PERIMETER SEARCH

- Perimeter
- Spatial reasoning
- Nonstandard units of measure

Getting Ready

What You'll Need

Pattern Blocks, at least 6 of each shape per pair

Pattern Block triangle paper, page 117

Crayons or markers

Activity Master, page 100

Overview

Students investigate the perimeters of shapes that can be made using different combinations of Pattern Blocks. In this activity, students have the opportunity to:

- reinforce their understanding of the concept of perimeter
- devise strategies for creating shapes with different perimeters
- explore the relationship between the compactness of a shape and its perimeter

Other *Super Source* activities that explore these and related concepts are:

Greta's Garden, page 9

Tiling Designs, page 13

Sandboxes, page 17

The Activity

On Their Own (Part 1)

During National Mathematics Week, Mr. Frangione invited students to present challenging problems to the class. Debbie posed the following question:* What are all the possible perimeters of shapes that can be made using six Pattern Blocks? *Can you solve Debbie's problem?

- Working with your partner, find all of the possible perimeters of shapes that can be made using six Pattern Blocks. You may use as many different combinations of blocks as you like.
- Use the length of the side of a green triangle as the unit of measure. Be sure to fit your blocks together so that each block shares at least one unit of length and at least one vertex with another block.
- Copy your shapes onto triangle paper and record the perimeter of each shape.
- Be ready to discuss the strategies you used to make shapes with new perimeters.

Thinking and Sharing

Ask students to tell what perimeters they found. List the perimeters on the chalkboard in numerical order. Invite pairs to share and compare the shapes they made and the strategies they used for creating shapes with new perimeters.

Use prompts like these to promote class discussion:

- How did you go about creating shapes with different perimeters?
- How did you search for the shape with the smallest perimeter? Do you think it is possible to make other shapes with this same perimeter? Why or why not?
- How did you search for the shape with the greatest perimeter? Do you think it is possible to make other shapes with this same perimeter? Why or why not?
- What generalizations can you make about the characteristics of shapes having large (small) perimeters?
- How do you know that you have found all possible perimeters?

On Their Own (Part 2)

What if... ***your shapes must be made using one of each of the six different Pattern Blocks? What perimeters would be possible?***

- Investigate the perimeters of shapes that can be made using one of each of the six different Pattern Blocks.
- Record your shapes and their perimeters.
- Be ready to discuss and explain your findings.

Thinking and Sharing

Invite students to tell about the shapes they made and their perimeters.

Use prompts like these to promote class discussion:

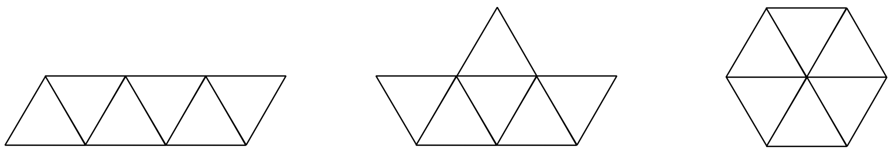
- What did you discover about the perimeters of shapes that could be made with the six different blocks?
- How did you go about searching for shapes with different perimeters?
- Why do you think the possible perimeters are limited to the ones you found?

Describe how you would go about finding the shapes with the smallest and greatest perimeters if you were given a set of ten Pattern Blocks.

Teacher Talk

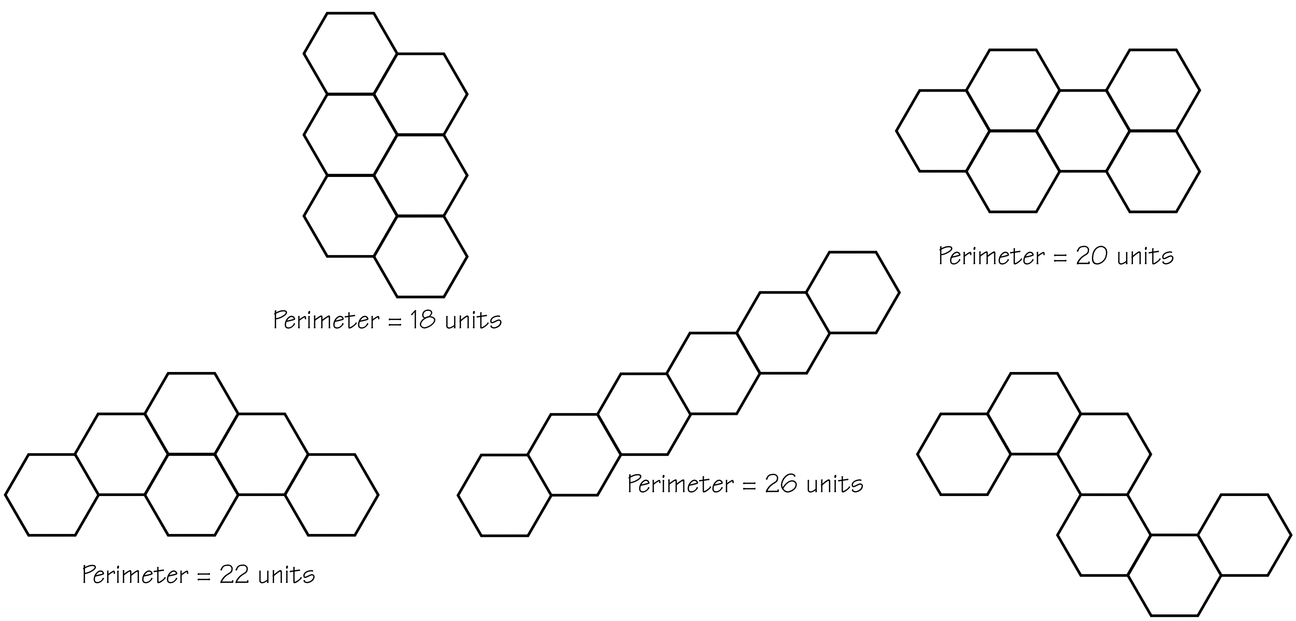
Where's the Mathematics?

In their search for all possible perimeters, students may realize that they can create the smallest possible perimeter using the smallest blocks (the green triangles) and the greatest possible perimeter using the largest blocks (the yellow hexagons). It is through their work with these blocks that they may discover that the blocks need to be arranged in certain ways to make shapes with the absolute smallest (and greatest) perimeters. For example, although several different shapes can be made using six green triangles, only the regular hexagon pictured below has the smallest possible perimeter, 6 units.

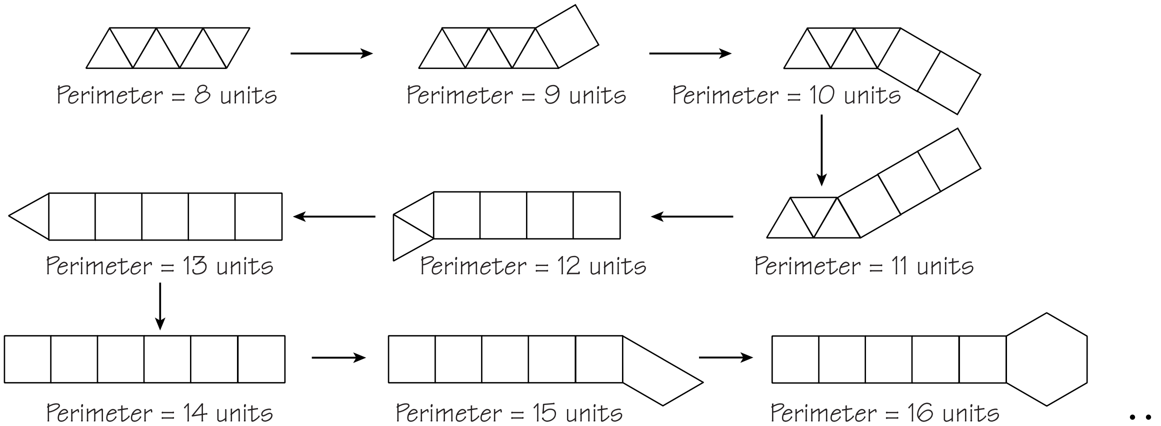


Perimeter = 8 units   Perimeter = 8 units   Perimeter = 6 units

Likewise, six hexagons can be arranged in a number of ways, but only some of them yield the greatest possible perimeter, 26 units.

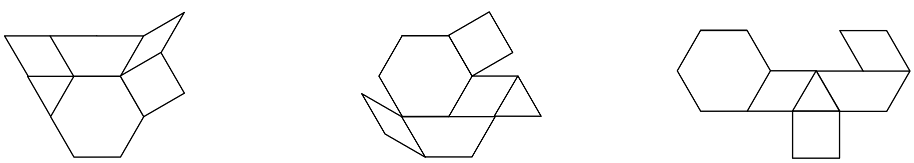


Some students may use trial and error to build shapes that have different perimeters, while others may use a more systematic approach. For example, students may begin with a particular shape, calculate its perimeter, and then exchange one or more blocks in the shape for blocks that will increase (or decrease) the perimeter. An example of one use of this strategy is shown on the next page.



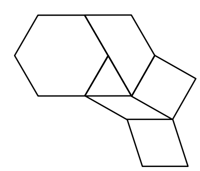
As students experiment with different ways of arranging the blocks, they may discover that shapes that are more compact usually have smaller perimeters than those that are more elongated. Students may use this observation to build and alter their shapes to produce new shapes with greater or smaller perimeters. Although there is only one way to make a shape that has the smallest perimeter, students should find that there are multiple ways of arranging the blocks to build shapes that have other perimeters. Students may notice that perimeters that lie towards the middle of the range of possible perimeters can be obtained by arranging the shapes in the widest variety of different ways.

In Part 2 of the activity, students may be surprised to find that only three perimeters are possible to obtain using six different Pattern Blocks: 12 units, 14 units, and 16 units. Some examples are shown here.

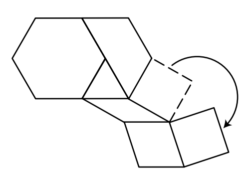


Perimeter = 12 units   Perimeter = 14 units   Perimeter = 16 units

Students may use what they learned from Part 1 of the activity, building compact shapes and elongated shapes, to investigate the smallest and greatest possible perimeters. As they rearrange the blocks to try to create shapes with different perimeters, students can see how the perimeter is affected by sides that become exposed or concealed by the change in arrangement. For example, when the orange square in Figure A is relocated as shown in Figure B, it will have one additional side exposed to the perimeter. Furthermore, the side of the trapezoid and the side of the tan rhombus that were previously concealed will also be exposed. With the concealment of one additional side of the blue rhombus, the net change is an increase of two units of perimeter.



A
Perimeter = 12 units



B
Perimeter = 14 units

Students may notice that whereas in the first investigation it was only possible to find one shape with the smallest perimeter and one with the greatest, in Part 2 this is not the case. This observation may motivate students to think about the different restrictions that were imposed in the two problems and how they affected the results.