Unit 1, Lesson 6

Scaling and Area

Goals

- Calculate and compare (orally and in writing) the areas of multiple scaled copies of the same shape.
- Generalize (orally) that the area of a scaled copy is the product of the area of the original figure and the "square" of the scale factor.
- Recognize that a two-dimensional attribute, like area, scales at a different rate than do one-dimensional attributes, like length and distance.

Learning Targets

- I can describe how the area of a scaled copy is related to the area of the original figure and the scale factor that was used.

Lesson Narrative

This lesson is optional. In this lesson, students are introduced to how the area of a scaled copy relates to the area of the original shape. Students build on their grade 6 work with exponents to recognize that the area changes by the square of the scale factor by which the sides changed. Students will continue to work with the area of scaled shapes later in this unit and in later units in this course. Although the lesson is optional, it will be particularly helpful for students to have already had this introduction when they study the area of circles in a later unit.

In two of the activities in this lesson, students build scaled copies using pattern blocks as units of area. This work with manipulatives helps accustom students to a pattern that many find counterintuitive at first (MP8). (It is a common but false assumption that the area of scaled copies increases by the same scale factor as the sides.) After that, students calculate the area of scaled copies of parallelograms and triangles to apply the patterns that they discovered in the hands-on activities (MP7).

Standards

Building On	**6.G.A.1**
Addressing	**7.G.A.1, 7.G.B.6**
Building Toward	**7.G.B.4, 7.G.B.6, 7.RP.A.2.a**

Instructional Routines

- 5 Practices
- MLR7: Compare and Connect
- MLR8: Discussion Supports

Required Materials

Materials to Gather

- Pattern blocks: Activity 1, Activity 2
- Geometry toolkits: Activity 3

Materials to Copy

- Area of Scaled Parallelograms and Triangles Cards (1 copy for every 6 students): Activity 3

Required Preparation

Activity 1:

Prepare to distribute the pattern blocks, at least 18 blue rhombuses, 18 green triangles, and 10 red trapezoids per group of 3–4 students. For the Are You Ready for More? prepare to distribute 7 yellow hexagons per group.

If there are not enough pattern blocks for each group to have a full set, consider rotating the blocks of each color through the groups. Using real pattern blocks is preferred, but the Digital Activity can be used if physical manipulatives are unavailable.

For the digital version of the activity, acquire devices that can run the applet.

Activity 2:

Redistribute the pattern blocks so that students can make scaled copies of their assigned figure. Each group needs only one type of block, either 20 blue rhombuses, 15 red trapezoids, or 24 green triangles.

Using real pattern blocks is preferred, but the Digital Activity can be used if physical manipulatives are unavailable.

For the digital version of the activity, acquire devices that can run the applet.

Student Facing Learning Goals

Let's build scaled shapes and investigate their areas.

6.1 Scaling a Pattern Block

Warm-up

10 min

Activity Narrative

There is a digital version of this activity.

By now, students understand that lengths in a scaled copy are related to the original lengths by the scale factor. Here they see that the area of a scaled copy is related to the original area by the *square* of the scale factor.

Students build scaled copies of a single pattern block, using blocks of the same shape to do so. They determine how many blocks are needed to create a copy at each specified scale factor. Each pattern block serves as an informal unit of area. Because each original shape has an area of 1 block, the $(\text{scale factor})^2$ pattern for the area of a scaled copy is easier to recognize.

Students use the same set of scale factors to build copies of three different shapes (a rhombus, a triangle, and a hexagon). They notice regularity in their repeated reasoning and use their observations to predict the number of blocks needed to build other scaled copies (MP8).

If pattern blocks are not available, consider using the digital version of the activity. In the digital version, students use several applets to build scaled copies of a single pattern block. The applets organize the placement of the blocks as they are added. The digital version may help students build the shapes quickly and accurately so they can focus more on the number of pattern blocks it takes to make the scaled copy rather than on how the blocks are arranged.

Standards

Addressing	**7.G.A.1, 7.G.B.6**
Building Toward	**7.RP.A.2.a**

Instructional Routines

- MLR8: Discussion Supports

Launch

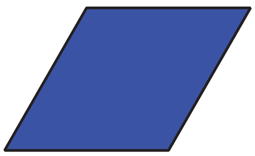
Arrange students in groups of 3–4. Distribute pattern blocks and ask students to use them to build scaled copies of each shape as described in the task. Each group would need at most 16 blocks each of the green triangle, the blue rhombus, and the red trapezoid. If there are not enough for each group to have a full set with 16 each of the green, blue, and red blocks, consider rotating the blocks of each color through the groups, or having students start with 10 blocks of each and ask for more as needed.

Give students 6–7 minutes to collaborate on the task and follow with a whole-class discussion. Make sure all students understand that “twice as long” means “2 times as long."

Student Task Statement

Your teacher will give you some pattern blocks. Work with your group to build the scaled copies described in each question.

A



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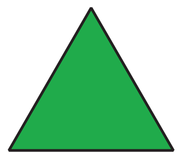
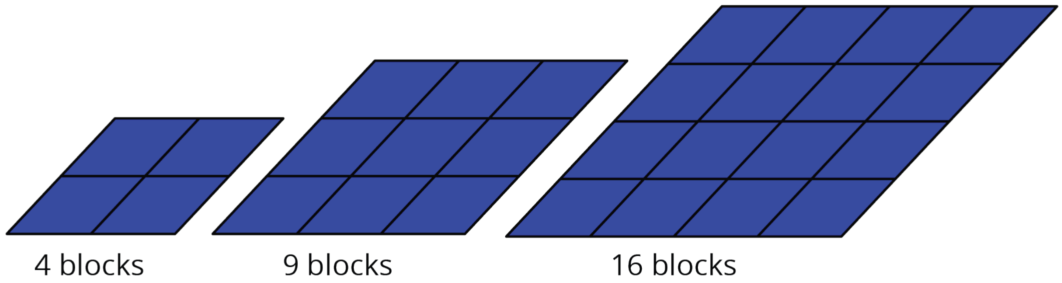


C

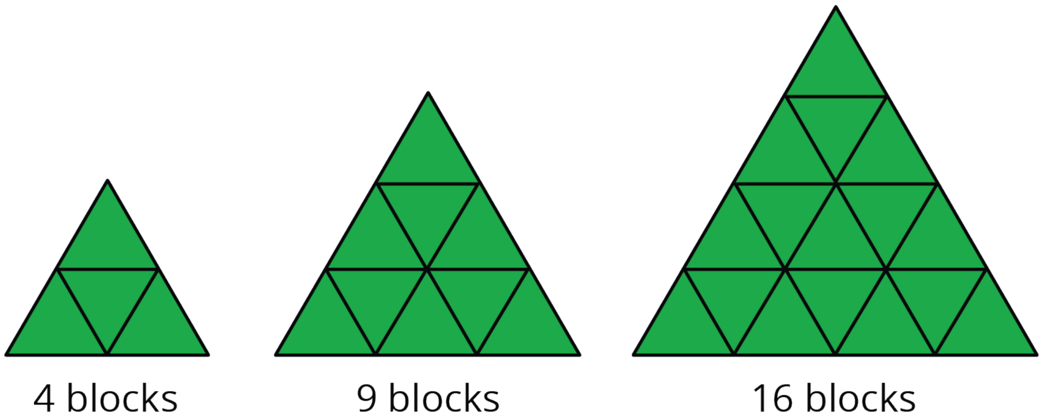
1. How many blue rhombus blocks does it take to build a scaled copy of Figure A:
    a. Where each side is twice as long?
    b. Where each side is 3 times as long?
    c. Where each side is 4 times as long?
2. How many green triangle blocks does it take to build a scaled copy of Figure B:
    a. Where each side is twice as long?
    b. Where each side is 3 times as long?
    c. Using a scale factor of 4?
3. How many red trapezoid blocks does it take to build a scaled copy of Figure C:
    a. Using a scale factor of 2?
    b. Using a scale factor of 3?
    c. Using a scale factor of 4?

Student Response

1.



2.



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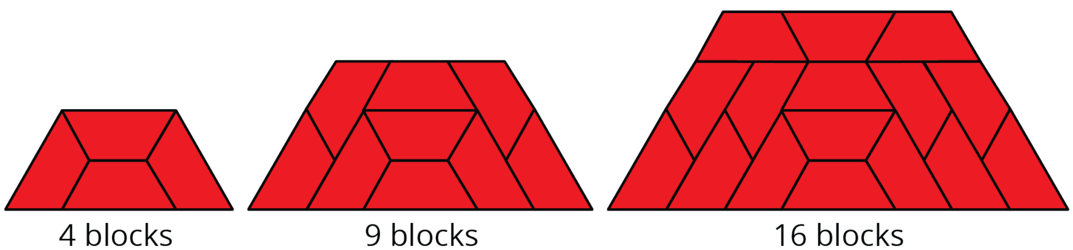
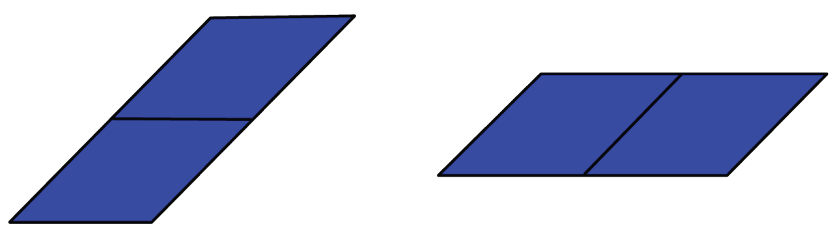


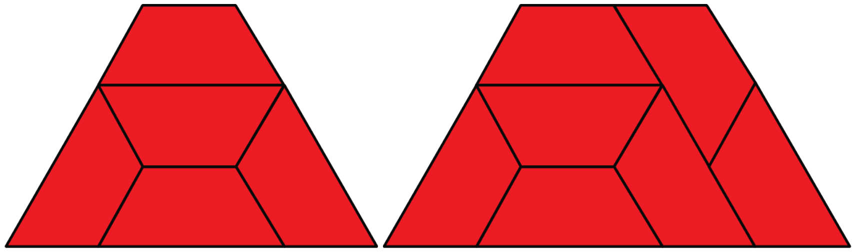
Building on Student Thinking

Some students may come up with one of these arrangements for the first question, because they assume the answer will take 2 blocks to build:



You could use one pattern block to demonstrate measuring the lengths of the sides of their shape, to show them which side they have not doubled.

Students may also come up with:



for tripling the trapezoid, because they triple the height of the scaled copy but they do not triple the length. You could use the process described above to show that not all side lengths have tripled.

Activity Synthesis

Display a table with only the column headings filled in. For the first four rows, ask different students to share how many blocks it took them to build each shape and record their answers in the table.

scale factor	number of blocks to build Figure A	number of blocks to build Figure B	number of blocks to build Figure C
1			
2			
3			
4			
5			
10			
s			
$\frac{1}{2}$			

To help students notice, extend, and generalize the pattern in the table, guide a discussion using questions such as these:

- “In the table, how is the number of blocks related to the scale factor? Is there a pattern?” (The number of blocks is equal to the scale factor times itself.)
- “How many blocks are needed to build scaled copies using scale factors of 5 or 10? How do you know?” (25; 100; $5 \cdot 5 = 25$, $10 \cdot 10 = 100$)
- “How many blocks are needed to build a scaled copy using any scale factor s?” (s^2)
- “If we want a scaled copy where each side is half as long, how much of a block would it take? How do you know? Does the same rule still apply?” ($\frac{1}{4}$ because $\frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$)

If not brought up by students, highlight the fact that the number of blocks it took to build each scaled shape equals the scale factor times itself, regardless of the shape (look at the table row for s). This rule applies to any factor, including those that are less than 1.

Access for English Language Learners

MLR8 Discussion Supports. For each generalization that is shared, invite students to turn to a partner and restate what they heard using precise mathematical language.
Advances: Listening, Speaking

6.2 Scaling More Pattern Blocks

15 min

Activity Narrative

There is a digital version of this activity.

This activity extends the conceptual work of the previous one by adding a layer of complexity. Students continue building scaled copies with pattern blocks, but now the original shapes are comprised of more than 1 block. Therefore, the number of blocks needed to build their scaled copies is not simply $(\text{scale factor})^2$, but rather $n \times (\text{scale factor})^2$, where n is the number of blocks in the original shape. Students begin to think about how the scaled area relates to the original area, which is no longer 1 area unit. They notice that the pattern $(\text{scale factor})^2$ presents itself in the factor by which the original number of blocks has changed, rather than in the total number of blocks in the copy.

As in the previous task, students observe regularity in repeated reasoning (MP8), noticing that regardless of the shapes, starting with n pattern blocks and scaling by s uses ns^2 pattern blocks.

Also as in the previous task, the shape composed of trapezoids might be more challenging to scale than those composed of rhombuses and triangles. Prepare to support students scaling the red shape by offering some direction or additional time, if feasible.

Monitor for groups who notice that the pattern of squared scale factors still occurs here, and that it is apparent if the original number of blocks is taken into account.

This is the first time Math Language Routine 7: *Compare and Connect* is suggested in this course. In this routine, students are given a problem that can be approached using multiple strategies or representations, and they record their method for all to see. They then compare and identify correspondences across strategies by means of a teacher-led gallery walk with commentary or teacher think-aloud (such as "I notice . . . I wonder . . ."). A typical discussion prompt is "What is the same and what is different?", comparing their own strategy to the others. The purpose of this routine is to allow students to make sense of mathematical strategies and, through constructive conversations, develop awareness of the language used as they compare, contrast, and connect other ways of thinking to their own.

If pattern blocks are not available, consider using the digital version of the activity. In the digital version, students use an applet to fill in outlines of scaled copies with pattern blocks. The applet allows students to move and rotate the pattern blocks. The digital version may help students build the shapes quickly and accurately so they can focus more on the number of pattern blocks it takes to make the scaled copy rather than on how the blocks are arranged.

Access for English Language Learners

This activity uses the *Compare and Connect* math language routine to advance mathematically precise language in discussion

Standards

Addressing **7.G.A.1, 7.G.B.6**

Building Toward **7.G.B.4**

Instructional Routines

- MLR7: Compare and Connect

Launch

Keep students in the same groups, or form combined groups if there are not enough blocks. Assign one shape for each group to build (or let groups choose a shape, as long as all 3 shapes are equally represented).

Give students 5–6 minutes to build their shapes and complete the task. Remind them to use the same blocks as those in the original shape and to check the side lengths of each built shape to make sure they are properly scaled.

Select work from students with different explanations for the question about predicting the number of blocks needed to make copies with scale factors 4, 5, and 6. Make sure to select one example of each of the 3 shapes.

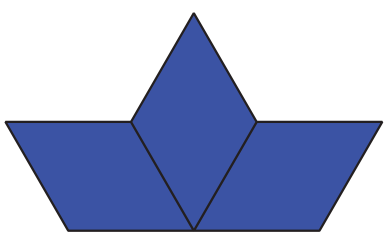
Access for Students with Disabilities

Action and Expression: Internalize Executive Functions. To support development of organizational skills in problem-solving, chunk this task into more manageable parts. For example, present one question at a time and monitor students to ensure that they are making progress throughout the activity.
Supports accessibility for: Organization, Attention

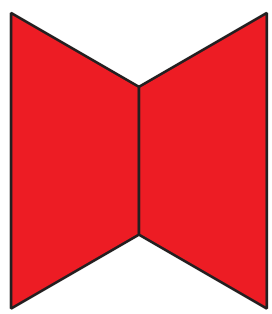
Student Task Statement

Your teacher will assign your group one of these figures.

D



E



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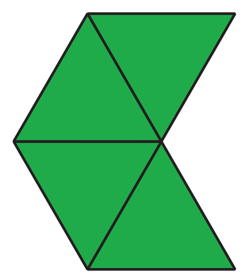


1. Build a scaled copy of your assigned shape using a scale factor of 2. Use the same shape blocks as in the original figure. How many blocks did it take?
2. Your classmate thinks that the scaled copies in the previous problem will each take 4 blocks to build. Do you agree or disagree? Explain your reasoning.
3. Start building a scaled copy of your assigned figure using a scale factor of 3. Stop when you can tell for sure how many blocks it would take. Record your answer.
4. Predict: How many blocks would it take to build scaled copies using scale factors 4, 5, and 6? Explain or show your reasoning.
5. How is the pattern in this activity the same as the pattern you saw in the previous activity? How is it different?

Student Response

1. 12 blue rhombuses, 8 red trapezoids, or 16 green triangles.
2. Each block in the pattern is replaced by 4 blocks in the scaled copy. There is more than one block in each pattern so the scaled copies of the patterns require more than 4 blocks.
3. 27 blue rhombuses, 18 red trapezoids, or 36 green triangles.
4. Blue rhombuses needed for scaled copies of the blue crown: $3 \cdot 4^2 = 48, 3 \cdot 5^2 = 75, 3 \cdot 6^2 = 108$. Red trapezoids needed for scaled copies of the red butterfly: $2 \cdot 4^2 = 32, 2 \cdot 5^2 = 50, 2 \cdot 6^2 = 72$. Green triangles needed for scaled copies of the green chevron: $4 \cdot 4^2 = 64, 4 \cdot 5^2 = 100, 4 \cdot 6^2 = 144$.
5. At first glance, the pattern does not seem the same because the answers are not 4 and 9. However, each individual block still scales by 4 and then 9, so you have to multiply that by the number of blocks in the original shape to get the number of blocks in the scaled copy.

Building on Student Thinking

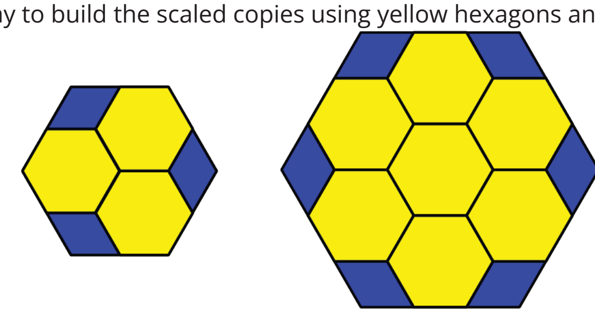
Students may forget to check that the lengths of all sides of their shape have been scaled and end with an inaccurate count of the pattern blocks. Remind them that all segments must be scaled by the same factor.

Are You Ready for More?

1. How many blocks do you think it would take to build a scaled copy of one yellow hexagon where each side is twice as long? Three times as long?
2. Figure out a way to build these scaled copies.
3. Do you see a pattern for the number of blocks used to build these scaled copies? Explain your reasoning.

Extension Student Response

1. It should take 4 blocks and 9 blocks following the pattern for the other shapes.
2. Sample response: here is a way to build the scaled copies using yellow hexagons and blue rhombuses:



3. The pattern does not work if you only count the number of blocks; however, it does work if you consider the size of each block being used. The first hexagon took 6 blocks to build: 3 yellow hexagons and 3 blue rhombuses, but 3 blue rhombuses cover the same area as 1 yellow hexagon, so the size of the scaled copy is equivalent to 4 yellow hexagons, because $3 + \frac{3}{3} = 4$. Similarly, the total size of the scaled copy with scale factor 3 is equivalent to 9 yellow hexagons.

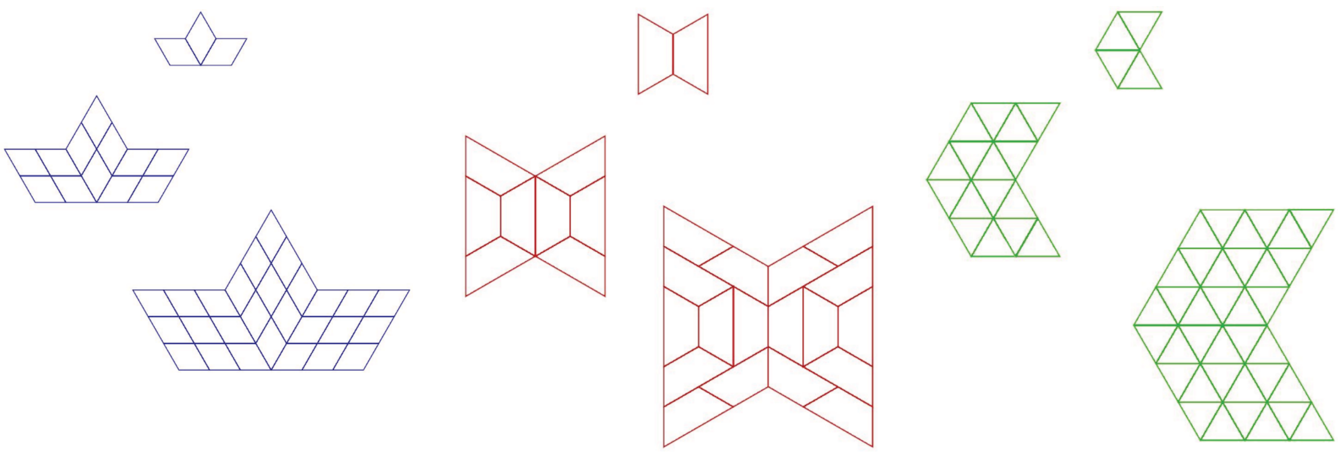
Activity Synthesis

The goal of this discussion is to ensure that students understand that the number of blocks in the scaled copies depends both on the scale factor and on the number of blocks in the original figure.

Display a table with only the column headings filled in. Ask students to share how many blocks it took them to build each scaled copy using the factors of 2 and 3. Record their answers in the table.

scale factor	number of blocks to build Figure D	number of blocks to build Figure E	number of blocks to build Figure F
1	3	2	4
2			
3			
4			
5			
6			
s			

Consider displaying pictures of the built shapes to help students see where the numbers in the table came from.



Next, focus the discussion on the question about predicting the number of blocks needed to make copies with scale factors 4, 5, and 6. Display the approaches from previously selected students for all to see. Record their predictions in the table. Use *Compare and Connect* to help students compare, contrast, and connect the different approaches. Here are some questions for discussion:

- "What do the solutions have in common? How are they different?"
- "How does the scale factor show up in each method?"
- "How does the pattern for the number of blocks in this activity compare to the pattern in the previous activity?"
- "For each figure, how many blocks does it take to build a copy using any scale factor s?" ($3s^2$ for Figure D, $2s^2$ for Figure E, and $4s^2$ for Figure F. In each case, it's the number of blocks in the original figure times the $(\text{scale factor})^2$.)

Once students can explain that the pattern of squared scale factors still occurs here, and that it is apparent if the original number of blocks is taken into account, move on to the next activity.

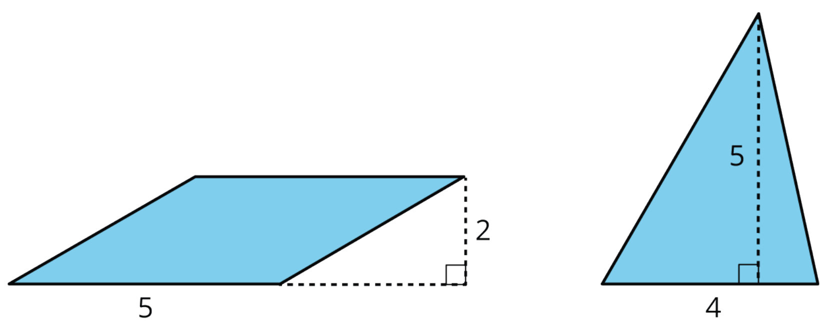
6.3 Area of Scaled Parallelograms and Triangles

15 min

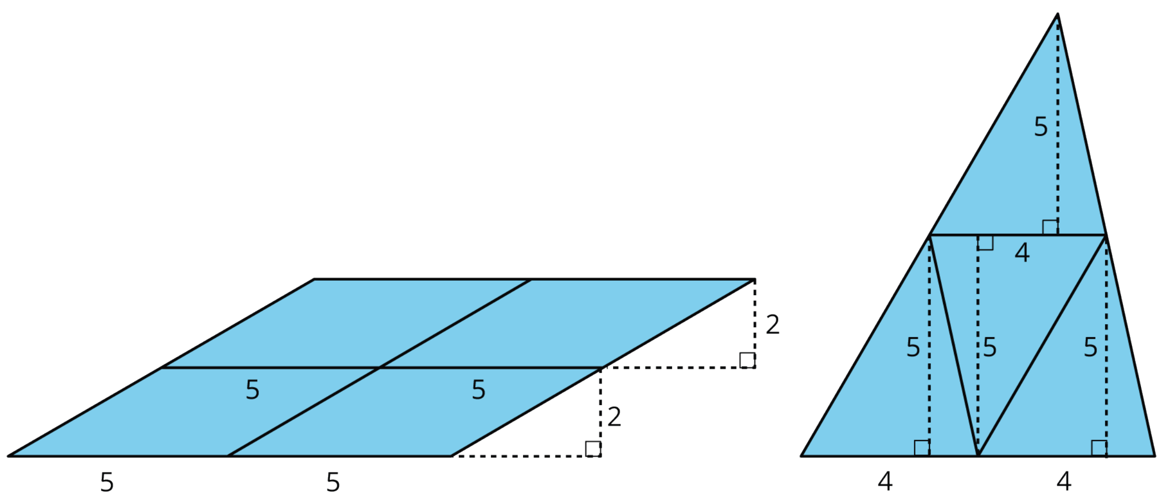
Optional

Activity Narrative

In this activity, students transfer what they learned with the pattern blocks about the structure of scaled copies to calculate the area of other scaled shapes (MP7). In groups of 2, students draw scaled copies of either a parallelogram or a triangle and calculate the areas. Then, each group compares their results with those of a group that worked on the other shape. They find that the scaled areas of two shapes are the same, even though the starting shapes are different and have different measurements. They attribute this to the fact that the two shapes had the same original area and were scaled using the same scale factors.



While students are not asked to reason about scaled areas by tiling (as they had done in the previous activities), each scaled copy can be tiled to illustrate how length measurements have scaled and how the original area has changed. Some students may choose to draw scaled copies and think about scaled areas this way.



Monitor for students who use these strategies to find the areas of copies with scale factors 5 and $\frac{3}{5}$:

- Scale the original base and height and then calculate the area of the new shape.
- Multiply the original area by the square of the scale factor.

Plan to have students present in this order, from more concrete to more abstract.

Standards

Building On	**6.G.A.1**
Addressing	**7.G.A.1**
Building Toward	**7.G.B.6**

Instructional Routines

- 5 Practices
- MLR8: Discussion Supports

Launch

Arrange students in groups of 2. Provide access to geometry toolkits.

Distribute slips showing the parallelogram to half of the groups and the triangle to the other groups. Give students 6–7 minutes to complete the first two questions with their partner. If desired, direct students to split up the drawings to save time. One person can draw the copies with scale factors 2 and $\frac{1}{2}$, while the other student draws the copies with scale factors 3 and $\frac{1}{3}$.

Give students 3–4 minutes to compare their answers with another group. Then, give students 3–4 minutes to complete the rest of the task with their partner, followed by whole-class discussion.

As students find the areas of copies with scale factors 5 and $\frac{3}{5}$, select students who used each strategy described in the activity narrative to share later. Aim to elicit both key mathematical ideas and a variety of student voices, especially from students who haven't shared recently.

Access for Students with Disabilities

Engagement: Develop Effort and Persistence. Connect a new concept to one with which students have experienced success. For example, draw students' attention to the warm-up and remind them how to build scaled copies of the rhombus with scale factors of 2, 3, and 4. Ask students how they can use this technique to draw scaled copies of the parallelogram or triangle with scale factors of 2, 3, and 5.
Supports accessibility for: Social-Emotional Functioning, Conceptual Processing

Student Task Statement

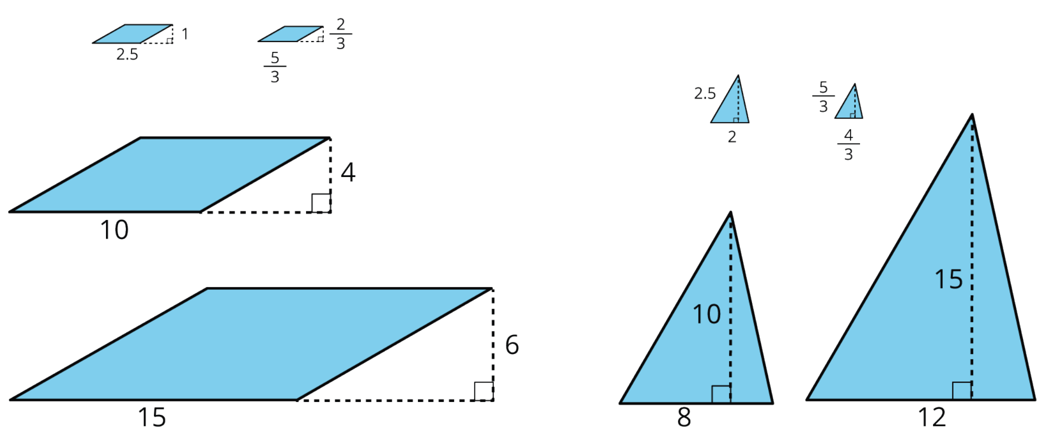
1. Your teacher will give you a figure with measurements in centimeters. What is the area of your figure? How do you know?
2. Work with your partner to draw scaled copies of your figure, using each scale factor in the table. Complete the table with the measurements of your scaled copies.

scale factor	base (cm)	height (cm)	area (cm^2)
1			
2			
3			
$\frac{1}{2}$			
$\frac{1}{3}$			

3. Compare your results with a group that worked with a different figure. What is the same about your answers? What is different?
4. If you drew scaled copies of your figure with the following scale factors, what would their areas be? Discuss your thinking. If you disagree, work to reach an agreement. Be prepared to explain your reasoning.

scale factor	area (cm^2)
5	
$\frac{3}{5}$	

Student Response

1. The area of either shape is 10 square units, because $5 \cdot 2 = 10$ and $\frac{1}{2} \cdot 4 \cdot 5 = 10$.
2. 

For the parallelogram:

scale factor	base	height	area
1	5	2	10
2	10	4	40
3	15	6	90
$\frac{1}{2}$	2.5	1	2.5
$\frac{1}{3}$	$\frac{5}{3}$	$\frac{2}{3}$	$\frac{10}{9}$

For the triangle:

scale factor	base	height	area
1	4	5	10
2	8	10	40
3	12	15	90
$\frac{1}{2}$	2	2.5	2.5
$\frac{1}{3}$	$\frac{4}{3}$	$\frac{5}{3}$	$\frac{10}{9}$

3. The areas are the same for each scale factor, even though the base and height measurements are different. Specifically, the bases of the parallelograms are equal to the heights of the triangles.

4.

scale factor	area
5	250
$\frac{3}{5}$	3.6

Building on Student Thinking

Students may not remember how to calculate the area of parallelograms and triangles. Make sure that they have the correct area of 10 square units for their original shape before they calculate the area of their scaled copies.

When drawing their scaled copies, some students might not focus on making corresponding angles equal. As long as they scale the base and height of their polygon correctly, this will not impact their area calculations. If time permits, however, prompt them to check their angles using tracing paper or a protractor.

Some students might focus unnecessarily on measuring other side lengths of their polygon, instead of attending only to base and height. If time is limited, encourage them to scale the base and height carefully and to check or measure the angles instead.

Activity Synthesis

The purpose of this discussion is to make clear that with scaled copies, the area changes by the square of the scale factor by which the sides change.

To establish that the areas of the scaled shapes are the same for both the parallelogram and the triangle, ask questions such as:

- “What did you notice when you compared your answers to the first part with another group that worked with the other figure?” (The areas for each scale factor were the same, even though the bases and heights were different.)
- “Why do you think that is?” (Because the areas of the original shapes were equal.)

Invite previously selected students to share how they determined the scaled areas for the scale factors 5 and $\frac{3}{5}$. Sequence the discussion of the strategies in the order listed in the *Activity Narrative*. If possible, record and display the students' work for all to see. To make it easier for students to compare the approaches, show both strategies for the same shape. If time permits, you can also show strategies for the other shape.

Connect the different responses to the learning goals by asking questions such as:

- “Did anyone solve the problem the same way, but would explain it differently?”
- “Why do the different approaches lead to the same outcome?”
- “How is the process for finding scaled area here the same as finding the number of pattern blocks in the previous activity? How is it different?” (The pattern of squaring the scale factor is the same. The area units are different.)

Highlight the connection between the two ways of finding scaled areas. Point out that when we multiply the base and height each by the scale factor and then multiply the results, we are essentially multiplying the original lengths by the scale factor two times. The effect of this process is the same as multiplying the original area by $(\text{scale factor})^2$.

Access for English Language Learners

MLR8 Discussion Supports. At the appropriate time, give groups 2–3 minutes to plan what they will say when they present to the class. “Practice what you will say when you share your strategies for calculating the areas of the copies with scale factors 5 and $\frac{3}{5}$ with the class. Talk about what is important to say, and decide who will speak.”

Advances: Speaking, Conversing, Representing

Lesson Synthesis

Share with students “Today we looked at how the area of a scaled copy compares to the area of the original figure.”

To review the relationship that area scales by the $(\text{scale factor})^2$, consider asking students:

- “If all the lengths in a scaled copy are twice as long as in the original shape, will the area of the scaled copy be twice as large? Why or why not?” (No, both the length and the width get multiplied by 2, so the area gets multiplied by 4.)
- “If the scale factor is 5, how many times larger will the scaled copy’s area be?” (25 times larger)

If desired, use this example to review these concepts: “A pentagon has an area of 10 square units.”

- “A scaled copy is created using a scale factor of 2. What is its area?” (40, because $10 \cdot 2^2 = 40$)
- “Another scaled copy is created using a scale factor of 5. What is its area?” (250, because $10 \cdot 5^2 = 250$)

6.4 Enlarged Areas

Cool-down

5 min

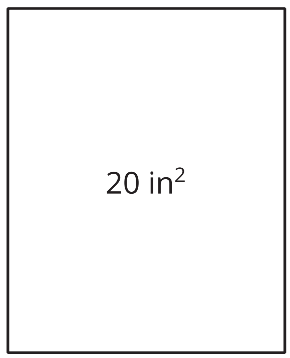
The first question gives students only the area of the original shape—but not the dimensions—to encourage them to find the area of the scaled copy by multiplying by the $(\text{scale factor})^2$; however, students can also choose a length and a width for the rectangle that would give the correct original area, and then scale those dimensions by the scale factor to calculate the area. Note that the second question asks students to find the $(\text{scale factor})^2$, but not to multiply by it.

Standards

Building On	**6.G.A.1**
Addressing	**7.G.A.1**
Building Toward	**7.G.B.6**

Student Task Statement

1. Lin has a drawing with an area of 20 in^2. If she increases all the sides by a scale factor of 4, what will the new area be?



2. Noah enlarged a photograph by a scale factor of 6. The area of the enlarged photo is how many times as large as the area of the original?

Student Response

1. 320 in^2, Sample responses:
    - $20 \cdot 4^2 = 320$
    - If the rectangle is 4 inches by 5 inches, the scaled copy will be $4 \cdot 4$ inches by $4 \cdot 5$ inches and $(4 \cdot 4) \cdot (4 \cdot 5) = 16 \cdot 20 = 320$.
    - If the rectangle is 2 inches by 10 inches, the scaled copy will be $4 \cdot 2$ inches by $4 \cdot 10$ inches and $(4 \cdot 2) \cdot (4 \cdot 10) = 8 \cdot 40 = 320$.
2. 36 times as large, because $6^2 = 36$.

Responding to Student Thinking

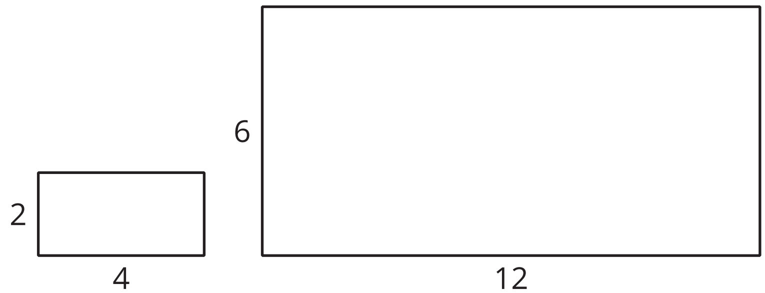
Points to Emphasize

If students struggle with finding the area of a scaled copy, revisit this when opportunities arise over the next several lessons. For example, in this activity, ask students to compare the area of the scale drawing to the area of the actual court:

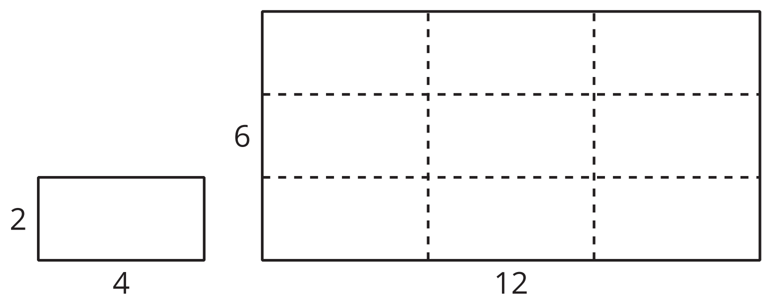
Grade 7, Unit 1, Lesson 7, Activity 2 Sizing Up a Basketball Court

Lesson 6 Summary

Scaling affects lengths and areas differently. When we make a scaled copy, all original lengths are multiplied by the scale factor. If we make a copy of a rectangle with side lengths 2 units and 4 units using a scale factor of 3, the side lengths of the copy will be 6 units and 12 units, because $2 \cdot 3 = 6$ and $4 \cdot 3 = 12$.



The area of the copy, however, changes by a factor of (scale factor)^2. If each side length of the copy is 3 times longer than the original side length, then the area of the copy will be 9 times the area of the original, because $3 \cdot 3$, or 3^2, equals 9.



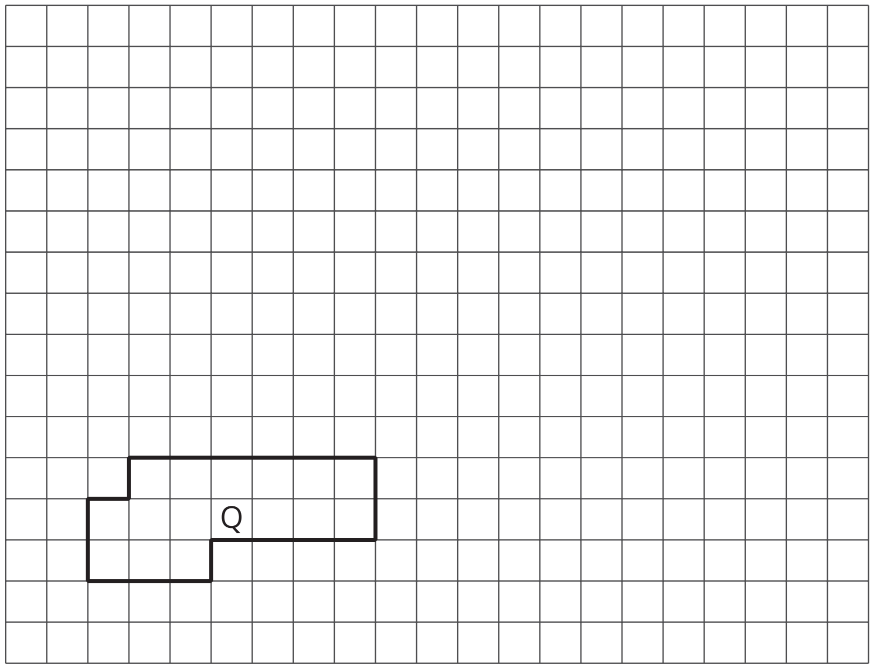
In this example, the area of the original rectangle is 8 units^2 and the area of the scaled copy is 72 units^2, because $9 \cdot 8 = 72$. We can see that the large rectangle is covered by 9 copies of the small rectangle, without gaps or overlaps. We can also verify this by multiplying the side lengths of the large rectangle: $6 \cdot 12 = 72$.

Lengths are one-dimensional, so in a scaled copy, they change by the scale factor. Area is two-dimensional, so it changes by the *square* of the scale factor. We can see this is true for a rectangle with length l and width w. If we scale the rectangle by a scale factor of s, we get a rectangle with length $s \cdot l$ and width $s \cdot w$. The area of the scaled rectangle is $A = (s \cdot l) \cdot (s \cdot w)$, so $A = (s^2) \cdot (l \cdot w)$. The fact that the area is multiplied by the square of the scale factor is true for scaled copies of other two-dimensional figures too, not just for rectangles.

Lesson 6 Practice Problems

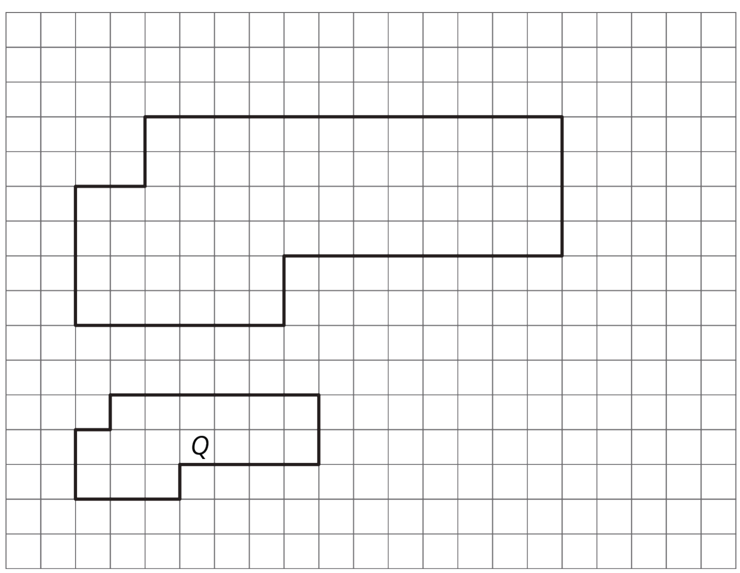
1 Student Task Statement

On the grid, draw a scaled copy of Polygon Q using a scale factor of 2. Compare the perimeter and area of the new polygon to those of Q.



Solution

The perimeter of Q is 20 units, and the area of Q is 16 square units. The perimeter of the scaled copy is 40 units, and its area is 64 square units. The perimeter is multiplied by the scale factor of 2, and the area is multiplied by the square of the scale factor, which is 4.



2 Student Task Statement

A right triangle has an area of 36 square units.

If you draw scaled copies of this triangle using the scale factors in the table, what will the areas of these scaled copies be? Explain or show your reasoning.

scale factor	area (units^2)
1	36
2	
3	
5	
$\frac{1}{2}$	
$\frac{2}{3}$	

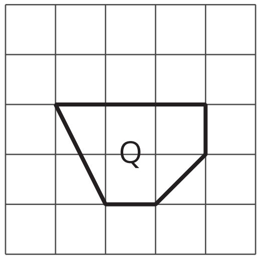
Solution

The area of each scaled triangle is the same as the area of the original triangle (36 square units) multiplied by the square of the scale factor:

scale factor	area (units^2)
1	36
2	144
3	324
5	900
$\frac{1}{2}$	9
$\frac{2}{3}$	16

3 Student Task Statement

Diego drew a scaled version of a Polygon P and labeled it Q.



If the area of Polygon P is 72 square units, what scale factor did Diego use to go from P to Q? Explain your reasoning.

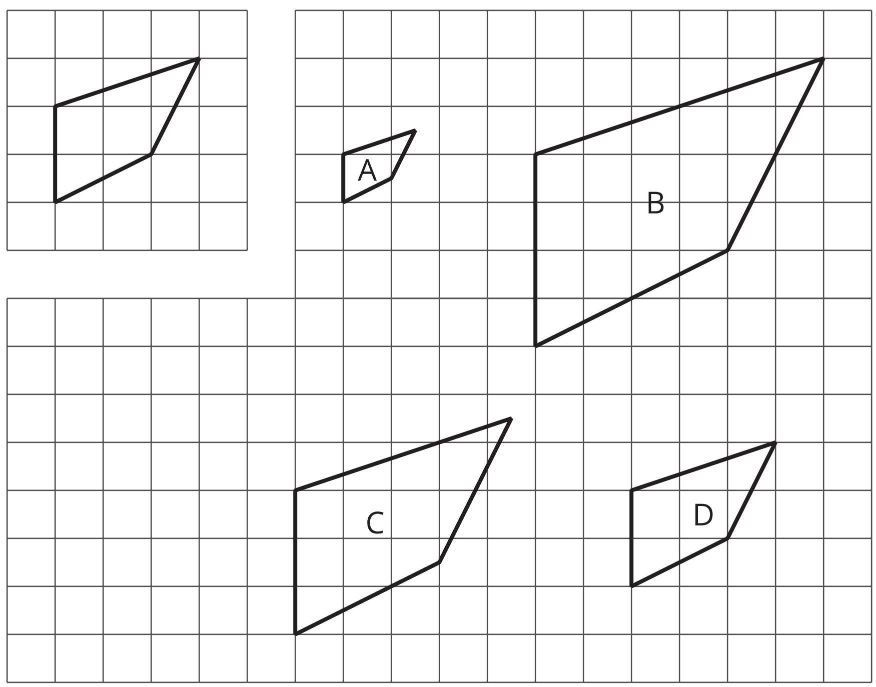
Solution

$\frac{1}{4}$. The area of Q is 4.5 square units (3 whole square units, one 2 unit by 1 unit right triangle, and one 1 unit by 1 unit right triangle). This area is $\frac{1}{16}$ of the area of P. This means the scale factor is $\frac{1}{4}$ because $\frac{1}{4} \cdot \frac{1}{4} = \frac{1}{16}$.

4 from Unit 1, Lesson 2

Student Task Statement

Here is an unlabeled polygon, along with its scaled copies Polygons A–D. For each copy, determine the scale factor. Explain how you know.



Solution

a. $\frac{1}{2}$ because the vertical side on the copy is $\frac{1}{2}$ the length of the vertical side on the original

b. 2 because the vertical side on the copy is twice the length of the vertical side on the original

c. $\frac{3}{2}$ because the vertical side on the copy is $\frac{3}{2}$ the length of the vertical side on the original

d. 1 because the original and the copy have the same size

5 from Unit 1, Lesson 5

Student Task Statement

Solve each equation mentally.

a. $\frac{1}{7} \cdot x = 1$

b. $x \cdot \frac{1}{11} = 1$

c. $1 \div \frac{1}{5} = x$

Solution

a. $x = 7$

b. $x = 11$

c. $x = 5$

