Name ______________________ Date ______________________

<u>ACTIVITIES FOR LEVEL 1 THINKERS</u>: Property Lists for Quadrilaterals

Directions: Working in groups of three or four, you will be assigned to one type of quadrilateral. Your task is to list as many properties as you can. Each property listed must be applicable to all shapes on your sheet.

You will need a simple index card to check right angles, to compare side lengths, and to draw straight lines. Mirrors (to check line symmetry) and tracing paper (for angle congruence and rotational symmetry) are also useful tools.

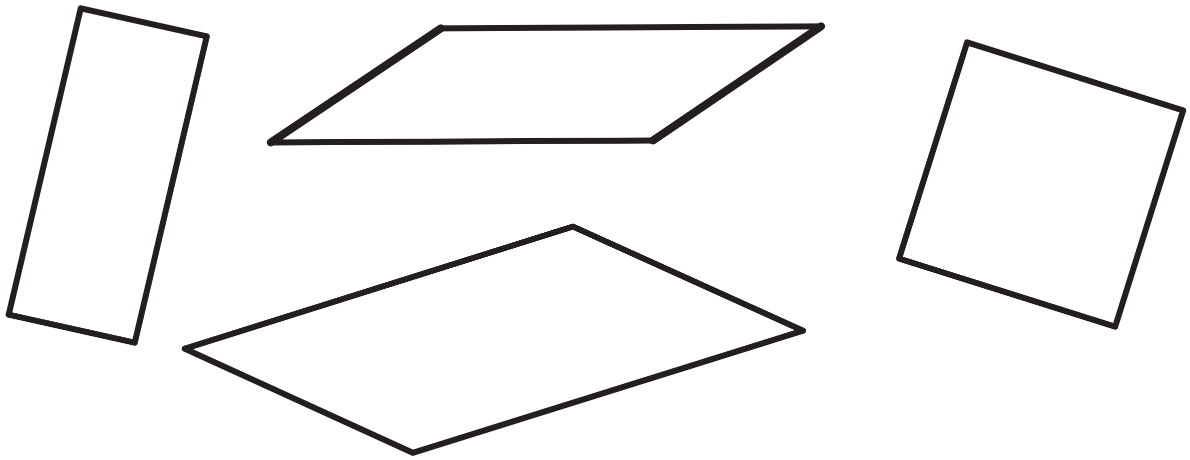
Use the words "at least" when describing how many of something: for example, "rectangles have at least two lines of symmetry," since squares – included in rectangles – have four.

After, groups share their lists with the class and eventually a class list for each shape is developed.

Extension: Repeat activity using kites and trapezoids.

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 226)

Parallelograms



Properties of sides:

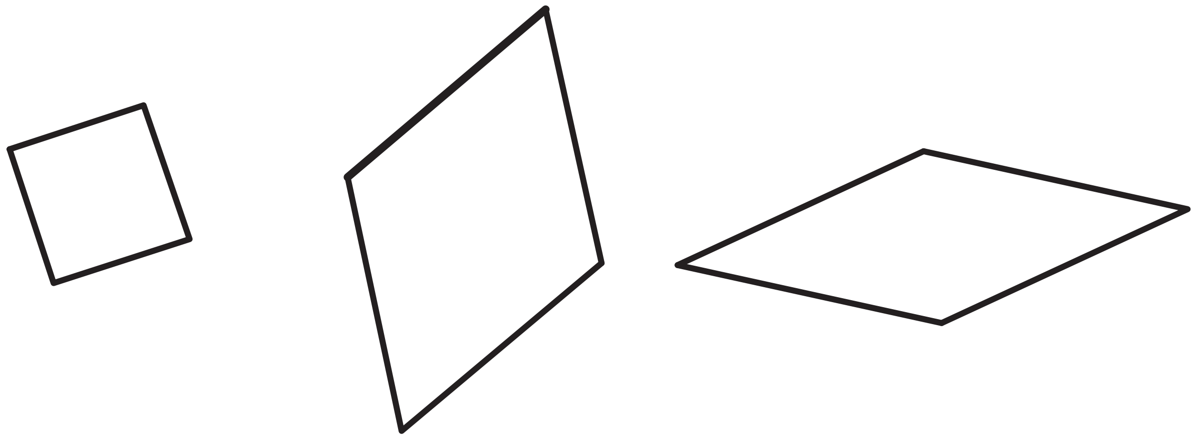
Properties of angles:

Properties of diagonals:

Note: Diagonals are perpendicular or not
Bisected by the other or not
Congruent or not

Properties of symmetry (line and point):

Rhombuses



Properties of sides:

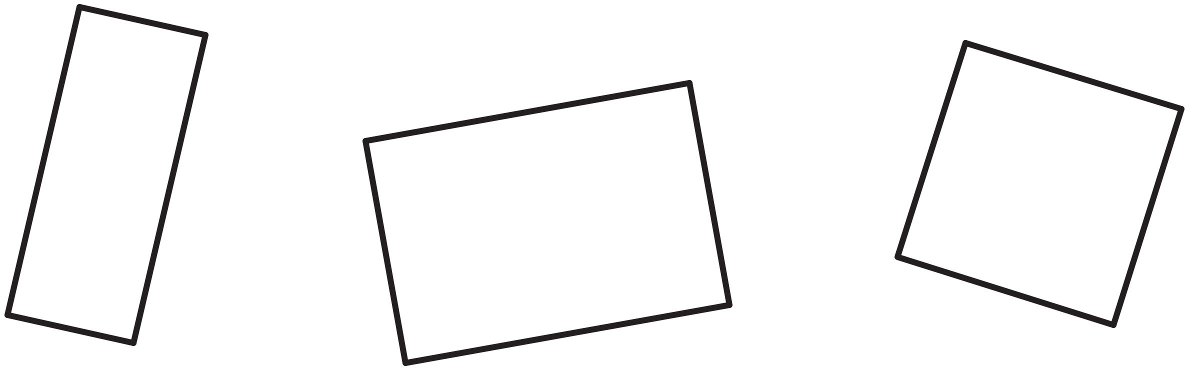
Properties of angles:

Properties of diagonals:

Note: Diagonals are perpendicular or not
Bisected by the other or not
Congruent or not

Properties of symmetry (line and point):

Rectangles



Properties of sides:

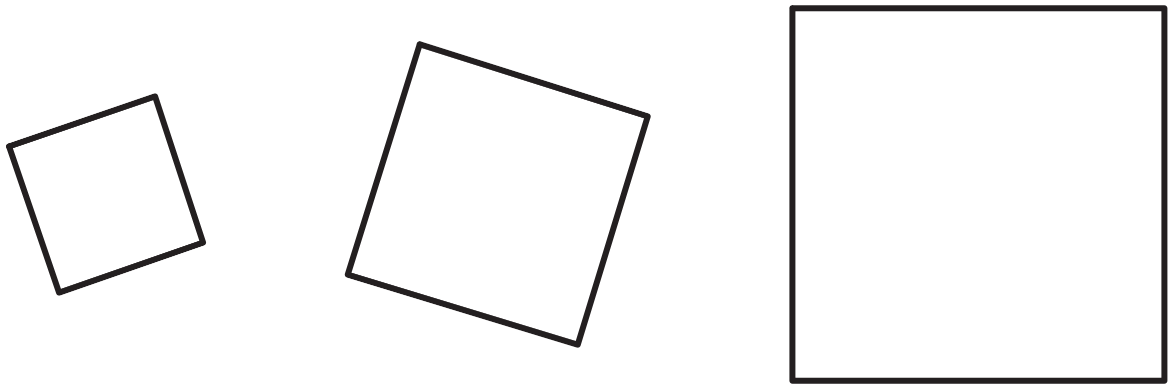
Properties of angles:

Properties of diagonals:

Note: Diagonals are perpendicular or not
Bisected by the other or not
Congruent or not

Properties of symmetry (line and point):

Squares



Properties of sides:

Properties of angles:

Properties of diagonals:

Note: Diagonals are perpendicular or not
Bisected by the other or not
Congruent or not

Properties of symmetry (line and point):

Name ___________________________ Date ___________________________

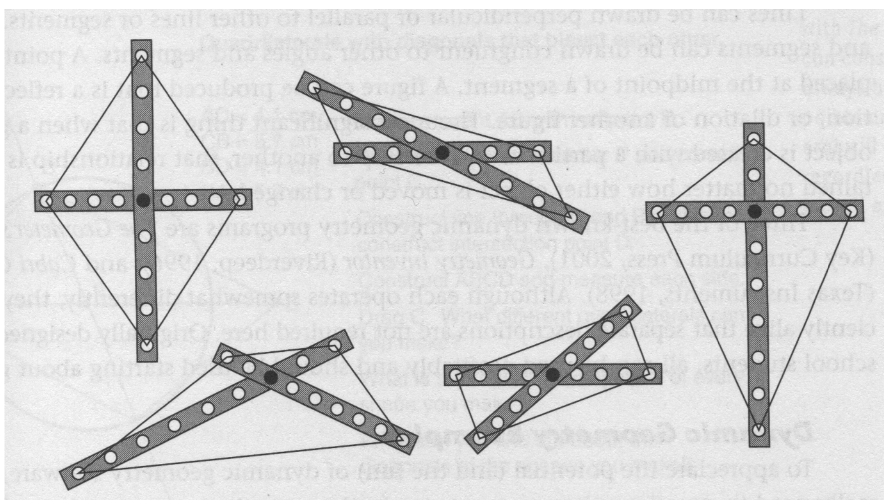
ACTIVITIES FOR LEVEL 1 THINKERS: Diagonal Strips

Materials: Three strips of tagboard about 2 cm wide. Two should be the same length (about 30 cm) and the third somewhat shorter (about 20 cm). Punch nine holes equally spaced along the strip. (Punch a hole near each end. Divide the distance between the holes by 8. This will be the distance between the remaining holes.) Use a brass fastener to join two strips. A quadrilateral is formed by joining the four end holes, as shown below.

Directions: Your task is to use the strips to determine the properties of diagonals that will produce different quadrilaterals.

You can use the third shorter diagonal with one of the longer diagonals to form a quadrilateral with noncongruent diagonals.

You are to work in pairs to identify the properties of the diagonals and the quadrilateral formed by the diagonals. Record your findings in the table and also draw a corresponding pair of diagonals and the quadrilateral on the dot grid. Put the name of the quadrilateral on each drawing.



Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 227)

Properties of Quadrilateral Diagonals

Name ____

Name of Quadrilateral	Congruent Diagonals		Diagonals Bisected			Intersection of Diagonals	
	Yes	No	Both	One	Neither	Perpendicular	Not

BLM 10—1-cm square dot grid

<u>ACTIVITIES FOR LEVEL 2 THINKERS</u>: Minimal Defining Lists

This activity must be done as a follow-up to the "Property List for Quadrilaterals" activity.

Once the property lists for the parallelogram, rhombus, rectangle, and square (and possibly the kite and trapezoid) have been agreed upon by the class, the teacher will post these lists or type them up and duplicate them.

Directions: In groups, the task is to find "minimal defining lists," or MDLs, for each shape. An MDL is a subset of the properties for a shape that is "defining" and "minimal." "Defining" here means that any shape that has all the properties of the MDL *must* be that shape. Thus, an MDL for a square will guarantee that you have a square. "Minimal" means that if any single property is removed from the list it is no longer defining. For example, one MDL for a square is a quadrilateral with four congruent sides and one right angle.

Students should attempt to find at least two or three MDLs for each shape. A proposed list can be challenged as either not minimal or not defining. A list is not minimal if a property can be removed yet the list still defines the shape. A list is not defining if a counterexample – a shape other than one being described – can be produced using only the properties on the list.

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 230-231)

Name ___________________________ Date ___________________________

ACTIVITIES FOR LEVEL 2 THINKERS: True or False?

Directions: For each statement, decide if it is true or false. Then, present an argument to support the decision.

1. If it is a square, then it is a rhombus. T F

____

____

2. All squares are rectangles. T F

____

____

3. Some parallelograms are rectangles. T F

____

____

4. All parallelograms have congruent diagonals. T F

____

____

5. If it has exactly two lines of symmetry, it must be a quadrilateral. T F

____

____

6. If it is a cylinder, then it is a prism. T F

____

____

7. All prisms have a plane of symmetry. T F

____

____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 231-232)

Name ______________________ Date ______________________

8. All pyramids have square bases. T F

____

____

9. If a prism has a plane of symmetry, then it is a right prism. T F

____

____

Directions: Make your own list of statements. Then, trade with a partner and solve.

10. ____

______________________________ T F

____

____

11. ____

______________________________ T F

____

____

12. ____

______________________________ T F

____

____

13. ____

______________________________ T F

____

____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 231-232)

Name ___________________________ Date ___________________________

<u>SLIDES, FLIPS, AND TURNS</u>: Motion Man

Materials: The teacher has made copies of the first Motion Man and then copied the mirror image on the backs of these copies. The back image matches the front image when held to the light. The excess paper has been cut off to leave a square. Then, each student is given a Motion Man.

1. The teacher will demonstrate each of the possible motions. As they are announced, slide, flip, or turn your Motion Man accordingly.

- Slide
- 1/4, 1/2, and 3/4 turns
- Horizontal flip (top goes to bottom)
- Vertical flip (left goes to right)

2. The teacher will display two Motion Men side by side in any orientation. The task is to decide what motion or combination of motions will get the man on the left to match the man on the right. Use your own man to work out a solution and then record their answer below.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

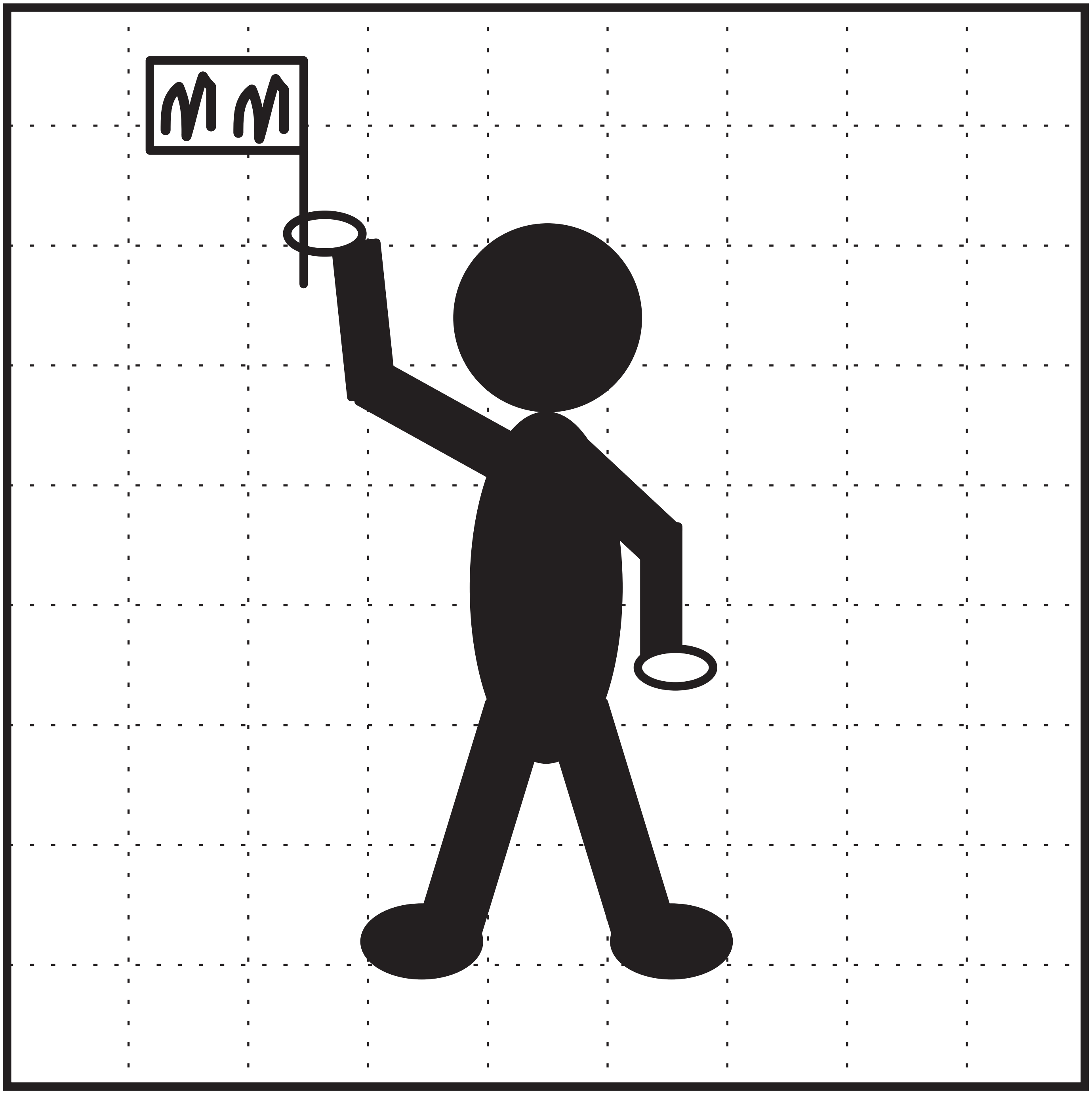
g. ____

h. ____

i. ____

j. ____

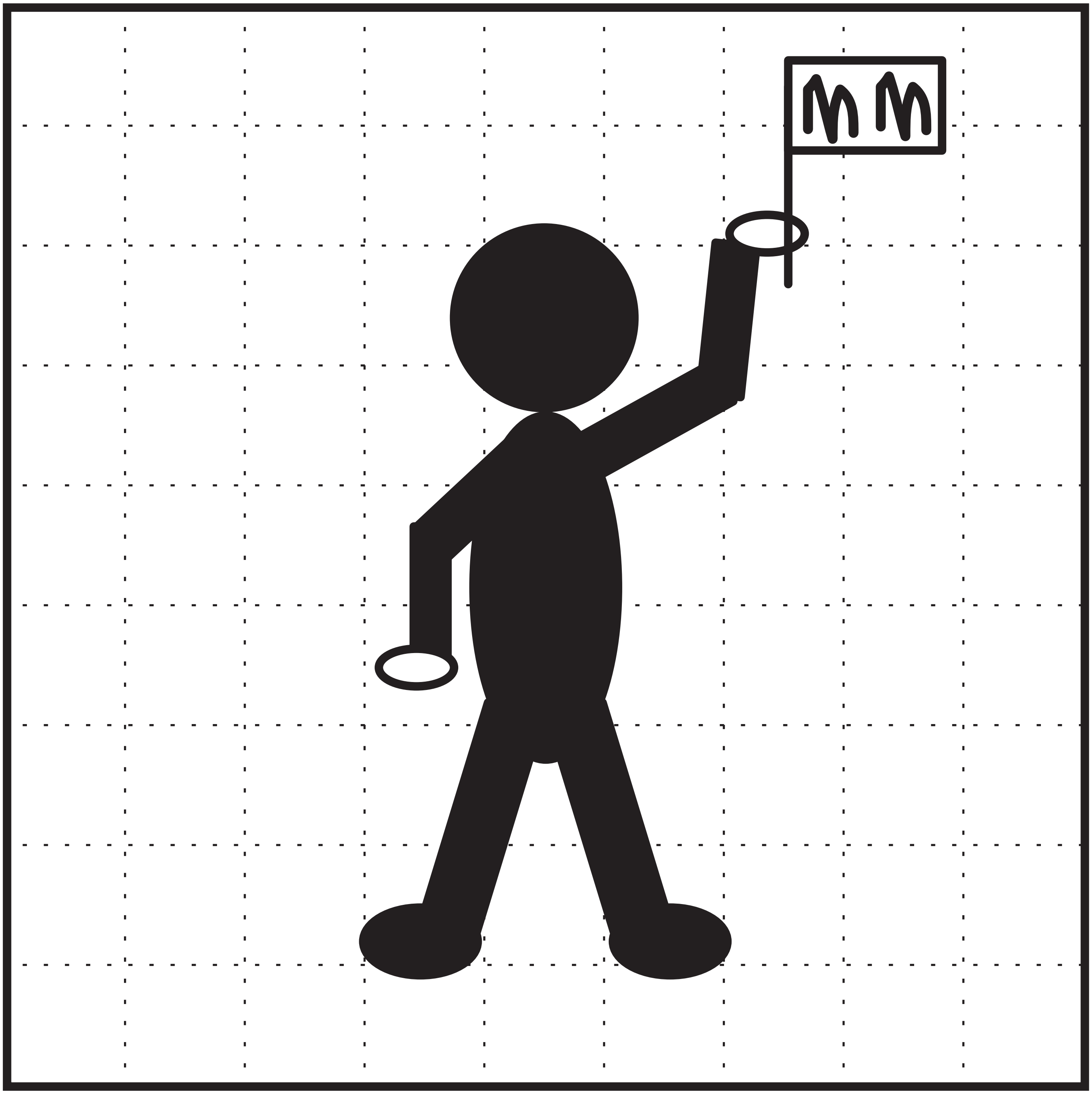
Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 233-234)



Motion man—Side 1

Directions:

Make copies of Side 1. Then copy Side 2 on the reverse of Side 1. Check the orientation with one copy. When done correctly the two sides will match up when held to the light.



Motion man—Side 2
(See directions on Side 1.)

Name ________________________ Date ________________________

LINE AND ROTATIONAL SYMMETRY: Pattern Block Mirror Symmetry

Materials: Students need a plain sheet of paper with a straight line through the middle.

Directions: Using about six to eight pattern blocks, make a design completely on one side of the line that touches the line in some way. The task is to make the mirror image of your design on the other side of the line.

When finished, use a mirror to check your work. Place the mirror on the line and look into it from the side of the original design. With the mirror in place, you should see exactly the same image as you see when you lift the mirror.

Extension: Make designs with more than one line of symmetry.

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 234)

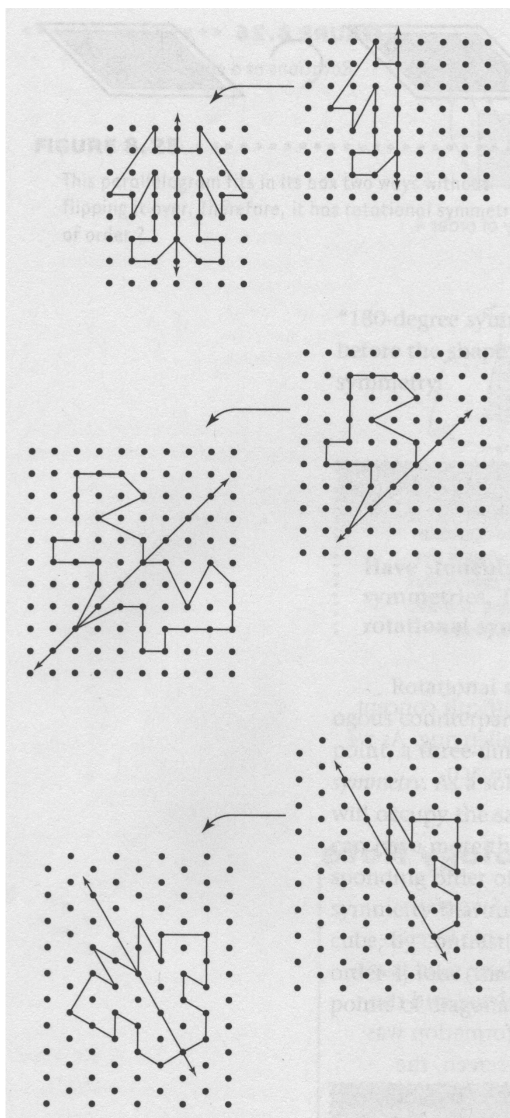
LINE AND ROTATIONAL SYMMETRY: Dot Grid Line Symmetry

Materials: Students need to use either isometric or rectangular dot grid paper.

Directions: Students should draw a line through several dots. The line can be horizontal, vertical, or skewed. Make a design completely on one side of the drawn line that touches the line in some way (see below). Now the task is to make the mirror image of your design on the other side of the line. (Students can exchange designs and make the mirror image of each other's design.)

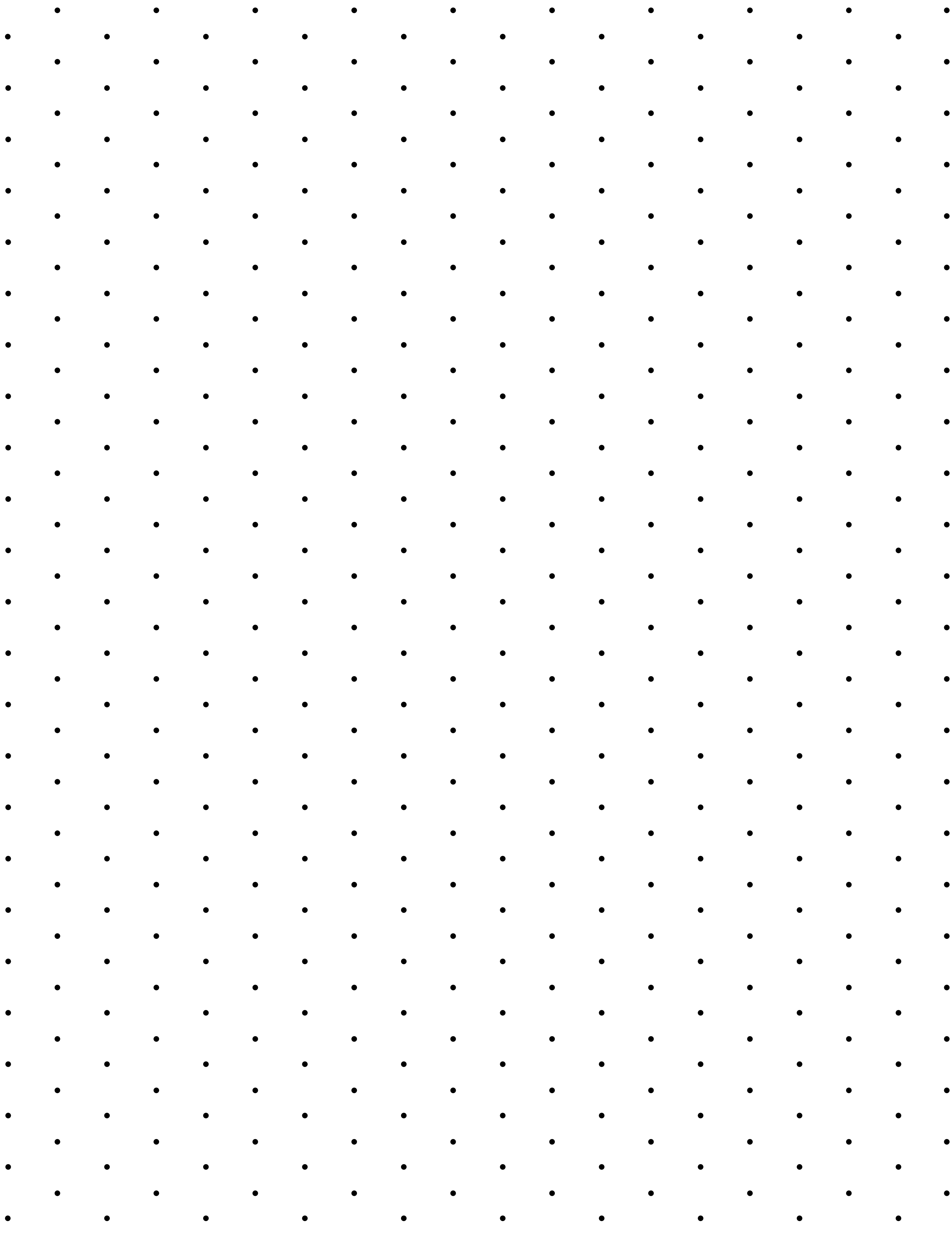
When finished, you can use a mirror to check your work. Place the mirror on the line and look into it from the side of the original design. With the mirror in place, you should see exactly the same image as you see when you lift the mirror.

Extension: Make designs with more than one line of symmetry.



Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 235)

BLM 10—1-cm square dot grid

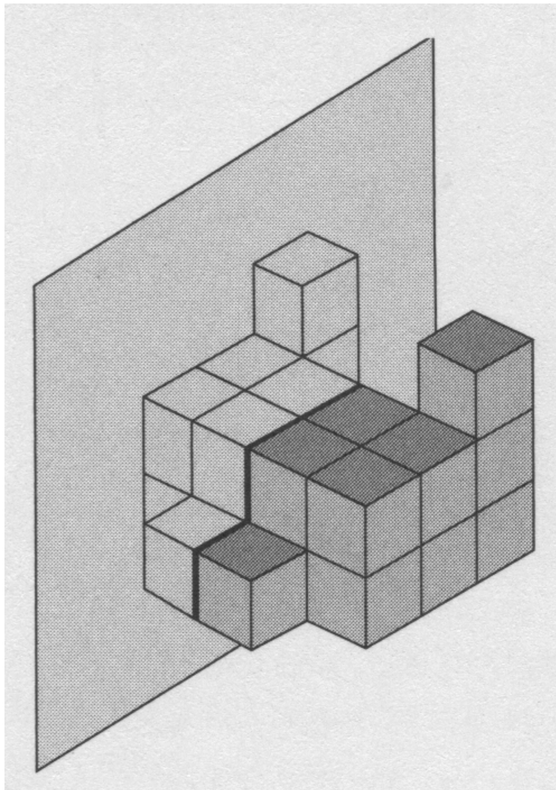


BLM 12—1-cm isometric dot grid

Name ________________________ Date ________________________

<u>LINE AND ROTATIONAL SYMMETRY</u>: Plane Symmetry Buildings

Directions: With cubes, build a building that has a plane of symmetry. If the plane of symmetry goes between cubes, slice the shape by separating the building into two symmetrical parts. Try making buildings with two or three planes of symmetry. Build various prisms. Do not forget that a plane can slice diagonally through the blocks.



Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 235)

Name ________________________ Date ________________________

<u>LINE AND ROTATIONAL SYMMETRY</u>: Pattern Block Rotational Symmetry

A good way to understand rotational symmetry is to take a shape with rotational symmetry, such as a square, and trace around it on a piece of paper. Call this tracing the shape's "box." The order of rotational symmetry will be the number of ways that the shape can fit into the box without flipping it over.

Directions: Construct designs with pattern blocks with different rotational symmetries. You should be able to make designs with order 2, 3, 4, 6, or 12 rotational symmetry. Which of these designs have mirror symmetry as well?

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 236)

Name ___________________________ Date ___________________________

LOCATION ACTIVITIES: Coordinate Slides

1. Students will need a sheet of centimeter grid paper on which to draw two coordinate axes near the left and bottom edges. Plot and connect about five or six points on the grid to form a small shape (see below). If you use only coordinates between 5 and 12, the figure will be reasonably small and near the center of the paper.

2. Make a **new figure** by adding 6 to each of the first coordinates (typically called the x-coordinates) of your shape, leaving the second coordinates the same. That is, for the point (5, 10) a new point (11, 10) is plotted. When new points for each point in the figure have been plotted, these are connected as before.

3. Create a **second figure** by adding 9 to the second coordinate.

4. A **third figure** is formed by adding 6 to the first coordinate and adding 9 to the second coordinate.

5. Finally, a **fourth figure** is drawn by subtracting 4 from both the first and second coordinates.

6. Your paper should show your original shape and four copies, each in a different location on the grid.

   a. What does adding (or subtracting) a number from the first coordinate cause?

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   b. What if the number is added or subtracted from the second coordinate?

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   c. What if the number is added or subtracted from both coordinates?

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Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 240)

7. Draw lines connecting corresponding points in the original figure with one of those where both coordinates changed.

a. What do you notice?

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b. Pick any two of the five shapes in the original drawing. How can you begin with one of the shapes and change the coordinates to get to the other?

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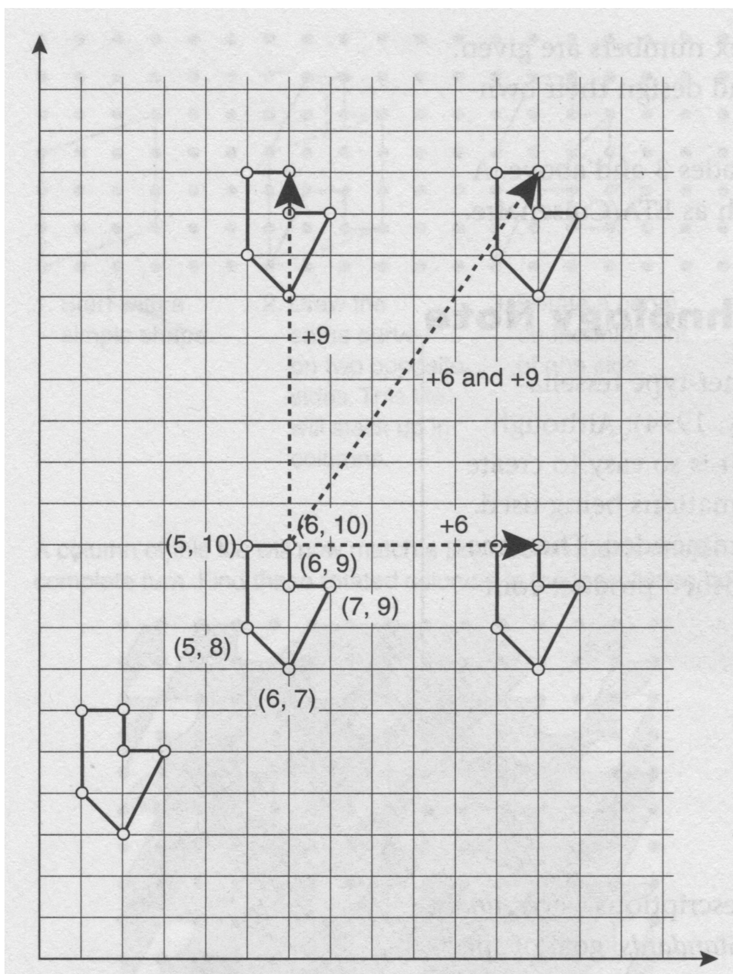

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 240)

Name ___________________________ Date ___________________________

LOCATION ACTIVITIES: Coordinate Reflections

1. Draw a five-sided shape in the first quadrant on coordinate grid paper using grid points for vertices. Label the Figure ABCDE and call it **Figure 1**.

2. Use the y-axis as a line of symmetry and draw the reflection of the shape in the second quadrant. Call it **Figure 2** (for second quadrant) and label the reflected points A'B'C'D'E'.

3. Now use the x-axis as the line of symmetry. Reflect both Figure 1 and Figure 2 into the third and fourth quadrants, respectively, and call these **Figures 3 and 4**. Label the points of these figures with double and triple primes (A'' and A''', and so on). Write in the coordinates for each vertex of all four figures.

4. How is Figure 3 related to Figure 4? How else could you have gotten to Figure 3? How else could you have gotten to Figure 4?

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5. How are the coordinates of Figure 1 related to its image in the y-axis, Figure 2? What can you say about the coordinates of Figure 4?

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Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 240-241)