

## Grade 8 Mathematics

### Patterns, Relations, and Functions: Lesson 1

Read aloud to the students the material that is printed in **boldface type** inside the boxes. Information in regular type inside the boxes and all information outside the boxes should **not** be read to students. Possible student responses are included in parentheses after the questions.

NOTE: The directions read to students may depend on the available materials. Read only those parts of the lesson that apply to the materials you are using.

Any directions that ask you to do something, such as to turn to a page or to hand out materials to students, will have an arrow symbol ( $\Rightarrow$ ) by them.

#### *Purpose of Lesson 1:*

- In this lesson, the tutor and the students will
  - ✓ identify missing shapes in a pattern, sequence, or display of geometric shapes; and
  - ✓ continue a given sequence or pattern of geometric shapes, designs, and quantity of objects.

#### *Equipment/Materials Needed:*

- Some type of geometric figures (patterns blocks, 2-color counters, colored tiles, cutout shapes, square tiles.) You will need about 10 figures per student. If you have access to an Ellison Machine, or die cut machine, you can cut figures out of construction paper or card stock.
- If the items above are not available, use Student Sheets 56 and 57. It would be better to run these sheets on card stock or heavy paper.
- Paper and pencils
- Student Sheets 58 and 59

#### *Preparations before beginning Lesson 1:*

- Gather the geometric figures or cut out the figures on Student Sheets 56 and 57.
- Have paper and pencils available.
- Run off one copy of Student Sheets 58 and 59 for each student.

## Lesson 1: Patterns, Functions, and Relations

⇒ Put the figures you are going to use in front of you. Give students some sort of figures with which to work. They do not all have to have the same figures.

Say:

**I am going to place some figures on the table. I am going to place them so that they make a repeating pattern. What do you think I mean by a repeating pattern?** (one that repeats or goes on and on in the same way) **I want you to see whether you can figure out what comes next in my pattern.**

⇒ Make an AB AB pattern. An *AB pattern* means that you use two different objects and just alternate each one. You can use any of the materials available. The instructions are for the figures on Student Sheets 56 and 57. Just adapt them to fit the materials with which you are working. Place a triangle, then a rectangle; repeat with a triangle, then a rectangle. Keep repeating the pattern until someone sees the pattern.



Say:


**I am making a pattern that repeats over and over. What figure should I place next?** (triangle) **Does anyone know what my pattern is? Would you say my pattern out loud?** (triangle, rectangle, triangle, rectangle, etc; or 3 sides, 4 sides, 3 sides, 4 sides, etc.) Having students say the patterns aloud helps them see the patterns. Always ask the students to say their patterns.

⇒ Make another AB AB pattern, but use different figures. Place a white pentagon, then a black pentagon; repeat with a white pentagon, then a black pentagon. Continue until someone sees the pattern.



Say:

**I am making a pattern that repeats over and over. What figure should I place next?** (white pentagon) **Does anyone know what my pattern is? Would you say my pattern out loud?** (white, black, white, black, etc.) **How is this pattern different from the last pattern?** (We used different figures and different colors.) **How is similar to the other pattern?** (We used one of the first object, then one of the second object, and then repeated this pattern.)

⇒ Make another pattern, but this time make an AAB AAB pattern. Place two gray circles, one checkered circle, two gray circles, one checkered circle. Continue until someone sees the pattern. 

Say:

**I am making a pattern that repeats over and over. What figure should I place next?** (gray circle) **Does anyone know what my pattern is? Would you say my pattern out loud?** (Gray, gray, checkered, gray, gray, checkered etc.; or two gray circles, one checkered circle, two gray circles, one checkered circle)

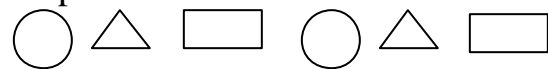
⇒ Make another AAB AAB pattern, but use different figures. Place two black rectangles, then a white triangle; repeat with two black rectangles, then a white triangle. Continue until someone sees the pattern.



Say:

**I am making a pattern that repeats over and over. What figure should I place next?** (black rectangle) **Does anyone know what my pattern is? Would you say my pattern out loud?** (black, black, white, black, black, white, etc; or rectangle, rectangle, triangle, rectangle, rectangle, triangle; or black rectangle, black rectangle, white triangle, black rectangle, black rectangle, white triangle) **How is this pattern different from the last pattern?** (We used different figures and different colors.) **How is similar to the other pattern?** (We placed 2 of the first object, then one of the second object, and kept repeating the pattern.)

⇒ Make another pattern, but this time make an ABC ABC pattern. Place one circle, one triangle, one rectangle, one circle, one triangle, and one rectangle. Continue until someone sees the pattern.



Say:

**I am making a pattern that repeats over and over. What figure should I place next?** (circle) **Does anyone know what my pattern is? Would you say my pattern out loud?** (circle, triangle, rectangle, circle, triangle, rectangle)

⇒ Make another ABC ABC pattern, but use different figures. Place a black rectangle, a striped triangle, and a white circle; then repeat black rectangle, striped triangle, white circle. Continue until someone sees the pattern.



Say:

**I am making a pattern that repeats over and over. What figure should I place next?** (striped triangle) **Does anyone know what my pattern is?** **Would you say my pattern out loud?** (black rectangle, striped triangle, white circle, black rectangle, striped triangle, white circle) **How is this pattern different from the last pattern?** (We used different figures and different colors.) **How is similar to the other pattern?** (We placed one of the first object, one of the second object, and one of the third object, and then continued repeating the pattern.)

⇒ Give Student Sheet 58 to the students. Work through each item separately.

Say:

**On this paper, there are some patterns that repeat. Let's look at each one. Say the patterns to yourself silently. Then tell me what the next object in the pattern would be.**

Answers:

- 1) bus
- 2) open mailbox
- 3) eye
- 4) 1 circle
- 5) A square with a diagonal drawn from bottom right to upper left
- 6) 1
- 7) a hand with 5 fingers
- 8) triangle
- 9) a square with the figure inside turned sideways
- 10) \$

Say:

**We have been looking at repeating patterns. Now, we will look at another kind of pattern. This type of pattern is called a *growing pattern*.**

⇒ Give the students Student Sheet 59.

Say:

**Look at the figures in Part A. How many squares (or blocks) are in figure 1? (2); Figure 2? (4); Figure 3? (6); Figure 4? (8) If the figures below continue to grow this way, how many squares will be in the 5<sup>th</sup> figure? (10) If you have squares available, let them make the first 4 figures to help them see the pattern. If not, you could use the rectangles from Student Sheets 56 or 57. If not, you may want to have them redraw the figures. **What are you thinking? How did you figure it out?** (*Sample response #1*: Some students will see that you are just adding 2 squares to the**

previous figure each time. To get the number of squares in the 5<sup>th</sup> figure, simply add 2 to the number of squares in the 4<sup>th</sup> figure. You get 10 squares.

*Sample response #2:* Some will see counting by 2's or even numbers. They may think: Figure 1 has two squares, Figure 2 has four squares, Figure 3 has six squares, Figure 4 has eight squares, so Figure 5 would have ten squares.

*Sample response #3:* Some will see that the first figure has 2 rows of one, the second figure has 2 rows of two, the third figure has 2 rows of three, the fourth figure has 2 rows of four, so the fifth figure should have 2 rows of five.

*Sample response #4:* Some will see area. Figure 1 is  $1 \times 2$ . Figure 2 is  $2 \times 2$ . Figure 3 is  $3 \times 2$ . Figure 4 is  $4 \times 2$ . Therefore, Figure 5 would be  $5 \times 2$ .)

**How is the number of squares related to the figure number?** Try to get them to see that, if they multiplied the figure number times 2, they would find the number of squares.

Say:

**Look at the figures in Part B. How many squares (or blocks) are in figure 1? (1); Figure 2? (3); Figure 3? (5); Figure 4? (7) If the figures below continue to grow this way, how many squares will be in the 5<sup>th</sup> figure? (9) What are you thinking? How did you figure it out?** (*Sample response #1:* Some students will see that you are just adding 2 squares to the previous figure each time. So, to get the number of squares in the 5<sup>th</sup> figure, simply add 2 to the number of squares in the 4<sup>th</sup> figure. You get 9 squares.

*Sample response #2:* Some will see odd numbers. They may think: Figure 1 has one square, Figure 2 has three squares, Figure 3 has five squares, Figure 4 has seven squares, so Figure 5 would have nine squares.

*Sample response #3:* Some will see that the first figure has 1 row of 1; the second figure has 1 row of 1 and 1 row of 2; the third figure has 1 row of 2 and 1 row of 3; the fourth figure has 1 row of 3 and 1 row of 4; so the fifth figure has to have 1 row of 4 and 1 row of 5.

*Sample response #4:* Some will see that you can take the figure number and double it, then subtract one (1). **How is the number of squares related to the figure number?** Try to get them to see that, if they multiplied the figure number times 2, and then subtracted one (1), they would find the number of squares.

Say:

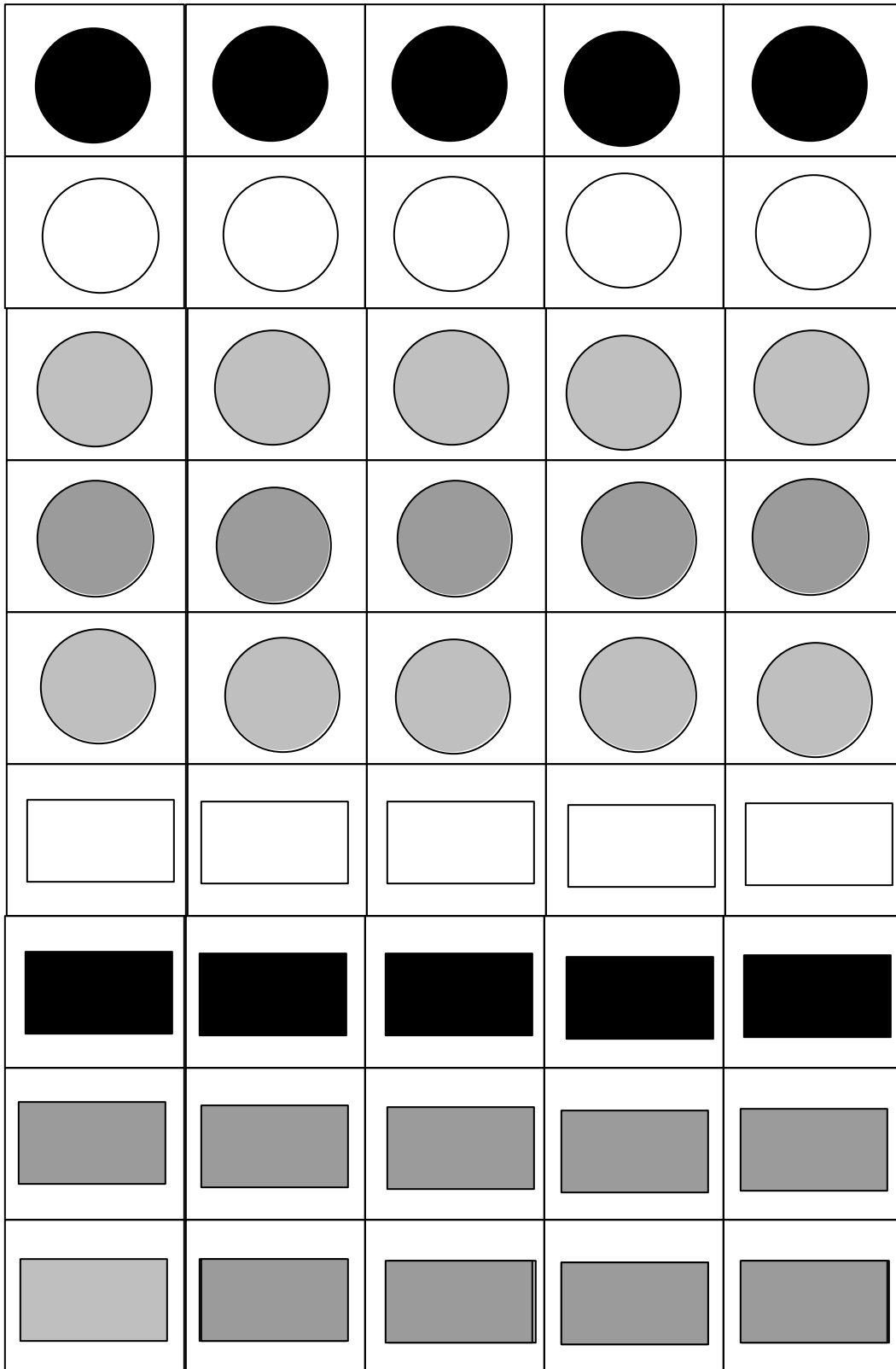
**Look at the figures in Part C. How many squares (or blocks) are in figure 1? (1); Figure 2? (4); Figure 3? (9); Figure 4? (16) If the figures below continue to grow this way, how many squares will be in the 5<sup>th</sup> figure? (25) What are you thinking? How did you figure it out?** (*Sample response #1:* Some students will see that to get figure 2, add 3 squares to

figure 1. To get figure 3, add 5 squares to figure 2. To get figure 4, add 7 squares to figure 3. To get figure 5, add 9 squares to figure 4.

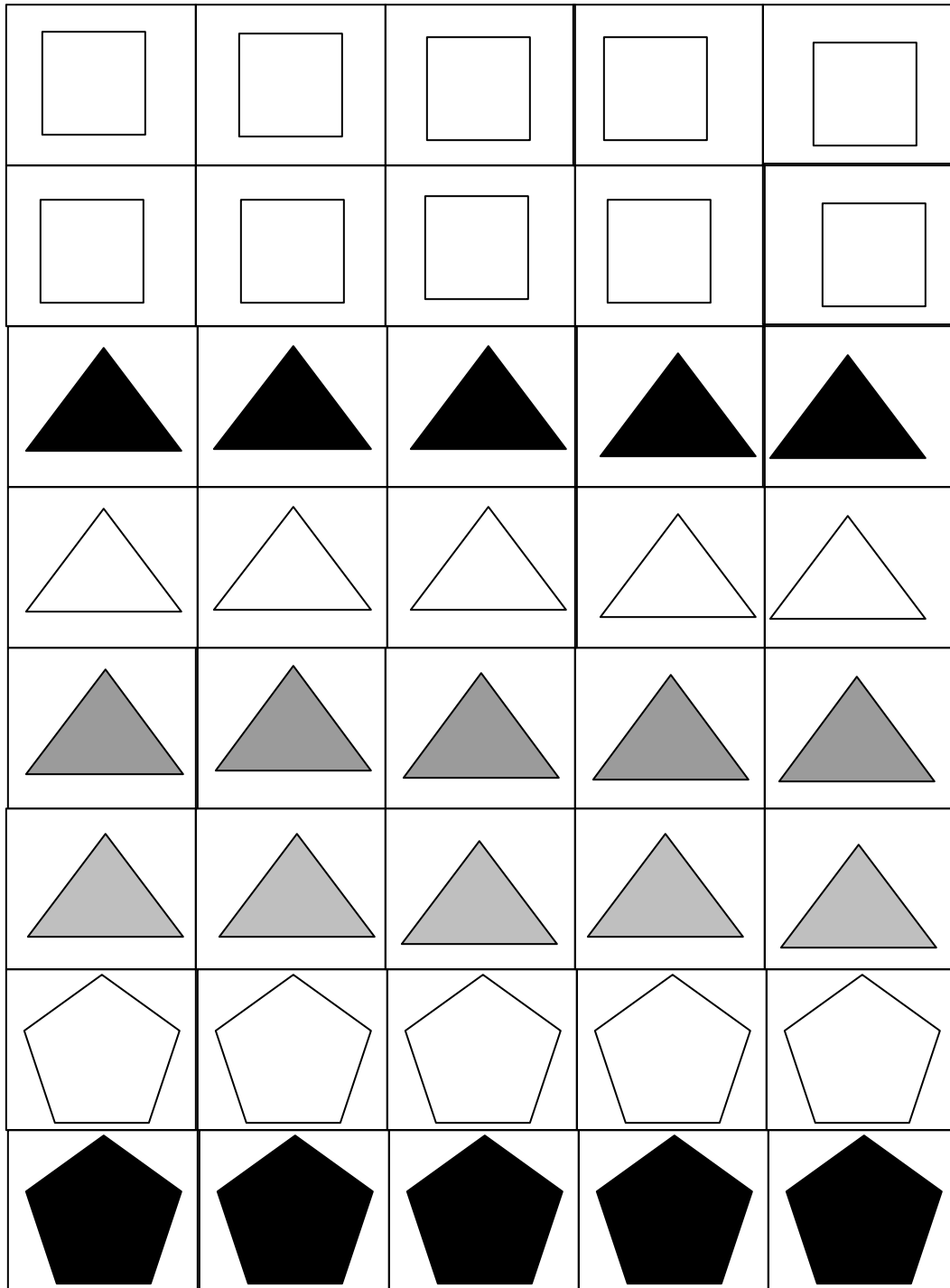
So  $16 + 9 = 25$ . *Sample response #2*: Some will see 1 row of 1, 2 rows of 2, 3 rows of 3, 4 rows of 4; therefore 5 would have 5 rows of 5, or 25. *Sample response #3*: Some will know square numbers and recognize the pattern 1, 4, 9, 16, 25. *Sample response #4*: Some will see area. Figure 1 is  $1 \times 1$ . Figure 2 is  $2 \times 2$ . Figure 3 is  $3 \times 3$ . Figure 4 is  $4 \times 4$ . So Figure 5 would be  $5 \times 5$  or 25.) **How is the number of squares related to the figure number?** Try to get the students to see that, if they multiplied the figure number times itself, they would find the number of squares; or if they squared the figure number, they would get the number of squares.

⇒ Have one student summarize today's lesson. Using geometric shapes can often help students see how patterns repeat or grow.

**Student Sheet 56 (Patterns: Lesson 1)**

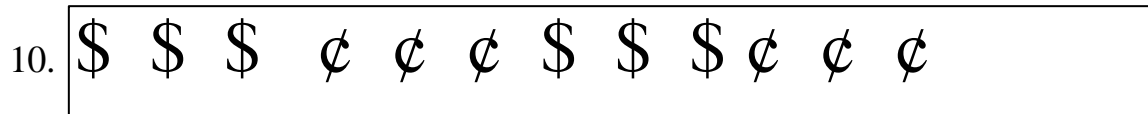
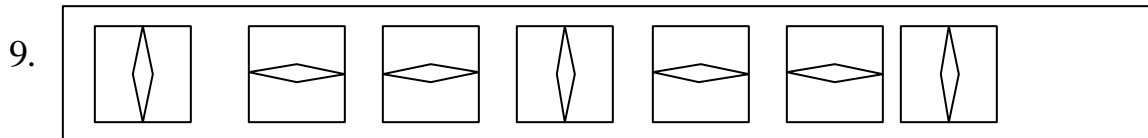
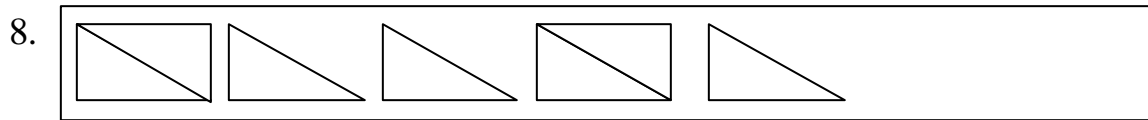
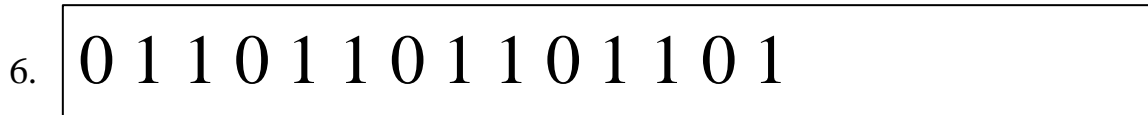
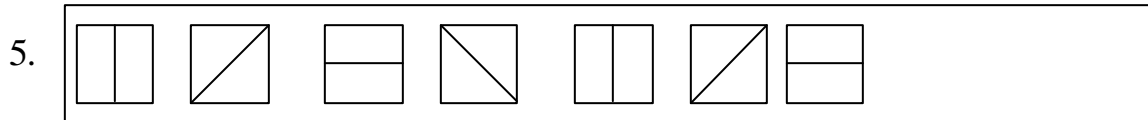
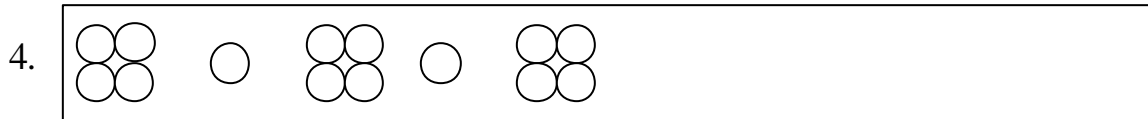
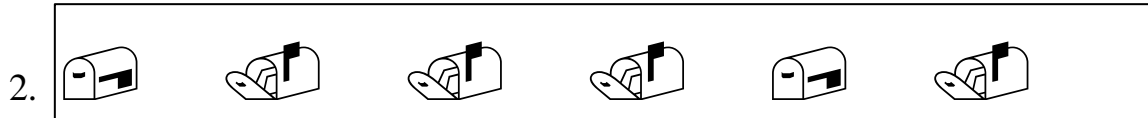


**Student Sheet 57 (Patterns: Lesson 1)**



**Student Sheet 58 (Patterns: Lesson 1)**

**Look at the patterns in each row. What would be the next object in each row?**



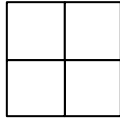
## Student Sheet 59 (Patterns: Lesson 1)

### Part A

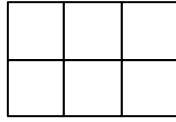
**Figure 1**



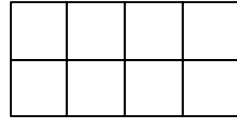
**Figure 2**



**Figure 3**



**Figure 4**

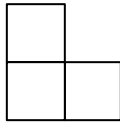


### Part B

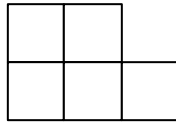
**Figure 1**



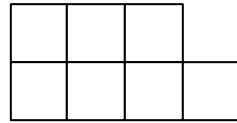
**Figure 2**



**Figure 3**



**Figure 4**

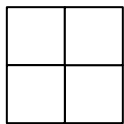


### Part C

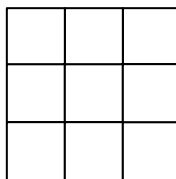
**Figure 1**



**Figure 2**



**Figure 3**



**Figure 4**

