Nasco Education™ LESSON PLAN

Math

Developed with Kristin Ulrich

Area and perimeter

Volume 24 | Gr. 3–5

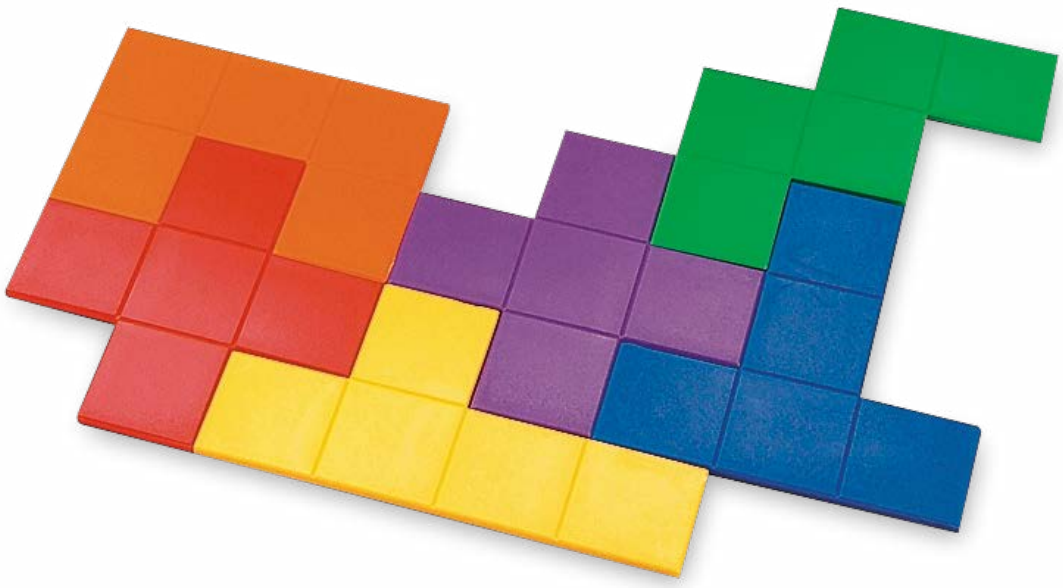
Day 1: 30–45 minutes
Day 2: 45–60 minutes

Time

For third grade students, you may find that only Day 1 is appropriate for instruction. Day 2 is meant as more of an extension activity for Day 1's activity. You may find it is more appropriate for grades 4 and 5.

Content

Use individual pentominoes to introduce the concepts of area and perimeter. Create different combinations of pentominoes to help students further understand the concepts of area and perimeter. Finally, when given a specific area or perimeter, students can create different shapes that fit the given criteria. In doing so, they will see that there can be multiple solutions to a given problem.



Objectives

Students will...

- Determine the area and perimeter of each individual pentomino
- Conclude that area is the space within a given object while perimeter is the space around the edge of that same object
- Create shapes when given specific parameters of area and perimeter

Materials

- A set of pentominoes for each student or small group of students. (This activity can be done in groups of up to 3 depending on how many sets of pentominoes you have.)
  - Pentominoes Individual Set (**TB16518**) or Bulk Pentominoes Pack (**TB22319**)
- 2 student worksheets and answer keys (included with lesson plan download)

Common Core State Standards

CCSS.Math.Content.3.MD.C.5 — Recognize area as an attribute of plane figures and understand concepts of area measurement.
CCSS.Math.Content.3.MD.C.6 — Measure areas by counting unit squares (square cm, square m, square in., square ft., and improvised units).
CCSS.Math.Content.4.MD.A.3 — Apply the area and perimeter formulas for rectangles in real world and mathematical problems.

Day 1: Introduction

1. Distribute Student Worksheet 1 and a set of 12 pentominoes to each small group or individual student. Tell students that for the next couple of days, they will be using pentominoes and different combinations of pentominoes to experiment and familiarize themselves with the concepts of area and perimeter. But first, they will need to understand what each term means.
2. Have students record each of the following definitions on the lines provided on Student Worksheet 1.
   The area of a figure is the space **inside** that figure.
   The perimeter of a figure is the distance **around** the outside edge.
3. Have students look at their pentominoes and ask what they notice about them. Students may give answers such as, "Some of them look like letters." "They are divided into square sections." "Each square of each pentomino is completely connected by at least one side to another square of the pentomino."
4. Have students find the pentomino that looks like an uppercase I. Ask how many squares they can see in the pentomino ***(5)***. Have them draw the pentomino in the first box of the pentomino column of their worksheet. They should be sure that it includes exactly five squares and is a straight line, just like the pentomino in front of them.
5. Tell students that they are going to determine the area of this particular pentomino. Ask what their definition of area tells them ***(that area is the space inside a figure)***. Have them measure the space inside of the "I" by counting the squares. Ask how many squares are inside this particular pentomino ***(5)***. That makes the area of the "I" pentomino 5.
6. Remind students that whenever they solve a problem they need to include the units. They can't just say 5 because it could mean five monkeys or five dollars or five cars or five of anything. They need to be specific. When talking about pentominoes and area in general, they should use the label "square units." Square is used because each piece inside of the figure is a square. Students should write "5 square units" on the line next to "Area" for Pentomino #1.
7. Now it's time to find the perimeter of the "I" pentomino. Ask students what the definition of perimeter tells them ***(perimeter is the distance around the outer edge of a figure)***. Ask how they think they could do that, since it doesn't look like they can count squares because there are no full squares around the edge of the figure. Give students a few minutes and see if they are able to determine that they need to count the sides of the squares to determine the perimeter. They may or may not be able to do this, but give them the time to try.
8. To find the perimeter, have students look at the edges of each square that are around the edges of the shape. Start at the top of the "I." There is one square on the top. Ask how many squares are on the right side of the pentomino ***(5)***, on the bottom ***(1)***, and on the left side ***(5)***. Have students add the numbers together and ask what they got as their total ***(1 + 5 + 5 + 1 = 12)***. The perimeter of this particular pentomino is 12, but remind students that they need a label for this number. When finding perimeter, they should use "units" as their measurement, making the perimeter of the "I" pentomino 12 units. They should record this on their worksheet for Pentomino #1.
9. Have students find the "L" pentomino and ask what they notice about this one ***(It's also made of squares. It has five squares as well)***. Students should draw the "L" pentomino in the space for Pentomino #2 on their worksheet.
10. Ask students how they can find the area of this pentomino. They should tell you that they need to count the number of squares that make it up. Since there are five squares that make up this pentomino, the area is 5 square units. Have students include this for Pentomino #2 on their worksheet.
11. Ask students how to find the perimeter of this pentomino ***(count the square edges around the sides of this pentomino)***. Although this pentomino isn't quite as straightforward as the "I" pentomino, the same method is used to count the edges. Ask the following questions:
    How many square edges go across the top? ***(1)***
    How many down the long part of the right side? ***(3)***
    How many edges do we move over to the right? ***(1)***
    How many more do we go down? ***(1)***
    How many square edges go across the bottom? ***(2)***
    How many square edges go up the right side? ***(4)***
12. This last question brings students back to the edge that they started with when they began counting around the "L." Have students add up the edges and ask how many they get ***(1 + 3 + 1 + 1 + 2 + 4 = 12)***. They should write "12 units" for the perimeter for Pentomino #2.

Day 1: Activity

You can decide at what point your students are ready to investigate the remaining pentominoes independently or in small groups. If you feel your students are ready after the two examples we have already gone through, you can let them investigate now. If you think they need further practice, continue with the "T" and "W." You can use the Check for Understanding below either to guide students through exploring the "T" and "W" if you feel they need further practice as a group, or you can use it to check in with students as they are working independently or in groups to make sure they are on the right path to determining area and perimeter.

After investigating the "T" and "W" pentominoes, students should be able to see that each pentomino that has been investigated has an area of 5 square units and a perimeter of 12 units. Ask students to predict if they all will have the same areas and perimeters. To keep students engaged, you may want to let them know that there is at least one pentomino that doesn't fit the pattern that has been developed so far. There is only one, but be sure to tell them "at least" so they don't stop practicing when they find the odd man out.

Day 1: Check for understanding (continued on next page)

1. How many square units make up the "T" pentomino? ***(5)***
2. What is the area of that pentomino? ***(5 square units)***
3. How many squared edges go across the top of the "T"? ***(3)***
4. How many on the far right side? ***(1)***
5. How many go to the edge to count back in? ***(1)***
6. How many down the inner right side? ***(2)***
7. How many edges across the bottom? ***(1)***
8. How many edges up the inner left side? ***(2)***

Day 1: Check for understanding (continued)

1. How many edges out the far left side? ***(1)***
2. How many edges are on the far left side? ***(1)***
3. What is the total perimeter of the "T"? ***(3 + 1 + 1 + 2 + 1 + 2 + 1 + 1 = 12 units)***
4. How many square units make up the "W"? ***(5)***
5. What is the area of that pentomino? ***(5 square units)***
6. Have a student count the edges around the "W" to determine its perimeter.
7. What is the perimeter of the "W"? ***(12 units)***

Recap

As students finish up their investigations, give them a chance to play around with the pentominoes until other students have finished. Ask them to try and make a square, rectangle, or other shapes until all students are ready to discuss. When all students are ready to discuss, ask them what they noticed about the investigation.

1. Every pentomino has an area of 5 square units.
2. The "P" pentomino has a perimeter of 10 units instead of 12 units.
3. All of the other pentominoes have the same perimeter.

Ask students why the "P" pentomino has a different perimeter than all the other ones. What makes it different? ***(It has more shared square sides than the other pentominoes.)*** Close out the day's activity by having students record two observations from today's work at the bottom of their worksheet.

Day 2: Introduction

1. Remind students that they spent some time the previous day investigating each individual pentomino. Get them to tell you some things they learned during the investigation. ***(Each pentomino has an area of 5 square units. The "P" pentomino has a perimeter of 10 units, while the other pentominoes have an area of 12 units. To find area, we count how many squares make up the figure. To find perimeter, we count the edges around the figure.)***
2. Tell students that today they will follow a very similar procedure, but that they will be looking at more than one pentomino at a time, then distribute pentominoes and Student Worksheet 2.

Day 2: Activity

1. Have students find the three pentominoes shown in **Figure 1**.
2. Give students a few minutes to try and arrange the three pentominoes in a rectangle. When they have created their rectangle, have them raise their hand so you can come around and check it. After you've approved the rectangle, students should draw the rectangle in the first box under "Pentomino Combination" on their worksheet. The rectangle should look like the one shown in **Figure 2**.

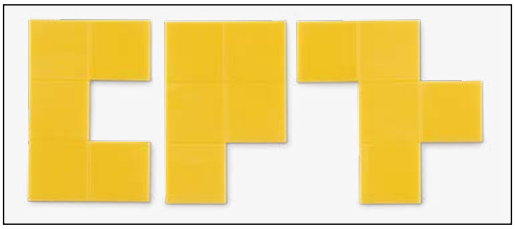


FIGURE 1

3. Prompt students to remember what they learned about area yesterday, then ask how to determine the area of the newly created rectangle ***(count the number of squares that make up the figure)***. Ask how many squares make up the figure ***(15 squares, making the area 15 square units)***. Have students record the area of the rectangle in the space provided in Box 1 of the worksheet.

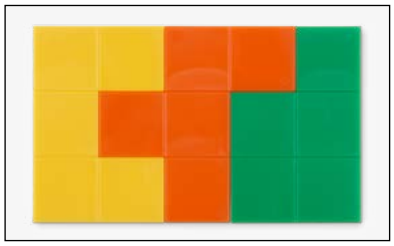


FIGURE 2

4. Ask if there was another way that area could have been determined. There are two different answers students can give. Get them to give both answers. One way is to say that since they put three shapes together that each have an area of 5 square units, they could do 5 square units x 3 figures = 15 total square units. The other way is to say that since they have a complete rectangle, they can use the formula L x W ***(5 x 3 = 15 square units)***.
5. Using what students learned about perimeter yesterday, ask how to determine the perimeter of the rectangle ***(count the square edges around the figure)***. To do this, students should start at the top and count how many square edges go across the top of the rectangle ***(5)***. Have them go down the right side ***(3)***, across the bottom of the rectangle ***(5)***, and up the left side ***(3)***, asking them how many they get with each step.
6. Point out that students have returned to their starting point, so now it is time to add up the sides to get the perimeter ***(5 + 3 + 5 + 3 = 16 units)***. Students should record "16 units" on the perimeter line of Box 1 of their worksheet.
7. Have students find the four pentominoes shown in **Figure 3**.

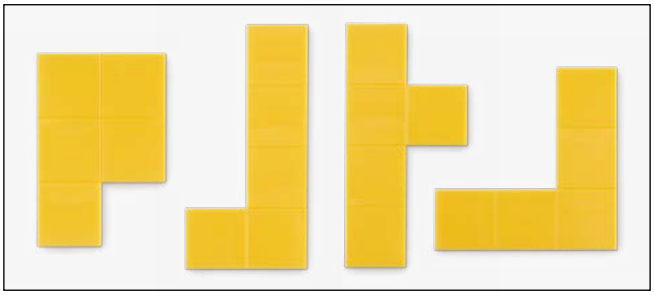


FIGURE 3

Day 2: Activity (continued)

8. Give students a few minutes to arrange the four pentominoes in a rectangle. As before, when students have created their rectangle, they should raise their hand so you can check it, then draw it in the second box under "Pentomino Combination" on their worksheet after you have approved the rectangle. The rectangle should look like the one in **Figure 4**. Have students tell you what the area of the rectangle is and explain how they came up with the solution. Students should be able to determine that the area of the rectangle is 20 square units. To arrive at that answer, they could count each individual square, say they know that 4 pentominoes x 5 square units in each = 20 square units, or use the L x W formula. Make sure that students record the area in Box 2.

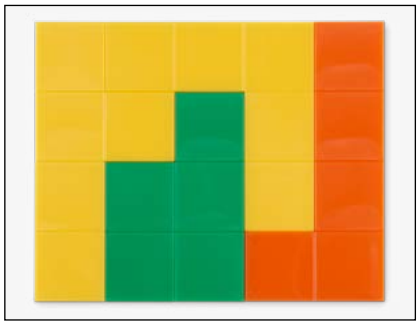


FIGURE 4

9. Have students tell you what the perimeter of the rectangle is and describe each step they went through to figure it out. Students should be able to determine that the perimeter of the rectangle is 18 units. They can count the edges on the top ***(5)***, right side ***(4)***, bottom ***(5)***, and left side ***(4)***. They should record the perimeter in Box 2.
10. In Box 3 of the worksheet, students have a picture of five pentominoes that can be used to make a rectangle (**Figure 5**). Give students a few minutes to create a rectangle using those particular shapes, then find the area and perimeter of the rectangle. Use the questions in the Check for Understanding listed to the right once students have finished.

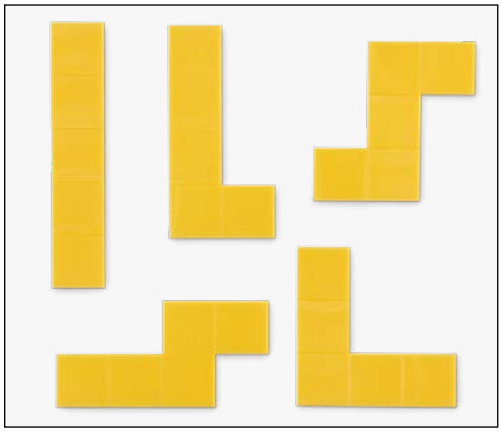


FIGURE 5

Day 2: Check for understanding

1. Have a student draw the rectangle that was made for all students to see.
2. What is the area of the rectangle that you made? ***(25 square units)***
3. What is the perimeter of the rectangle that you made? ***(20 units)***

Day 2: Activity 2

1. Students will now make shapes of their own using some specific rules. The shape will have an area of 15 square units, but it does not have to be a square or rectangle. The only rule is that it must have an area of 15 square units. Give students time to make the shape, then ask how many pentominoes they need to use in order to make a shape with an area of exactly 15 square units ***(3)***.
2. Ask students to share the shapes they have created. Any shape made with three pentominoes is acceptable. Show a few shapes that you can create quickly using three different pentominoes. Ask student volunteers to find the perimeter of the shapes you create.
3. Once students have had a chance to determine the perimeter of your shapes, ask them to talk with a partner or with others in their pentomino group about the perimeter of the shapes they have created. Students should be able to determine that the perimeter of each shape will vary.

Day 2: Check for understanding 2

Ask each student to move to Box 4 of today's worksheet. There they will find the "Area" line has been filled in with "20 square units." Ask each student to create a figure that follows that rule. Remind them their shapes do not need to be squares or rectangles.

1. How many pentominoes does it take to create a figure with an area of 20 square units? ***(4 pentominoes)***
2. Have volunteers show their shapes.
3. Ask students to work with a partner to determine the perimeter of each created shape.
4. Have students draw the shapes they have made and record the perimeters of those given shapes on their worksheets.

Intervention

Students may find it challenging to create a shape given a specific perimeter. If that is the case, replace those questions in Student Worksheet 2 with more practice with larger given pentomino sets. Given the shapes, students will be able to determine the area and perimeter, which is the skill you are assessing with this lesson.

Extension

Students can create their own criteria for pentomino area and perimeter combinations. They can challenge a friend to determine the correct pentomino creation based on the given area and/or perimeter.

Area and perimeter — **worksheet 1**

Name: _____ Date: _____

Area: _____

Perimeter: _____

Pentomino #1 Area: _____ Perimeter: _____	Pentomino #2 Area: _____ Perimeter: _____
Pentomino #3 Area: _____ Perimeter: _____	Pentomino #4 Area: _____ Perimeter: _____
Pentomino #5 Area: _____ Perimeter: _____	Pentomino #6 Area: _____ Perimeter: _____

cont. next page

Area and Perimeter Worksheet I Continued

Pentomino #7 Area: _____ Perimeter: _____	Pentomino #8 Area: _____ Perimeter: _____
Pentomino #9 Area: _____ Perimeter: _____	Pentomino #10 Area: _____ Perimeter: _____
Pentomino #11 Area: _____ Perimeter: _____	Pentomino #12 Area: _____ Perimeter: _____

My Pentomino Observations:

1. _____

2. _____

Area and perimeter — **worksheet 2**

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Name: _____ Date: _____

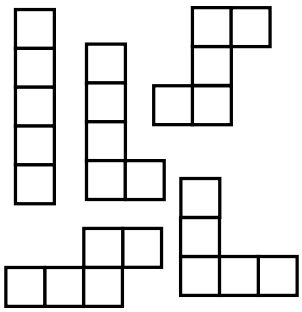
1. Draw a Rectangle Pentomino Combination (3 pieces)

Area: _____ Perimeter: _____

2. Draw a Rectangle Pentomino Combination (4 pieces)

Area: _____ Perimeter: _____

3. Make a rectangle using these 5 pentominoes.



Area: _____ Perimeter: _____

4. Draw your shape.

Area: 20 square units Perimeter: _____

5. Draw your shape.

Area: _____ Perimeter: 18 units

6. Draw your shape.

Area: _____ Perimeter: 22 units

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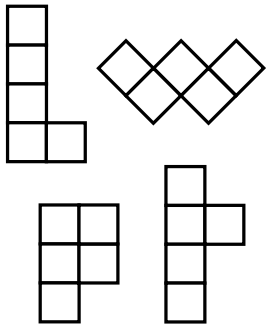
7. Make a rectangle using these 4 pentominoes. Draw your shape.



Area: _____ Perimeter: _____

8. Draw your shape.

Area: 25 square units Perimeter: _____

9. Draw your shape.

Area: 30 square units Perimeter: _____

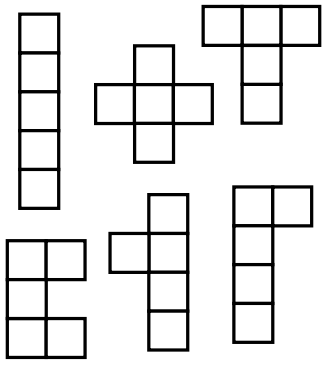
10. Draw your shape.

Area: _____ Perimeter: 26 units

11. Draw your shape.

Area: 35 square units Perimeter: _____

Challenge: Make a rectangle using these 6 pentominoes. Draw your shape.

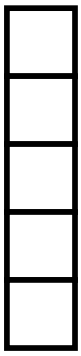


Area: _____ Perimeter: _____

Area: The space inside of a figure.

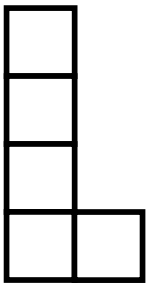
Perimeter: The distance around the outside edge of a figure.

Pentomino #1



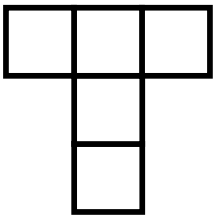
Area: 5 square units Perimeter: 12 units

Pentomino #2



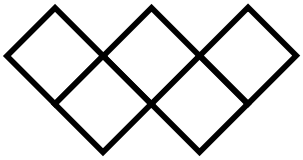
Area: 5 square units Perimeter: 12 units

Pentomino #3



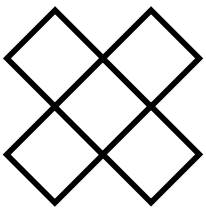
Area: 5 square units Perimeter: 12 units

Pentomino #4



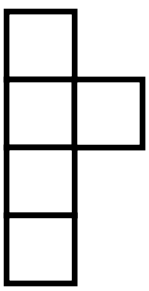
Area: 5 square units Perimeter: 12 units

Pentomino #5



Area: 5 square units Perimeter: 12 units

Pentomino #6



Area: 5 square units Perimeter: 12 units

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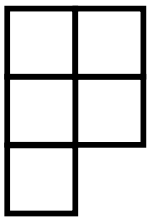
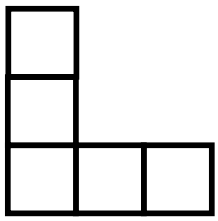
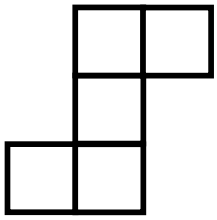
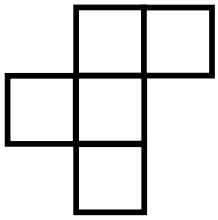
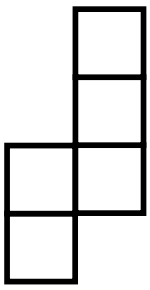
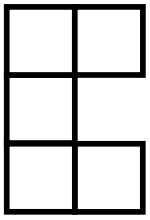
Area and perimeter answer key I continued

Pentomino #7  Area: 5 square units Perimeter: 10 units	Pentomino #8  Area: 5 square units Perimeter: 12 units
Pentomino #9  Area: 5 square units Perimeter: 12 units	Pentomino #10  Area: 5 square units Perimeter: 12 units
Pentomino #11  Area: 5 square units Perimeter: 12 units	Pentomino #12  Area: 5 square units Perimeter: 12 units

My Pentomino Observations: (Answers will vary. Two sample observations are written below.)

1. The "P" pentomino is the only one with a perimeter of 10 units.
2. All of the pentominoes have an area of 5 square units.

Area and perimeter — **answer key 2**

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1.

Area: 15 square units Perimeter: 16 units

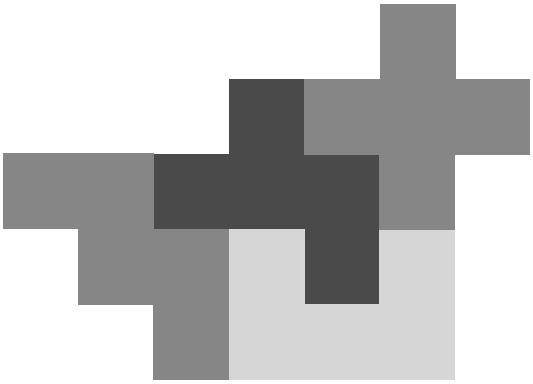
2.

Area: 20 square units Perimeter: 18 units

3.

Area: 25 square units Perimeter: 20 units

4.



Area: 20 square units Perimeter: 24 units

5.

Area: 15 square units Perimeter: 18 units

6.

Area: 15 square units Perimeter: 22 units

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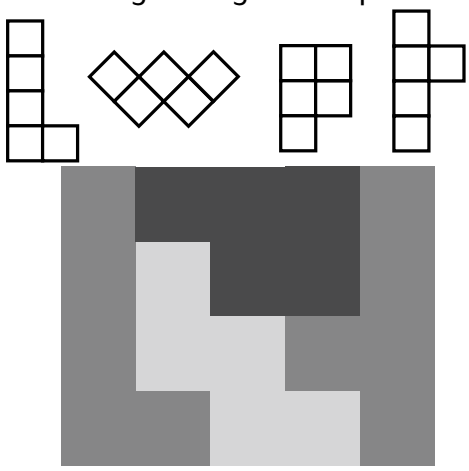
7. Make a rectangle using these 4 pentominoes.



Area: 20 square units Perimeter: 18 units

8. Sample shape

Area: 25 square units Perimeter: 24 units

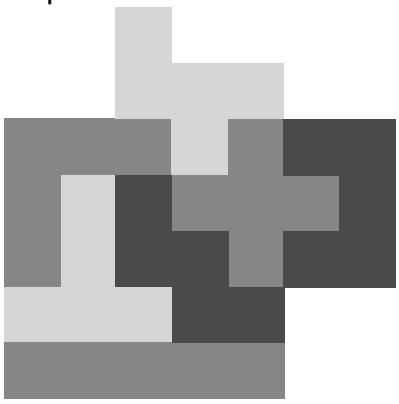
9. Sample shape

Area: 30 square units Perimeter: 26 units

10. Sample shape

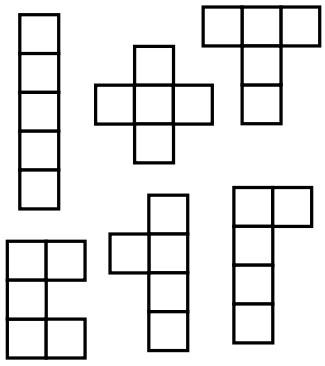
Area: 25 square units Perimeter: 26 units

11. Sample shape



Area: 35 square units Perimeter: 28 units

Challenge: Make a rectangle using these 6 pentominoes.



Area: 30 square units Perimeter: 22 units