Unit 1, Lesson 3
Making Scaled Copies

Goals

- Critique (orally and in writing) different strategies (expressed in words and through other representations) for creating scaled copies of a figure.
- Draw a scaled copy of a given figure using a given scale factor.
- Generalize (orally and in writing) that the relationship between the side lengths of a figure and its scaled copy is multiplicative, not additive.

Required Materials

- Cool-down
- geometry toolkits

3.1 More or Less?

Warm-up: 5 minutes

Display problems for all to see. 2 minutes of quiet think time, followed by whole-class discussion.

Student-Facing Task Statement

For each problem, select the answer from the two choices.

1. The value of $25 \cdot (8.5)$ is:
    a. More than 205

Possible Responses

1. a. More than 205.
2. b. Less than 10.
3. b. Less than 0.2.

b. Less than 205

2. The value of $(9.93) \cdot (0.984)$ is:

   a. More than 10

   b. Less than 10

3. The value of $(0.24) \cdot (0.67)$ is:

   a. More than 0.2

   b. Less than 0.2

Anticipated Misconceptions

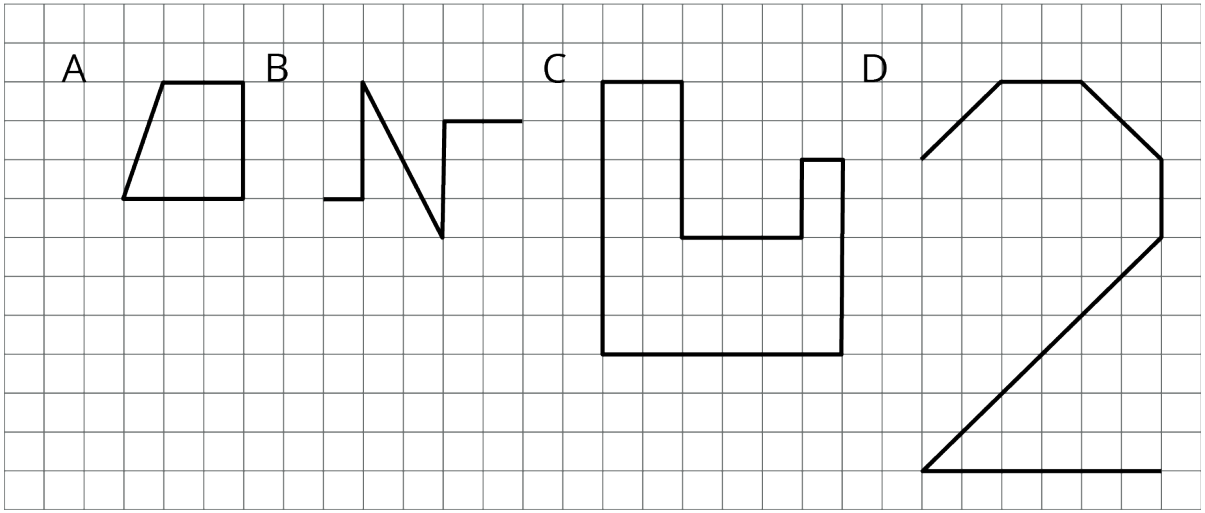
Students may attempt to solve each problem instead of reasoning about the numbers and operations. If a student is calculating an exact solution to each problem, ask them to look closely at the characteristics of the numbers and how an operation would affect those numbers.

3.2 Drawing Scaled Copies

Optional classroom activity: 10 minutes

3 minutes of quiet work time and 3 minutes to discuss drawings with a partner and revise. Access to geometry toolkits.

Student-Facing Task Statement



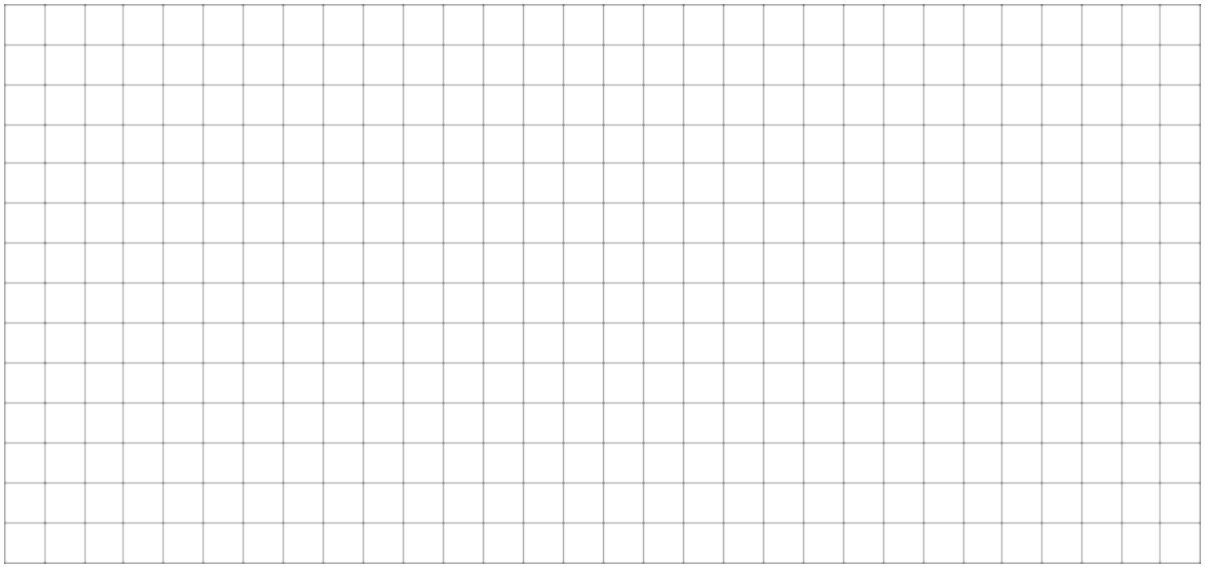
1. Draw a scaled copy of either Figure A or B using a scale factor of 3.
2. Draw a scaled copy of either Figure C or D using a scale factor of $\frac{1}{2}$.

Possible Responses

See lesson plan for drawings of scaled copies.

Anticipated Misconceptions

Some students may think that Figure C cannot be scaled by a factor of $\frac{1}{2}$ because some vertices will not land on intersections of grid lines. Clarify that the grid helps us see lengths in whole units but segments we draw on them are not limited to whole units in length.



3.3 Which Operations? (Part 1)

Classroom activity: 10 minutes

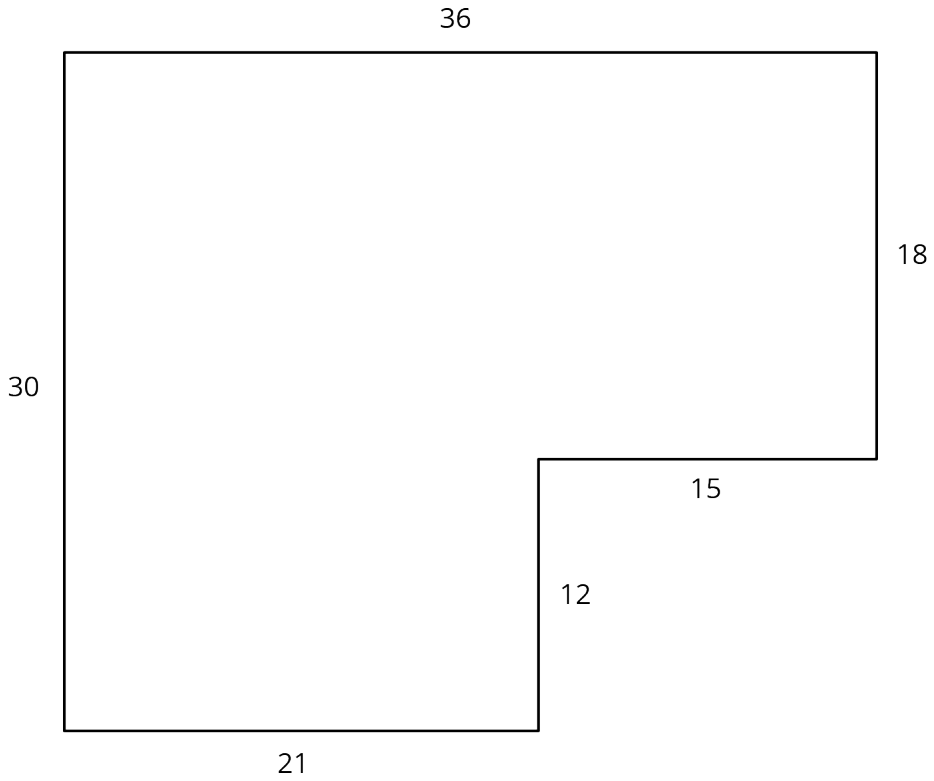
2–3 minutes of quiet think time, followed by a partner discussion.

Student-Facing Task Statement

Diego and Jada want to scale this polygon so the side that corresponds to 15 units in the original is 5 units in the scaled copy.

Possible Responses

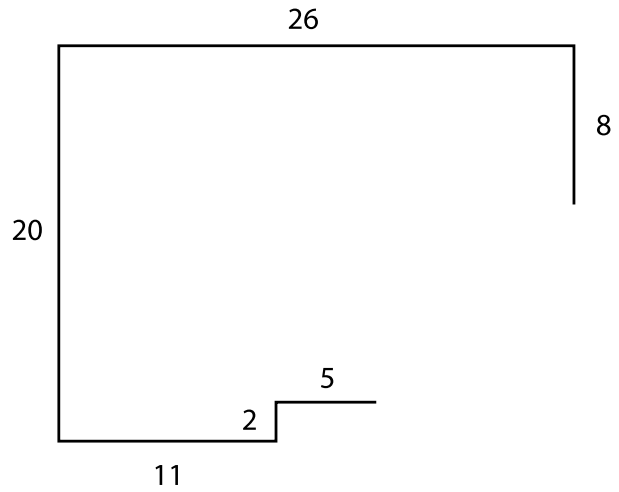
1. Diego subtracted 10 units from the length of every side.



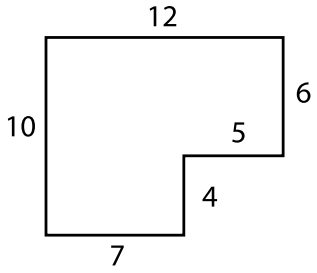
Diego and Jada each use a different operation to find the new side lengths. Here are their finished drawings.

2. Jada multiplied every side length by $\frac{1}{3}$.

3. No, only Jada's method produces a scaled copy.



Diego's Drawing



Jada's Drawing

1. What operation do you think Diego used to calculate the lengths for his drawing?
2. What operation do you think Jada used to calculate the lengths for her drawing?
3. Did each method produce a scaled copy of the polygon? Explain your reasoning.

3.4 Which Operations? (Part 2)

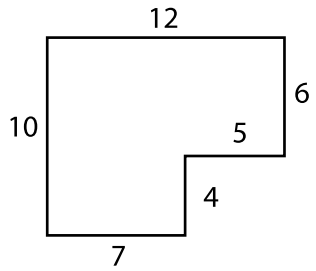
Classroom activity: 10 minutes

Make sure students understand task. 5–6 minutes of quiet work time, followed by partner and whole-class discussion. Access to index cards.

Student-Facing Task Statement

Andre wants to make a scaled copy of Jada's drawing so the side that corresponds to 4 units in Jada's polygon is 8 units in his scaled copy.

1. Andre says "I wonder if I should add 4 units to the lengths of all of the segments?" What would you say in response to Andre? Explain or show your reasoning.
2. Create the scaled copy that Andre wants. If you get stuck, consider using the edge of an index card or paper to measure the lengths needed to draw the copy.



Jada's Drawing

Possible Responses

1. Answers vary. Sample reasoning: No, adding 4 units to each segment either gives a figure that is not closed so is not a polygon, or changes the angles.
2. See lesson plan for the correctly drawn figure.

Anticipated Misconceptions

Some students might not be convinced that making each segment 4 units longer will not work. To show that adding 4 units would work, they might simply redraw the polygon and write side lengths that are 4 units longer, regardless of whether the numbers match the actual lengths. Urge them to check the side lengths by measuring. Tell them (or show, if needed) how the 4-unit length in Jada's drawing could be used as a measuring unit and added to all sides.

Other students might add 4 units to all sides and manage to make a polygon but changing the angles along the way. If students do so to make the case that the copy will not be scaled, consider sharing their illustrations with the class, as these can help to counter the idea that "scaling involves adding." If, however, students do this to show that adding 4 units all around does work, address the misconception. Ask them to recall the size of corresponding angles in scaled copies, or remind them that angles in a scaled copy are the same size as their counterparts in the original figure.

Are you ready for more?

The side lengths of Triangle B are all 5 more than the side lengths of Triangle A. Can Triangle B be a scaled copy of Triangle A? Explain your reasoning.

"Are you ready for more?" Student Response

Yes, if triangle A is equilateral then its side lengths are all the same. Adding 5 to each side, the lengths will still be the same and so triangle B will also be equilateral.

If triangle A is not equilateral then triangle B will not be a scaled copy of triangle A. To see why, notice that adding 5 to a side length of 5 doubles the side length. Adding 5 to a side length that greater than 5 changes the side by a scale factor less than 2 while adding 5 to a side length less than 5 changes the side length by a scale factor less than 2. So if one side length of triangle A is 5, all side lengths have to be 5 or else triangle B will not be a scaled copy of triangle A. This reasoning works for other side lengths than 5. In general, adding 5 to a *greater* side length uses a *smaller* scale factor.

Lesson Summary

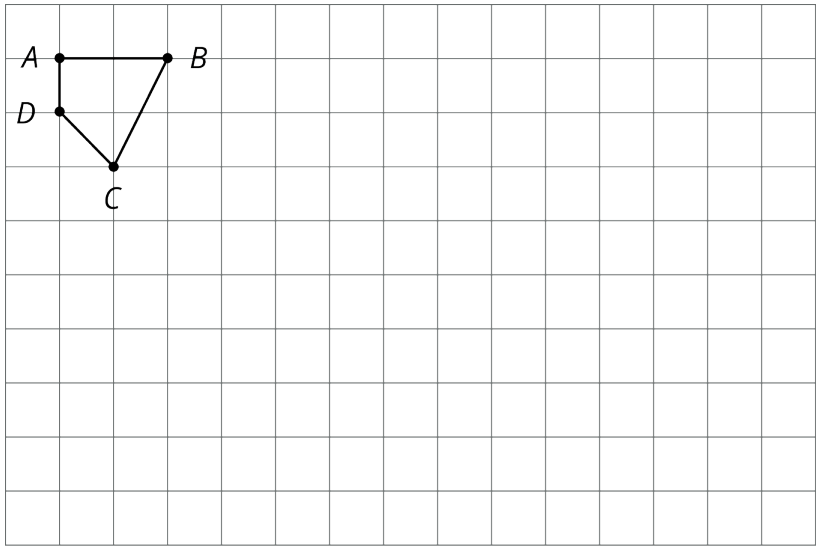
How do we draw a scaled copy of a figure? Can we create scaled copies by adding or subtracting the same value from all lengths? Why or why not?

3.5 More Scaled Copies

Cool-down: 5 minutes

Student-Facing Task Statement

1. Create a scaled copy of $ABCD$ using a scale factor of 4.

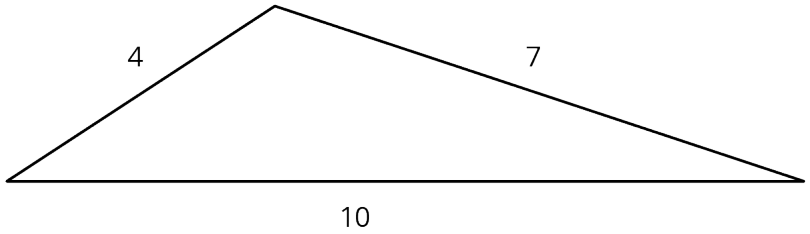


2. Triangle Z is a scaled copy of Triangle M.

Possible Responses

1. The horizontal side of the copy should be 8 units long and the vertical side 4 units. See lesson plan for drawing.
2. B, D, and E.

M



Select **all** the sets of values that could be the side lengths of Triangle Z.

A. 8, 11, and 14.

B. 10, 17.5, and 25.

C. 6, 9, and 11.

D. 6, 10.5, and 15.

E. 8, 14, and 20.