapes. [Geometry Goal 1]

Key Activities
Children construct polygons out of straws and twist-ties, compare their constructions, and contrast polygons with non-polygons. They discuss defining and non-defining attributes of polygons. They construct more plane shapes using pattern blocks and circle blocks.

Ongoing Assessment: Recognizing Student Achievement
Use Mental Math and Reflexes. [Measurement and Reference Frames Goal 2]

Ongoing Assessment: Informing Instruction
See page 640.

Materials
Math Journal 2, p. 143
Home Link 7-3
Math Masters, pp. 205A and 205D
- transparencies of Math Masters, pp. 205 (optional), 205B, and 205C (3 each per child: 8" straws, 6" straws, and 4" straws)
- 15 twist-ties per child
- pattern blocks (3 of each shape per partnership)

Advance Preparation
Continue to add to the Shapes Museum. Place same-size straws (8", 6", and 4") and twist-ties in four separate open boxes near the Math Message. Copy Math Masters, page 205A onto construction paper or another firm paper. Make enough copies so that each partnership has 1 whole circle, 2 half-circles, and 4 quarter-circles. Cut out the circle blocks prior to the lesson. For the optional Readiness activity in Part 3, cut poster-size sheets of paper into the following shapes: triangle, square, rhombus, circle, and rectangle. Label each shape with its name.

Investigating Flipping Pennies
Math Masters, p. 329
transparency of Math Masters, p. 329 (optional)
- pennies
- Class Data Pad
Children flip a penny, record the results in a tally chart, and draw a bar graph.

Practicing with Name-Collection Boxes
Math Masters, p. 206
Children practice with name-collection boxes.

Math Boxes 7-4
Math Journal 2, p. 144
Children practice and maintain skills through Math Box problems.

Home Link 7-4
Math Masters, p. 207
Children practice and maintain skills through Home Link activities.

Finding 2-Dimensional Shapes
per group: magazines or catalogs to cut apart, glue or tape, scissors, poster-size sheets of paper
Children collect and sort 2-dimensional shapes.

Comparing Polygons and Other Figures
Math Masters, pp. 208 and 209
Children compare shapes using Venn diagrams.
Getting Started

Math Message

Take 3 straws from each box. Take 15 twist-ties. Look for as many different shapes as you can in the room. Be ready to talk about what you see.

Home Link 7-3 Follow-Up

Review the names of the pattern blocks as you hold each one up or show it on the overhead.

1 Teaching the Lesson

Math Message Follow-Up

Have children point out objects in the room with shapes they recognize. Consider having volunteers go to the objects and trace the shapes with their fingers.

Constructing Straw Polygons

Review what children have learned about the shapes called polygons.

- The sides of a polygon are all straight.
- Polygons have corners, where two sides meet.
- Sides meet only at their ends.
- The sides are connected—there aren’t any gaps.

Tell children that they will be constructing polygons using straws and twist-ties. Show children how to join straws to make polygons.

1. Insert one end of a twist-tie into one end of a straw.
2. Insert the other end of the twist-tie into another straw.
3. Push the straws together until their ends meet. The joint forms a corner.
4. Connect other straws in a similar way. The straws form the sides of the polygon.

After children have had time to put straws and twist-ties together, have them work in partnerships to make polygons with the straws and twist-ties. Encourage them to make polygons that are shaped like pattern blocks, as well as other polygons, using straws of varying lengths. Each partnership should make (and keep) at least three different polygons.

Circulate and assist as needed. Ask children to show and report to you the number of sides and corners in their constructions.

Ongoing Assessment: Recognizing Student Achievement

Use Mental Math and Reflexes to assess children’s ability to count the value of quarters. Children are making adequate progress if they are able to count to $1.00. Some children may have success counting further.

[Measurement and Reference Frames Goal 2]

Adjusting the Activity

List or draw the shapes on the board and keep a tally of each shape children find in the room.

AUDITORY • KINESTHETIC • TACTILE • VISUAL

NOTE: If the fit is too tight when joining straws, pinch the ends of the twist-tie a little in order to slide it into the straws. If the fit is too loose, fold back the end of the twist-tie an inch or so for a tighter fit. Several twist-ties can go into the ends of most straws.
Ongoing Assessment: Informing Instruction

Watch for children who make 3-dimensional shapes. Remind them that their polygon should lay flat, as if it were made on a geoboard, using rubber bands.

Discussing Similarities and Differences Among Shapes

(Math Journal 2, p. 143)

After partners have constructed at least three polygons, bring the class together. Bring out the chart paper with Defining and Non-Defining Attributes of Triangles from the last lesson. Make a new set of columns for Defining and Non-Defining Attributes of Squares. Ask children who have made squares to hold up their constructions.

- How are the squares alike? They have the same number of sides and the same number of corners. All four sides are the same length. The corners all look the same.
- How are they different? The squares may not be the same size.

When children have answered the questions above, add their responses for how the squares are alike to the Defining Attributes of Squares column and their answers for how squares can be different to the Non-Defining Attributes column.

Ask a child who constructed a square to come to the front of the class. Have him or her try to change its shape without bending or removing a side. (This can be done by gently tugging the square at opposite corners.) What kind of polygon do you have now? rhombus

Point to the Defining Attributes of Squares list and ask children Can your shape be a square if it is missing any of these attributes? no Why? Sample answers: If you take away a side, it's a triangle. When you pull the corners so they don't all look the same, it's a rhombus. Emphasize that squares and triangles need all of their defining attributes to still be squares and triangles.

Have children share and compare their own shape constructions.

Ask a child who constructed a triangle to try to change its shape without bending or removing a side. What happens? It can't be done; triangles are rigid.

Ask a child who constructed a polygon with more than four sides to push in one of the corners to make a concave polygon. Mention that this shape is also a polygon.

Ask children to examine the shapes on journal page 143. Have them trace the sides of polygons with their fingers. Explain that polygons are “closed” figures—their sides make fences with no openings. Figures that are not closed are called “open” figures. Reinforce the difference between “open” and “closed” figures by comparing one of each.
Next, draw on the board some polygons and some figures that are not polygons or display an overhead transparency of *Math Masters*, page 205. Have children identify the shapes that are polygons and explain why the others are not polygons.

Since many children enjoy making these constructions, you might make the materials available to children for several days.

**NOTE** The polygon constructions make great displays. Choose a few to add to a bulletin board or another display. Consider including several in the Shapes Museum. For the rest of the polygons, allow time for children to dismantle their constructions and return the straws and twist-ties to the proper boxes.

### Composing New Shapes

*(Math Masters, pp. 205A–205D)*

Group children into pairs for the beginning of this activity. Provide each partnership with three pattern blocks of each shape and with a set of circle blocks from *Math Masters*, page 205A. Discuss the circle blocks with children, introducing the terms *half-circle* and *quarter-circle*.

Tell children that they are going to practice making new shapes from pattern blocks and circle blocks. Display overhead transparencies of *Math Masters*, pages 205B and 205C. Work through Problems 1 through 4, first letting each partnership make a composite shape for the given problem and then asking the following questions:

> Ask: *What shape did you make? Answers vary.* Trace the outline of several of the children's shapes in the space provided under each problem.

> Ask: *Could you use any other blocks to make these shapes? Answers vary.* Encourage children to come to the overhead and try placing different pattern blocks on the new shape outlines.

> Ask: *Do any of these new shapes remind you of other shapes you know? Which ones? Answers vary.*

After this discussion, have partners complete *Math Masters*, page 205D. Each child creates a composite shape with pattern blocks and circle blocks and traces the outline of the shape. Children then trade papers and try to fill each other's shapes with pattern blocks and circle blocks.
2 Ongoing Learning & Practice

Investigating Flipping Pennies
(Math Masters, p. 329)

Children work with a partner. Each child flips a penny 10 times while the partner records in a tally chart how many times the penny landed head-side up and how many times it landed tail-side up.

When children have finished collecting their data, draw a bar chart on the Class Data Pad, showing the class results for the number of times that each partnership flipped the coin head-side up. Then make a bar graph of the results on the Class Data Pad or on an overhead transparency of Math Masters, page 329.

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NOTE Everyday Mathematics does not draw a distinction between histograms and bar graphs. For a discussion of how some people contrast them, see Section 12.2.3: Organizing and Displaying Data in the Teacher’s Reference Manual.

Practicing with Name-Collection Boxes
(Math Masters, p. 206)

Use Math Masters, page 206 to provide more practice with name-collection boxes.

Math Boxes 7-4
(Math Journal 2, p. 144)

Mixed Practice Math Boxes in this lesson are linked to Math Boxes in Lessons 7-2 and 7-6. The skills in Problem 4 preview Unit 8 content.

Home Link 7-4
(Math Masters, p. 207)

Home Connection Children use characteristics of a polygon to identify polygons.
**Differentiation Options**

**Finding 2-Dimensional Shapes**

To provide experience with basic polygons, have children cut out pictures from magazines to match specified polygons. Display the large shapes you have prepared. Review the name of each shape and discuss its attributes. Have children cut out pictures from magazines that match each of those shapes. Have children glue their pictures onto the appropriate shapes. Children can add their own drawings if they wish.

**Comparing Polygons and Other Figures**

*(Math Masters, pp. 208 and 209)*

To further explore attributes of polygons, have children compare polygons to figures that are not polygons. Explain to children how to complete a Venn diagram. Have children write attributes for each shape, with common attributes listed in the intersection of the two circles. Encourage partnerships to share their completed Venn diagrams.
Circle Blocks

LESSON 7.4

205A
1. Make a shape from three triangles.

2. Make a shape from a half-circle and two quarter-circles.
3. Make a shape from three fat rhombuses.

4. Make a shape from a trapezoid and a triangle.
My New Shape

Use your pattern blocks and circle blocks. Make a new shape. Trace the outline of your new shape.