# Scale Drawing

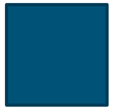
## AREA

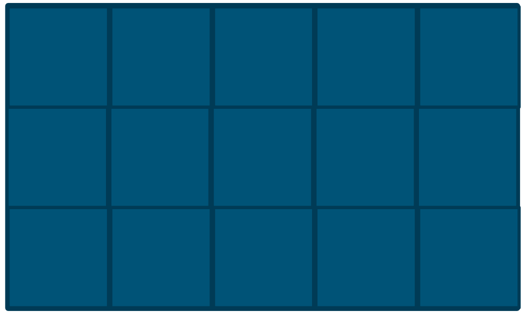
# Scale Drawing and Area: Lesson

Polygons are flat 2-Dimensional shapes, so we need to use a square to measure their area.

We are going to measure different polygons using a square centimeter.

- How many square centimeters fill the space of the rectangle to the right.
- Explain the process of finding the area of this rectangle using the words: square unit, centimeter, iterate and cover





# Scale Drawing and Area: Lesson

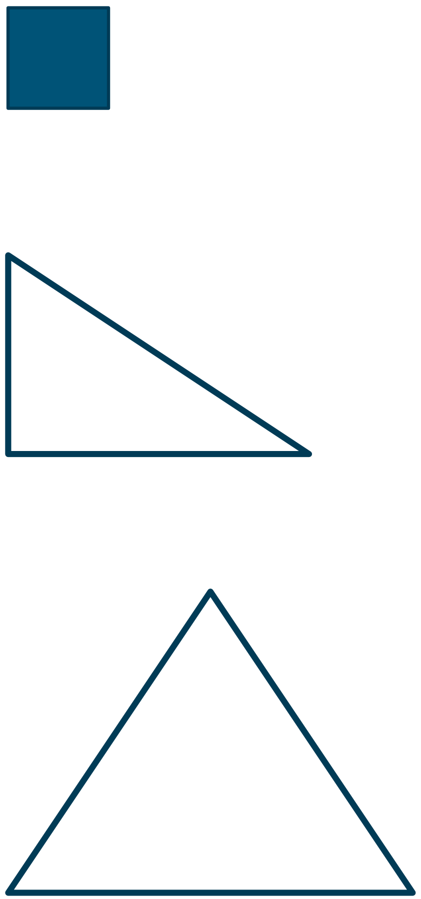
To measure the area of triangles, we can think of composing or decomposing the shapes to form rectangular figures.

To the right is a right triangle and an isosceles triangle.

Think about how you might use the ideas of composing or decomposing to form these triangles into rectangles.

Draw your idea for the right triangle. And explain what you did using the words **composing** or **decomposing**.

Draw your idea for the isosceles triangle. And explain what you did using the words **composing** or **decomposing**.



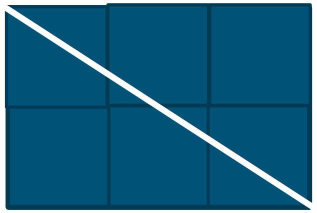
# Scale Drawing and Area: Lesson

Here is one method to construct a rectangle for the right triangle.
Check to see whether your way was similar or different.

First, I composed another right triangle that is congruent or the same as the first.

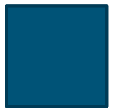
Then, I rotated this second right triangle $180°$.

And slid it up to form a rectangle.

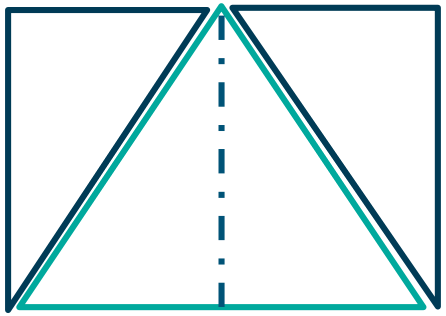


Finally, I covered the rectangle with six square centimeters and cut it in half to get the area of the triangle, which is 3 square centimeter units.

# Scale Drawing and Area: Lesson



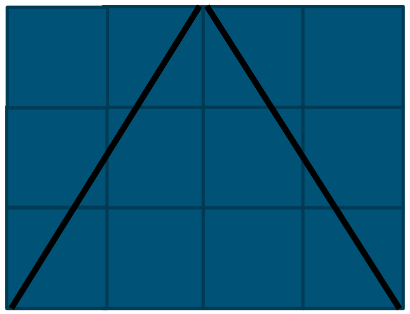
Here is a second, similar, method to construct a rectangle for the isosceles triangle. Check to see whether your way was similar or different.



First, I decomposed the isosceles triangle into two congruent right triangles.

Then, I rotated a copy of each of the right triangles $180°$ to form a larger rectangle composed from 2 of the original isosceles triangles.

Now, I can multiply the base and height of the rectangle and divide it in half to find the area of the original triangle.



It would look like this on graph paper. The area of the rectangle is 12 square units, so the area of the triangle is 6 square units.

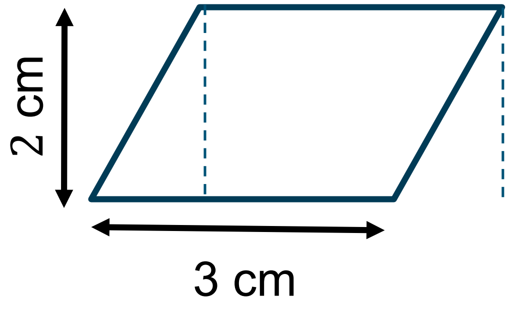
# Scale Drawing and Area: Lesson

We can also use composing and decomposing to find the area of a parallelogram.

Use the diagram below to determine why multiplying the base and the height of the parallelogram will allow us to find the area.

Where are the 6 square units?

$$3\ cm \cdot 2\ cm = 6\ cm^2$$




Note: Students may need to physically draw this shape and decompose on the first dotted line. Then we can slide the small triangle over to the second dotted line to form a rectangle with a base of 3cm and height of 2cm.

# Scale Drawing and Area: Triangles

1. Draw the original triangle with the given ratio of the Base : Height and then use the scale factor to draw the new triangle.
2. Determine the Base : Height ratio for the new figure and area for both figures.  Use the graph paper to help.
3. Use your completed work to answer the questions at the end.

# Worksheet 1.1 – Scale Drawing: Triangles

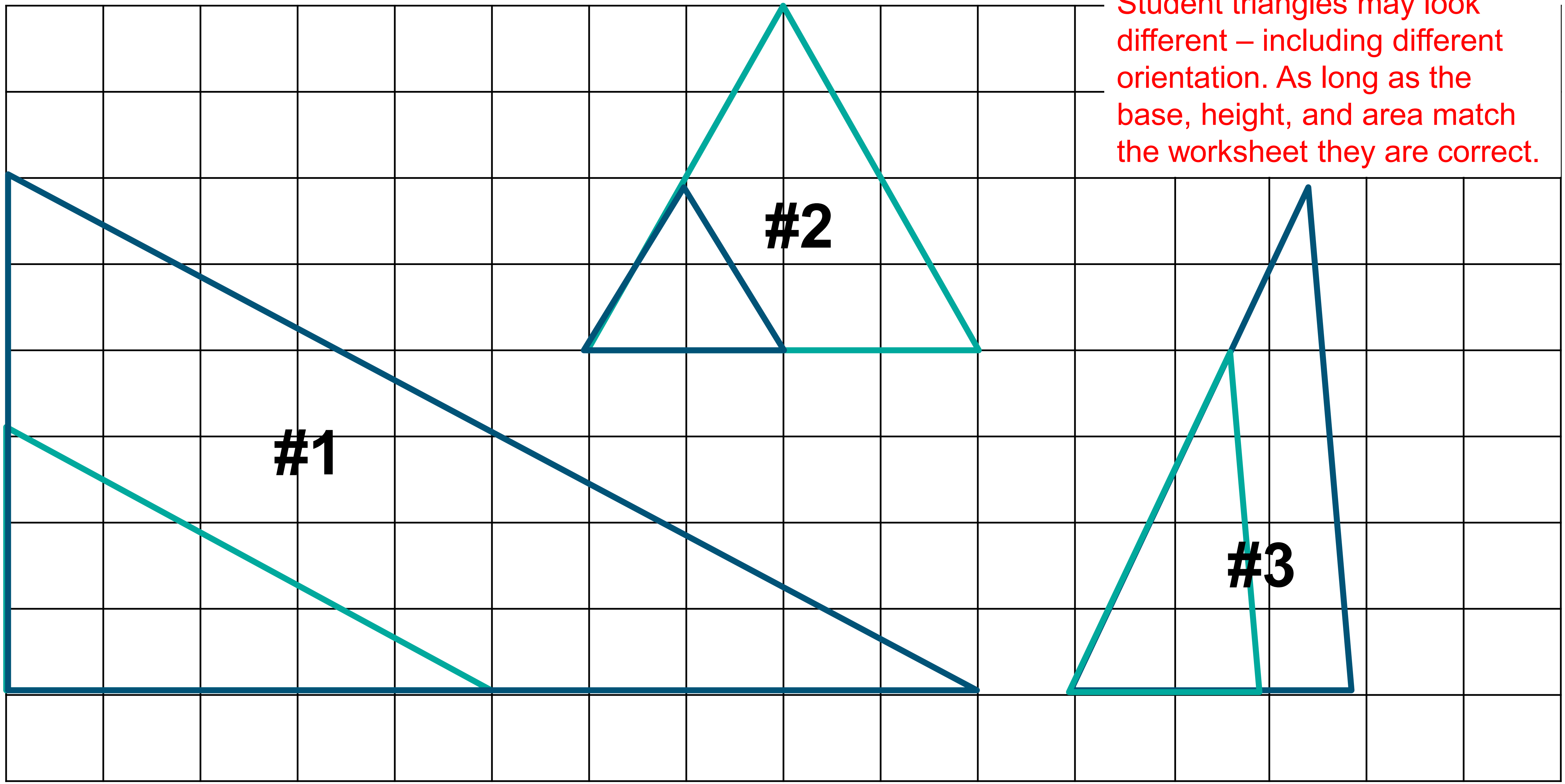
| | Original Figure | | New Figure | | |
|---|---|---|---|---|---|
| | **B : H** | **Area** | **Scale Factor** | **B : H** | **Area** |
| #1 | 3 : 5 | | x2 | | |
| #2 | 4 : 4 | | x$\frac{1}{2}$ | | |
| #3 | 2 : 4 | | x1$\frac{1}{2}$ | | |

# Worksheet 1.1 – Scale Drawing: Triangles

# Worksheet 1.1 – Scale Drawing: Triangles

**KEY**

Student triangles may look different – including different orientation. As long as the base, height, and area match the worksheet they are correct.



# Worksheet 1.1 – Scale Drawing: Triangles

KEY

| | Original Figure | | New Figure | | |
|---|---|---|---|---|---|
| | B : H | Area | Scale Factor | B : H | Area |
| #1 | 3 : 5 | $7\frac{1}{2}\ sq.units$ | x2 | 6 : 10 | $30\ sq.units$ |
| #2 | 4 : 4 | $8\ sq.units$ | x$\frac{1}{2}$ | 2 : 2 | $2\ sq.units$ |
| #3 | 2 : 4 | $4\ sq.units$ | x$1\frac{1}{2}$ | 3 : 6 | $9\ sq.units$ |

# Questions:

1. Can you draw the triangle a different way and still have the same area?
   - For example, if you drew a right triangle for the 3:5 scale ratio can you draw an isosceles and still have the same area?
2. What patterns can you find with the ratios and the area of each figure?
3. How can you use negative space to help find the area?

KEY

# Questions:

1. Can you draw the triangle a different way and still have the same area?

Yes, you can draw the triangle however you'd like and as long as it has the same base and height the area will be the same. This would we a fun idea for students to begin to explore on the graph paper. More formal ideas with this will come in later years, but this questions allows them to explore how and why the formula $\frac{1}{2}bh$ or $\frac{bh}{2}$ will work for the area of all triangles.

2. What patterns can you find with the ratios and the area of each figure?

This questions is to help students start to see the patterns that lead to the formula(s) for finding the area of the triangle. So we might probe them to look at the relationship between the values they found for base, height, and area and see if they can see how the area is half of the base and height multiplied together. Students may also start seeing the pattern between the area of the original figure and the new figure based upon the scale factor.

3. How can you use composing and decomposing to help find the area?

This question refers back to the ideas in the lesson where we can draw a rectangle around the triangle (or duplicate the triangle) which doubles the area. Then we can find the area of the rectangle and divide it in half to find the area of the triangle.

# Scale Drawing and Area: Parallelograms

1. Draw the original parallelogram with the given ratio of the Base : Height and then use the scale factor to draw the new parallelogram.
2. Determine the Base : Height ratio for the new figure and area for both figures. Use the graph paper to help.
3. Use your completed work to answer the questions at the end.

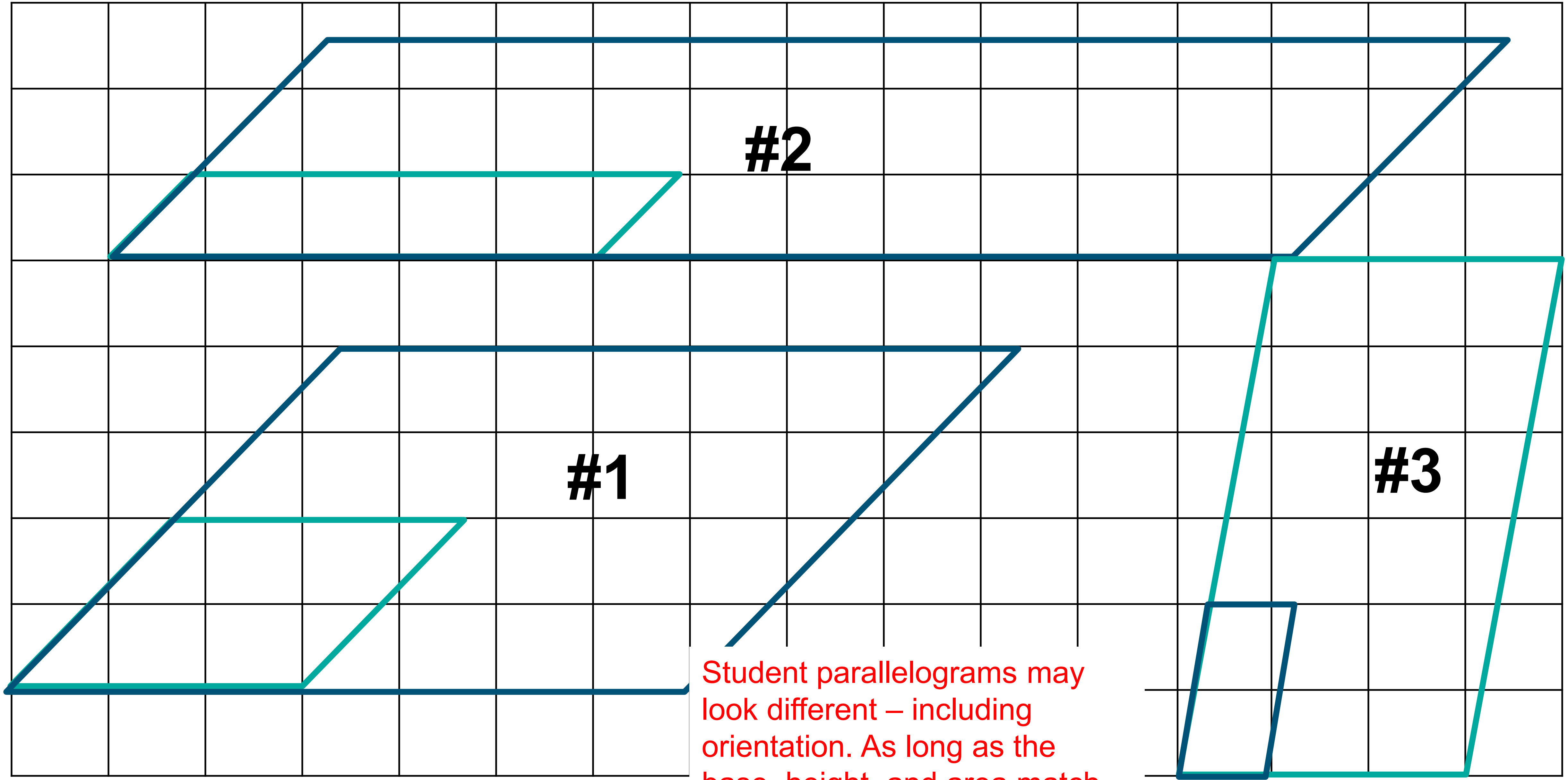
# Worksheet 1.2 – Scale Drawing: Parallelograms

| | Original Figure | | New Figure | | |
|---|---|---|---|---|---|
| | **B : H** | **Area** | **Scale Factor** | **B : H** | **Area** |
| #1 | 3 : 2 | | x2 | | |
| #2 | 5 : 1 | | x$2\frac{1}{2}$ | | |
| #3 | 3 : 6 | | x$\frac{1}{3}$ | | |

# Worksheet 1.2 – Scale Drawing: Parallelograms

# Worksheet 1.2 – Scale Drawing: Parallelograms

KEY




Student parallelograms may look different – including orientation. As long as the base, height, and area match the worksheet they are correct.

# Worksheet 1.2 – Scale Drawing: Parallelograms

**KEY**

| | Original Figure | | New Figure | | |
|---|---|---|---|---|---|
| | **B : H** | **Area** | **Scale Factor** | **B : H** | **Area** |
| #1 | 3 : 2 | $6\ sq.units$ | x2 | 6 : 4 | $24\ sq.units$ |
| #2 | 5 : 1 | $5\ sq.units$ | x$2\frac{1}{2}$ | $12\frac{1}{2}$ : $2\frac{1}{2}$ | $31\frac{1}{4}\ sq.units$ |
| #3 | 3 : 6 | $18\ sq.units$ | x$\frac{1}{3}$ | 1 : 2 | $2\ sq.units$ |

# Questions:

1. Can you draw the parallelogram a different way and still have the same area?
2. What patterns can you find with the ratios and the area of each figure?
3. How can you use decomposing and composing to help find the area?

KEY

# Questions:

1. Can you draw the parallelogram a different way and still have the same area?

   We may not see as much variation here as we did with triangles, but the parallelogram could change depending on the angles. The area stays the same but it might look different.

2. What patterns can you find with the ratios and the area of each figure?

   We are hoping students see that we can multiply the base and height of the parallelogram to find the area. Students may also start seeing the pattern between the area of the original figure and the new figure based upon the scale factor.

3. How can you use decomposing and composing to help find the area?

   This ties back to the ideas in the lesson where 'slice' off part of the parallelogram at a 90 degree angle which decomposes it into two parts. Then we can move the piece to the other side to compose a rectangle. This works with a parallelogram because the opposite angles will always be congruent due to the parallel lines.