COMPOSITION BOOK

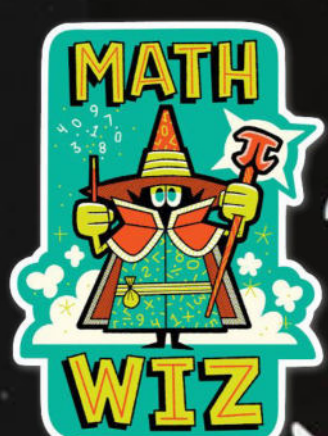
Ms. Forbes'

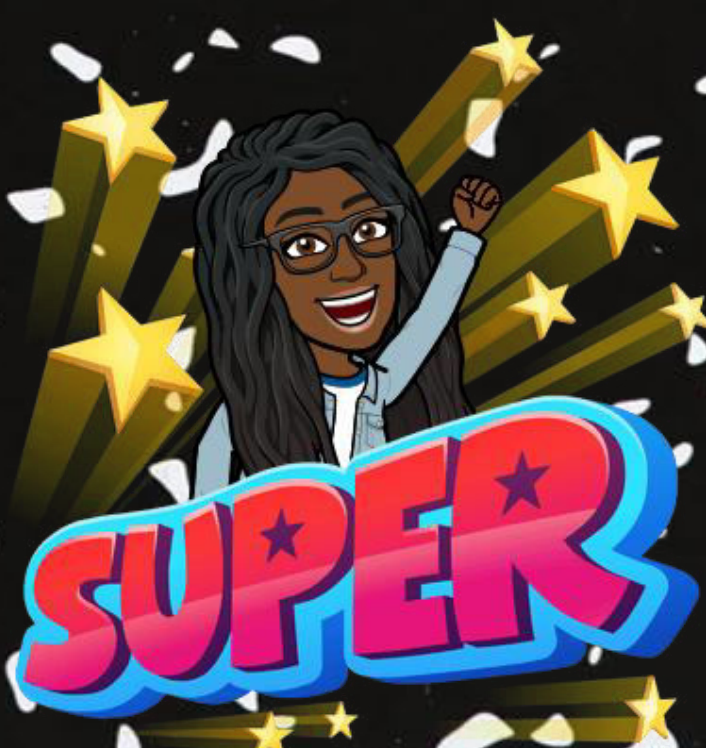
Math 7 Journal

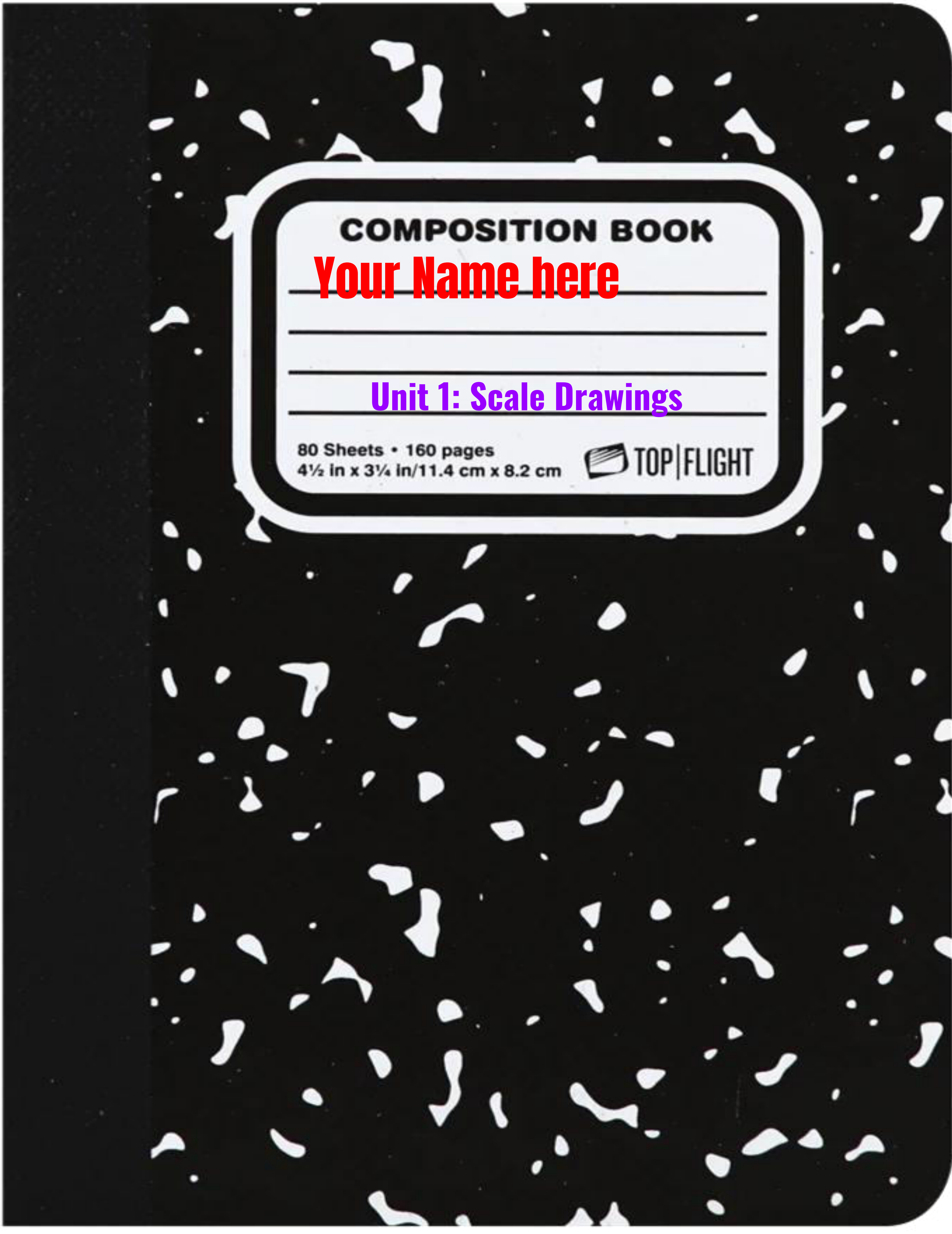
Unit 1: Scale Drawings

80 Sheets • 160 pages
4½ in x 3¼ in/11.4 cm x 8.2 cm

TOP|FLIGHT



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Your Name here
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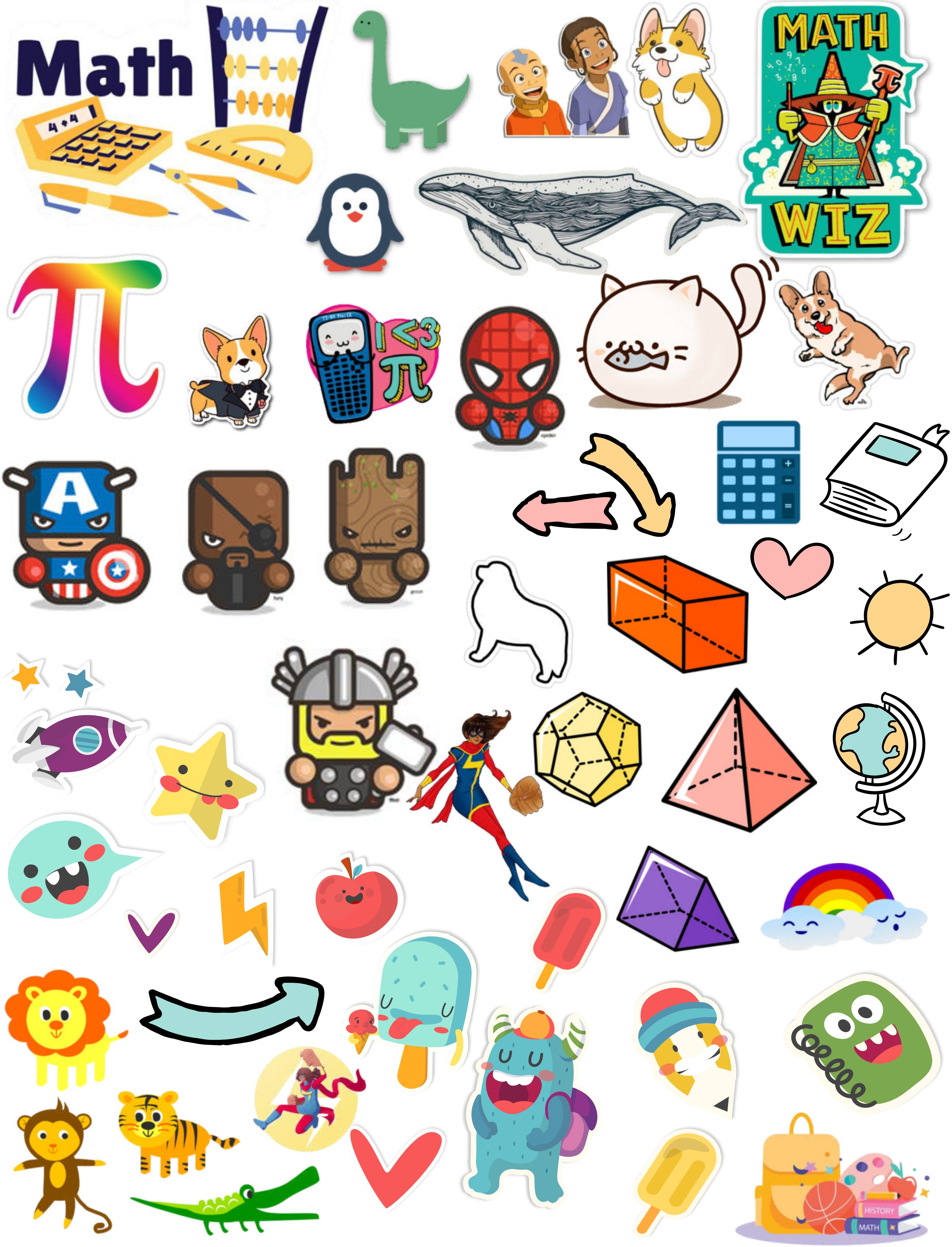
Math
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HISTORY
MATH


OK!
STRANGER THINGS
NOPE
COMPOSITION
OMG!
LOL!
STAR WARS

Table of Contents

Lesson 1

Lesson 1: What are Scaled Copies?

Part 1:
Click on the link here to see a portrait of a student. Move the slider under each image, A-E, to see it change.

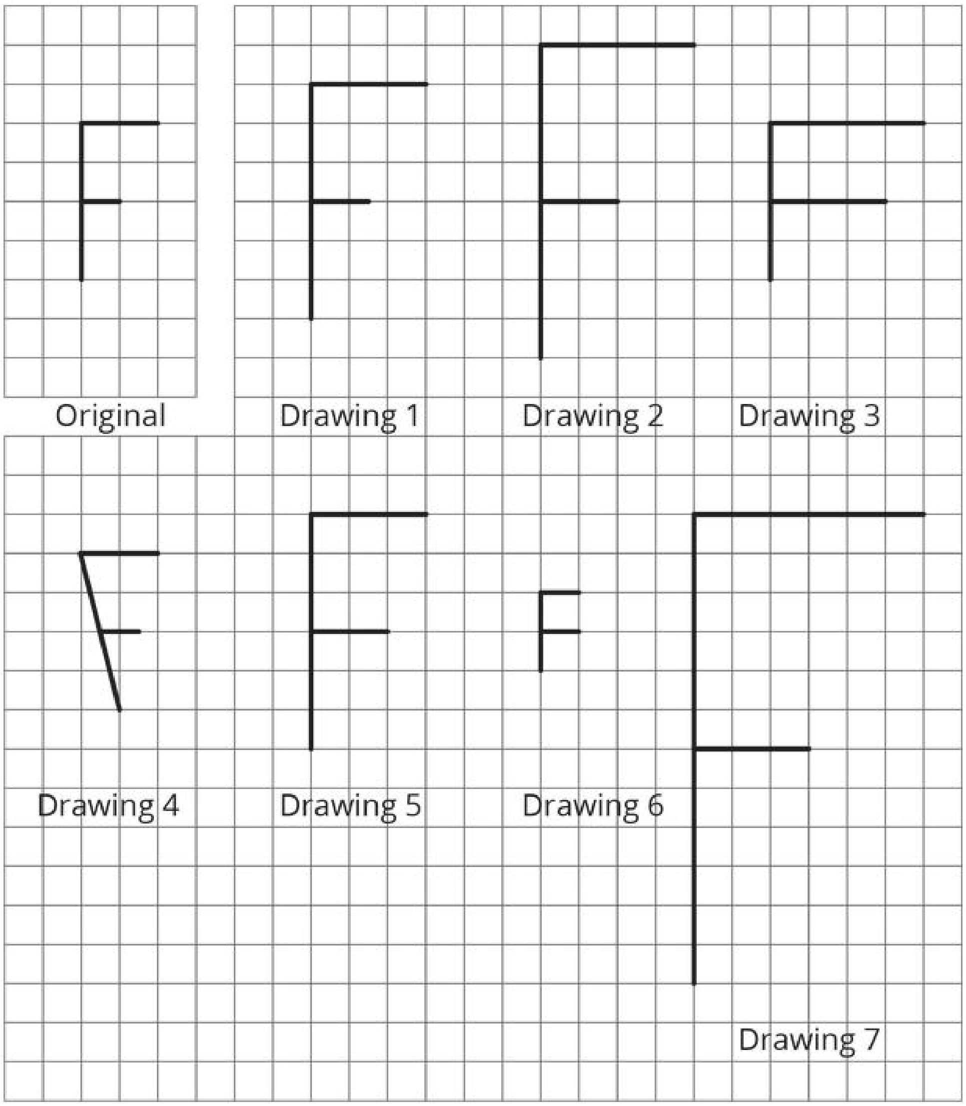
After using the app, how is ***each*** one the same as or different from the original portrait of the student?

Some of the sliders in the app make scaled copies of the original portrait. Which ones do you think are **scaled copies**? Explain your reasoning.

Based on the previous questions, what do you think “scaled copy” means?

Part 2:

On the top left is the original drawing of the letter F. There are also several other drawings.



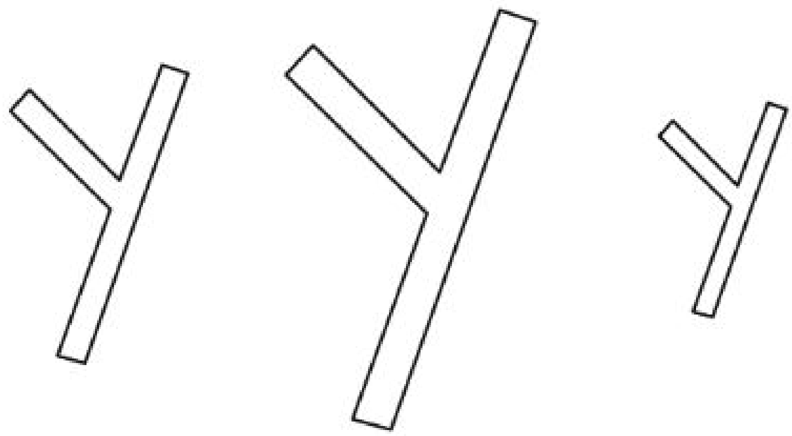
Identify **ALL** of the drawings that are scaled copies of the original letter F drawing. Explain how you know.

Examine all the scaled copies from the previous image more closely, specifically, the lengths of each part of the letter F. How do they compare to the original? What do you notice?

Lesson 1 Summary

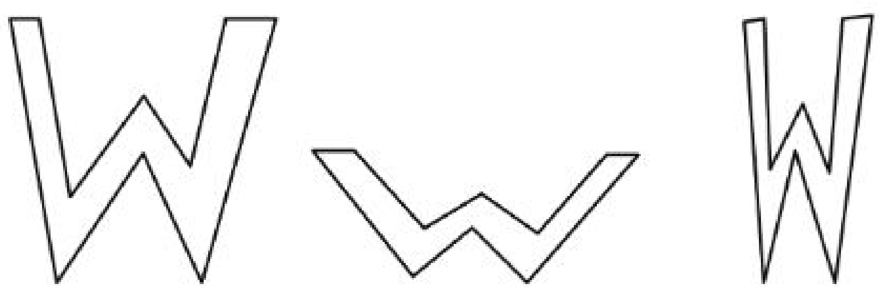
What is a **scaled copy** of a figure? Let's look at some examples.

The second and third drawings are both scaled copies of the original Y.



Original

However, here, the second and third drawings are *not* scaled copies of the original W.



Original

The second drawing is spread out (wider and shorter). The third drawing is squished in (narrower, but the same height).

We will learn more about what it means for one figure to be a scaled copy of another in upcoming lessons.

Lesson 2

Lesson 2: Corresponding Parts and Scale Factors

Corresponding Parts

One road sign for railroad crossings is a circle with a large X in the middle and two R's- with one on each side. Here is a picture with some points labeled and two copies of the picture. Use the applet to drag and turn the moveable angle tool to compare the angles in the copies with the angles in the original.

Complete the table to show corresponding parts in the three figures.

original	Copy 1	Copy 2
point P		
segment LM		
	segment EF	
		point W
angle KLM		
		angle XYZ

1. Is either copy a scaled copy of the original figure? Explain your reasoning.

1. Use the moveable angle tool to compare angle KLM with its corresponding angles in Copy 1 and Copy 2. What do you notice?

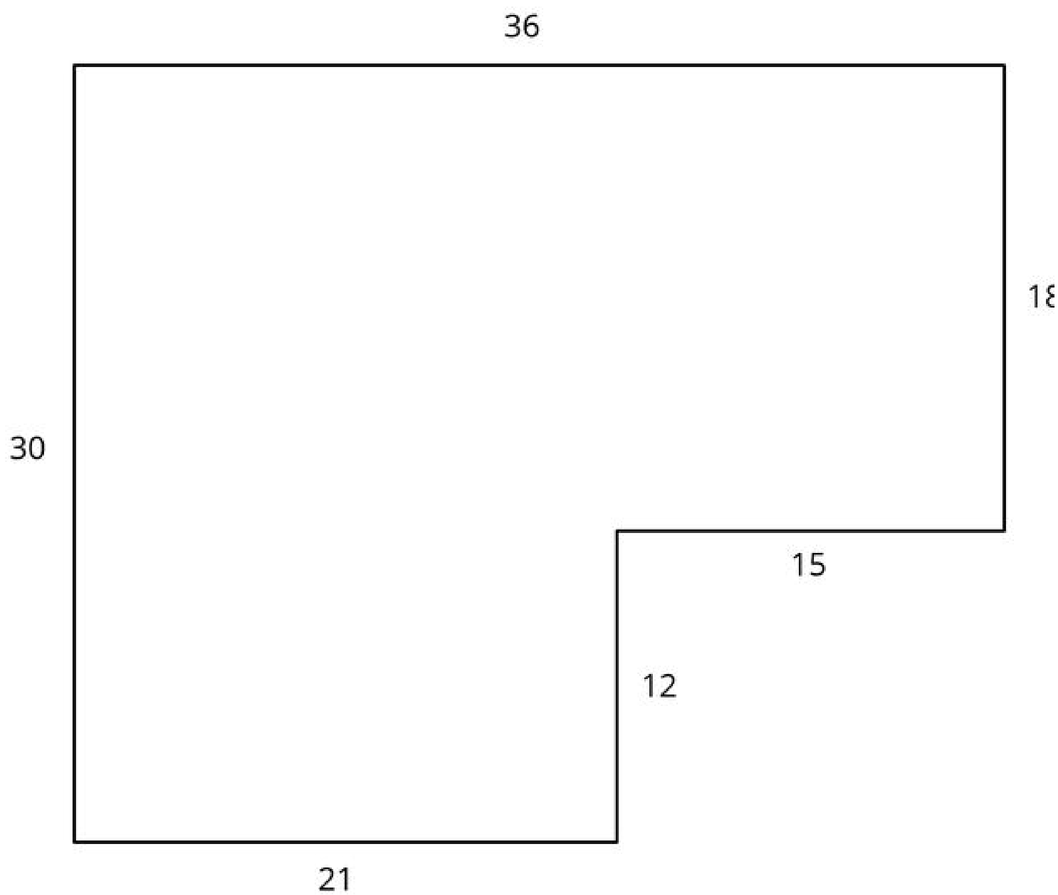
1. Use the moveable angle tool to compare angle NOP with its corresponding angles in Copy 1 and Copy 2. What do you noitce?

Lesson 3

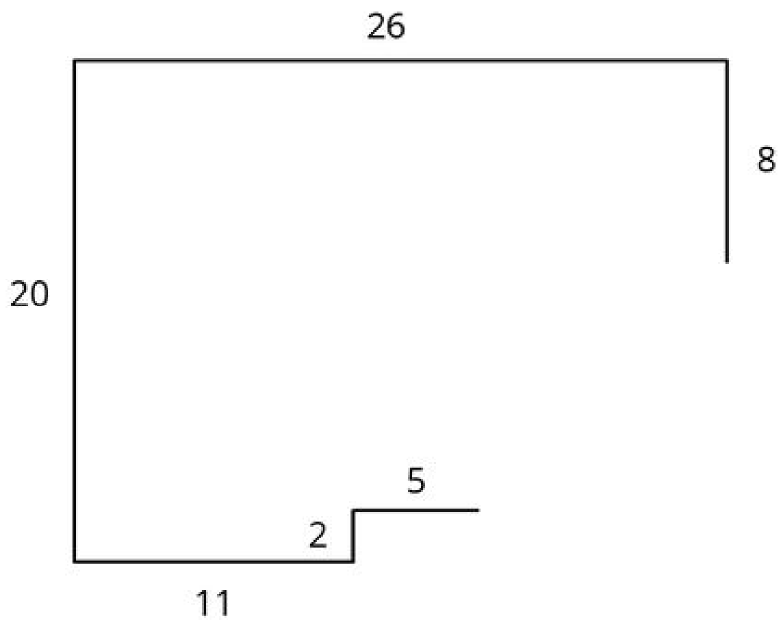
Lesson 3: Making Scaled Copies

Which Operations? (Part 1)

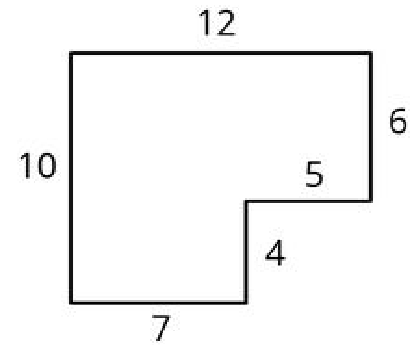
Diego and Jada want to scale this polygon so the side that corresponds to 15 units in the original is 5 units in the scaled copy.



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



Diego’s drawing



Jada’s drawing

1. What operation do you think Diego used to calculate the lengths for his drawing?

1. What operation do you think Jada used to calculate the lengths for her drawing?

1. Did each method produce a scaled copy of the polygon? Explain your reasoning.

Which Operations? (Part 2)

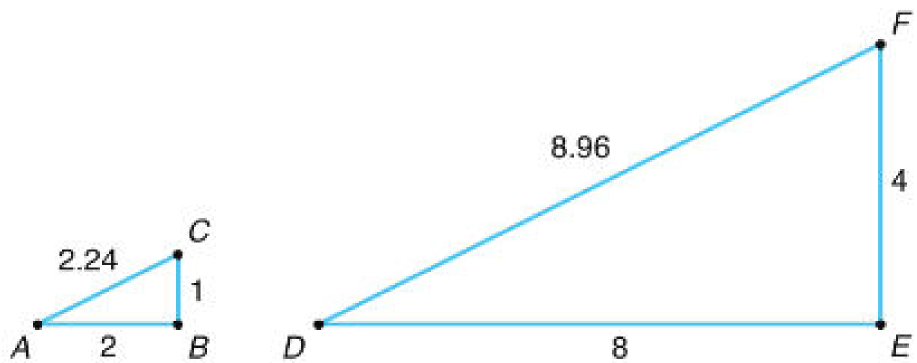
Andre wants to make a scaled copy of jada's drawing so the side that corresponds to 4 units in Jada's polygon is 8 units in his scaled copy.

1. Andre says "I wonder if I should add 4 units to the lengths of all the segments?"
   What would you say in response to Andre? Explain or show your reasoning by uploading a picture or video.

Lesson 3 Summary

Creating a scaled copy involves *multiplying* the lengths in the original figure by a scale factor.

For example, to make a scaled copy of triangle ABC where the base is 8 units, we would use a scale factor of 4. This means multiplying all the side lengths by 4, so in triangle DEF, each side is 4 times as long as the corresponding side in triangle ABC.

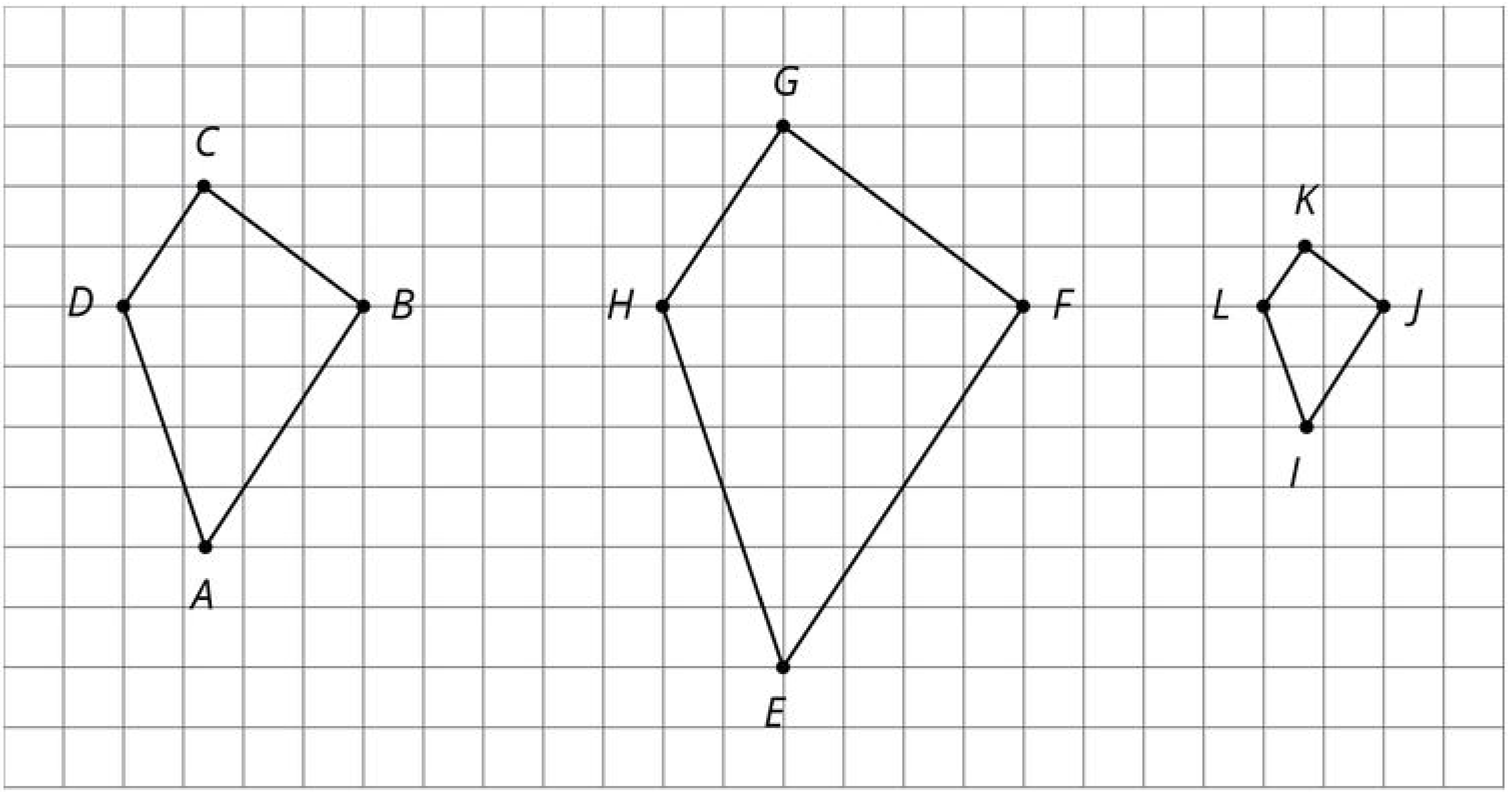


Lesson 4

Lesson 4: Scaled Relationships

Three Quadrilaterals (Part 1)

Each of these polygons is a scaled copy of the others



1. Name two pairs of corresponding angles. What can you say about the sizes of these angles?

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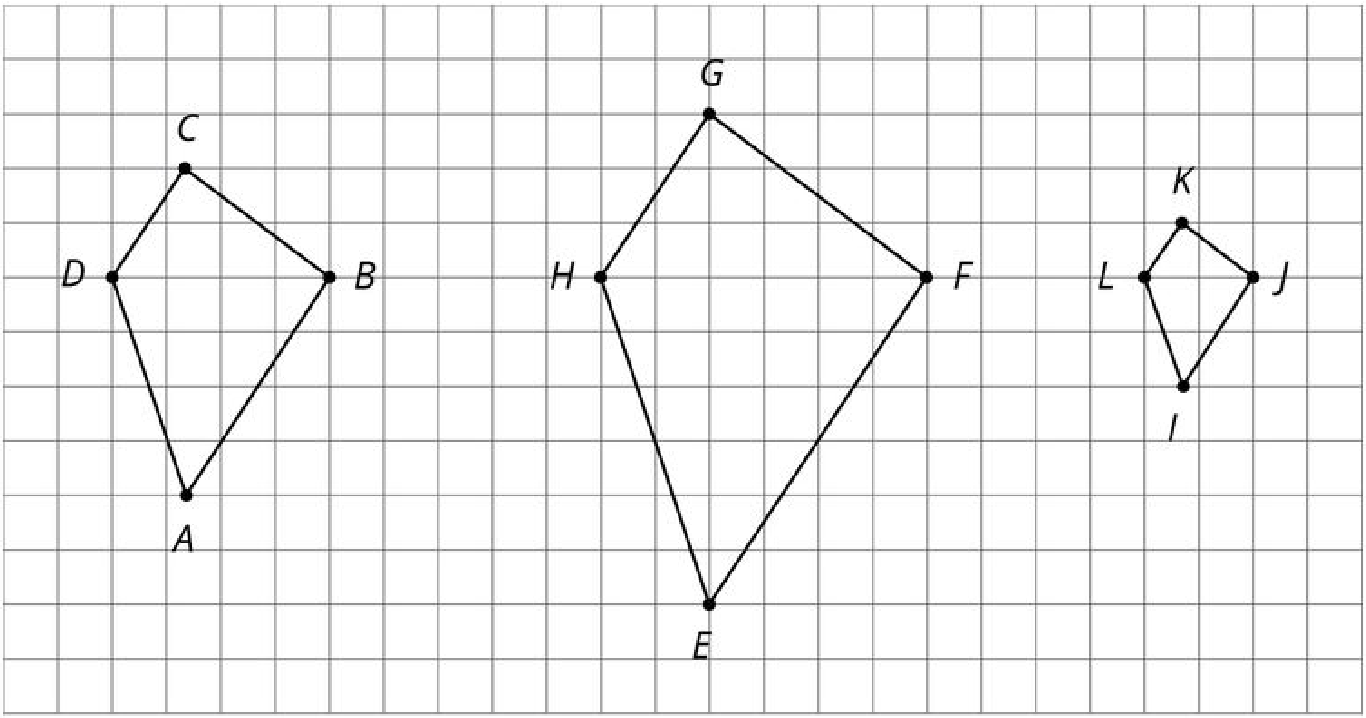
Three Quadrilaterals (Part 2)

Each of these polygons is a scaled copy of the others. You have already looked at some of their corresponding angles.



1. The side lengths of the polygon are hard to tell from the grid, but there are other corresponding distances that are easier to compare
   Identify the distances in the other two polygons that correspond to DB and AC, and record them in the table.

quadrilateral	distance that corresponds to DB	distance that corresponds to AC
$ABCD$	$DB = 4$	$AC = 6$
$EFGH$		
$IJKL$		

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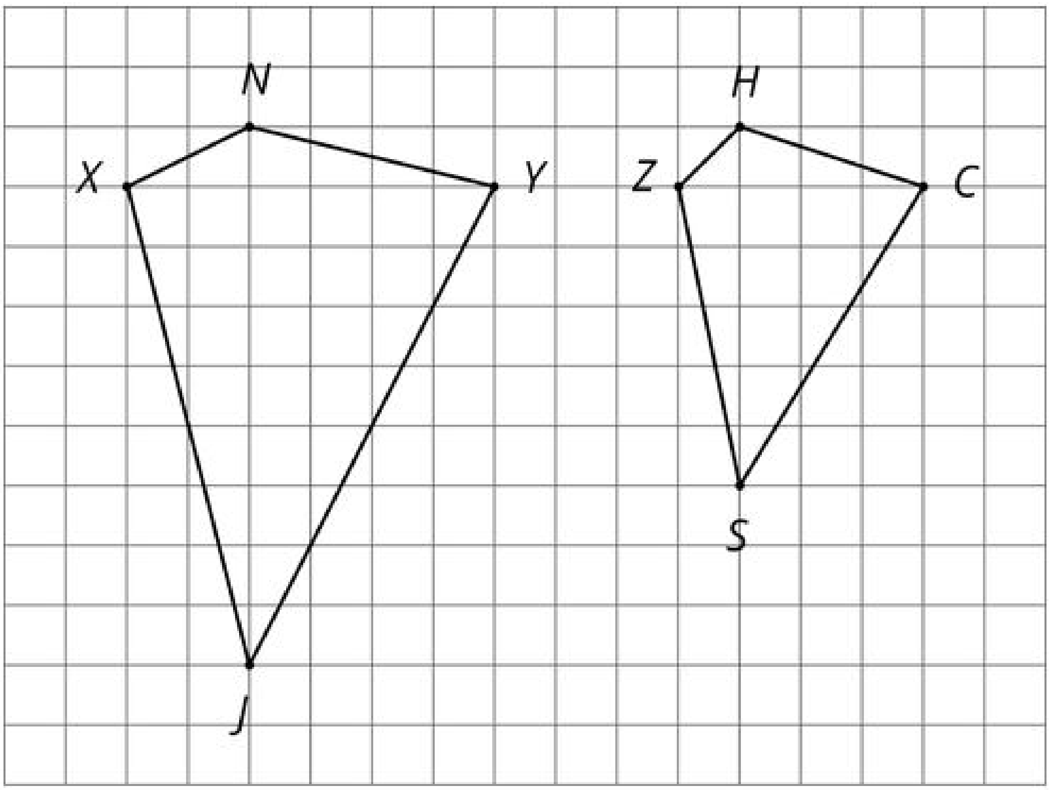
Three Quadrilaterals (Part 2)

2. Look at the values you put in the table. What do you notice?

Scaled or Not Scaled?

Here are two quadrilaterals.



1. Mai says that Polygon ZSCH is a scaled copy of Polygon XJYN, but Noah disagrees. Do you agree with either of them? Explain or show your reasoning.

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2. Record the corresponding distances in the table. What do you notice.

quadrilateral	horizontal distance		vertical distance	
$XJYN$	$XY =$		$JN =$	
$ZSCH$	$ZC =$		$SH =$	

3. Measure at least three pairs of corresponding angles in XJYN and ZSCH using a protractor. Record your measurements to the nearest 5. What do you notice?

4. Do these results change your answers to the first question? Explain.

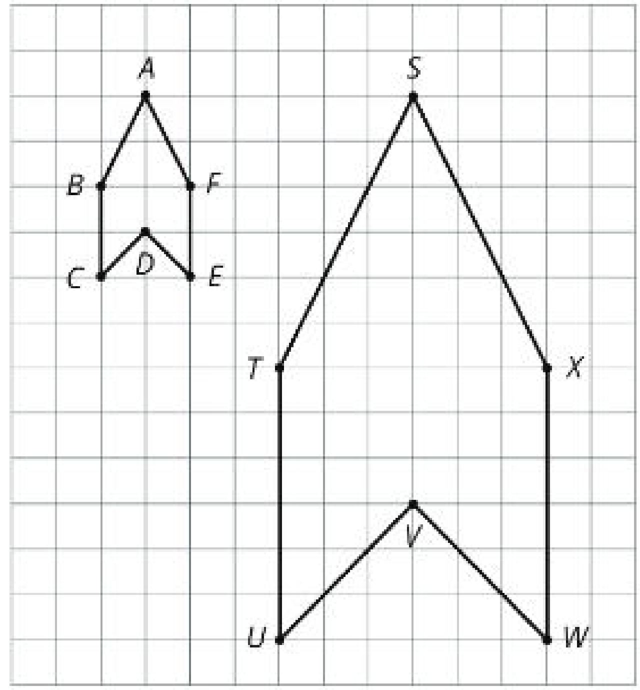
.

Lesson 4 Summary

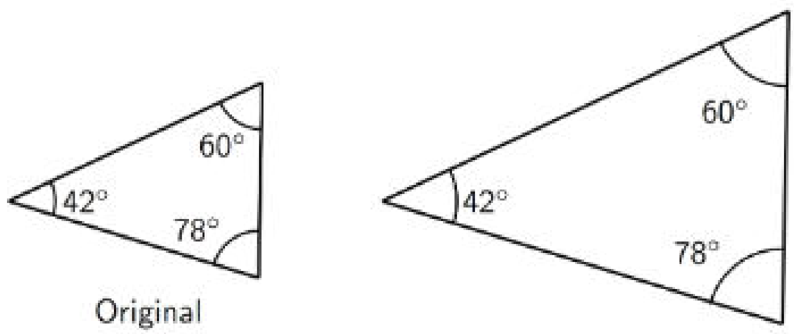
When a figure is a scaled copy of another figure, we know that:

1. All distances in the copy can be found by multiplying the *corresponding distances* in the original figure by the same scale factor, whether or not the endpoints are connected by a segment.

   For example, Polygon $STUVWX$ is a scaled copy of Polygon $ABCDEF$. The scale factor is 3. The distance from T to X is 6, which is three times the distance from B to F.



2. All angles in the copy have the same measure as the corresponding angles in the original figure, as in these triangles.



Original

These observations can help explain why one figure is *not* a scaled copy of another.

For example, even though their corresponding angles have the same measure, the second rectangle is not a scaled copy of the first rectangle, because different pairs of corresponding lengths have different scale factors, $2 \cdot \frac{1}{2} = 1$ but $3 \cdot \frac{2}{3} = 2$.

Lesson 5

Lesson 5: The Size of the Scale Factor

Scaled Copies Sort

Each set of cards has Figure A (original) and Figure B (scaled copy).

1. Sort the cards based on their scale factors. Explain how you sorted the cards and why you chose to sort that way.

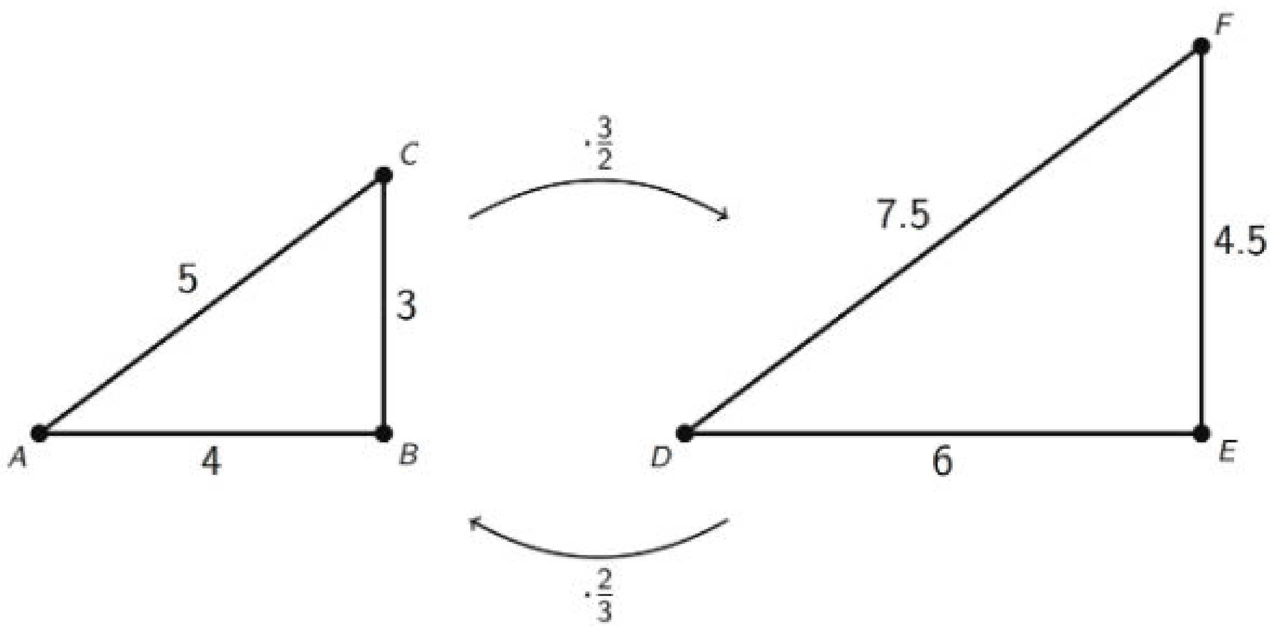
1. Examine cards 10 and 12 more closely. What do you notice about the shapes and sizes of the figures? What do you notice about the scale factors?

1. Examine cards 8 and 12 more closely. What do you notice about the figures? What do you notice about the scale factors?

Lesson 5 Summary

The size of the scale factor affects the size of the copy. When a figure is scaled by a scale factor greater than 1, the copy is larger than the original. When the scale factor is less than 1, the copy is smaller. When the scale factor is exactly 1, the copy is the same size as the original.

Triangle DEF is a larger scaled copy of triangle ABC, because the scale factor from ABC to DEF is $\frac{3}{2}$. Triangle ABC is a smaller scaled copy of triangle DEF, because the scale factor from DEF to ABC is $\frac{2}{3}$.



This means that triangles ABC and DEF are scaled copies of each other. It also shows that scaling can be reversed using reciprocal scale factors, such as $\frac{2}{3}$ and $\frac{3}{2}$.

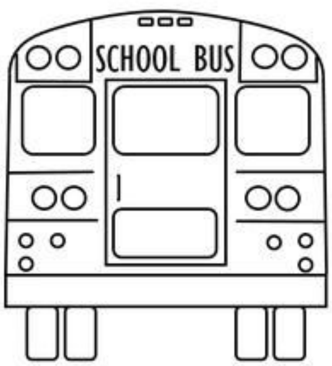
In other words, if we scale Figure A using a scale factor of 4 to create Figure B, we can scale Figure B using the reciprocal scale factor, $\frac{1}{4}$, to create Figure A.

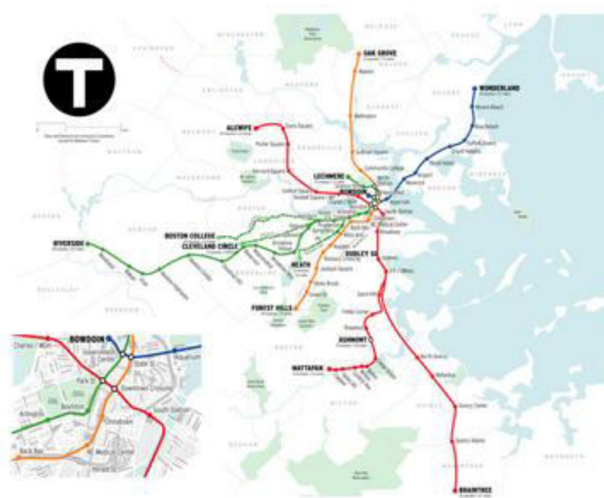
Lesson 7

Lesson 7: Scale Drawings

What is a Scale Drawing?

Here are some drawings of a school bus, a quarter and the subway lines around Boston, Massachusetts. The first three drawing are scale drawings of these objects.





The next three drawings are not scale drawings of these objects.

Based off this, what is a scale drawing?

Sizing Up a Basketball Court

This link will take you to a copy of the scale drawing of a basketball court. Be careful to not resize the ruler. There are no labeled measurements but 1 centimeter represents 2 meters.

1. Measure the distances on the scale drawing that are labeled a - d to the nearest tenth of a centimeter. Record your results in the first row of the table (next slide)
2. The statement “1 cm represents 2m” is the scale of the drawing. It can also be expressed as “1 cm to 2m,” or “1 cm for every 2m.” What you think the scale tells us?

1. How long would each measurement from the first question be on an actual basketball court? Explain or show your reasoning.

1. On an actual basketball court, the bench area is typically 9 meters long.
   Without measuring, determine how long the bench area should be on the scale drawing.

   Now, measure the bench area on the scale drawing. Did your prediction match your measurement?

Sizing Up a Basketball Court

	(a) length of court	(b) width of court	(c) hoop to hoop	(d) 3 point line to sideline
scale drawing				
actual court				

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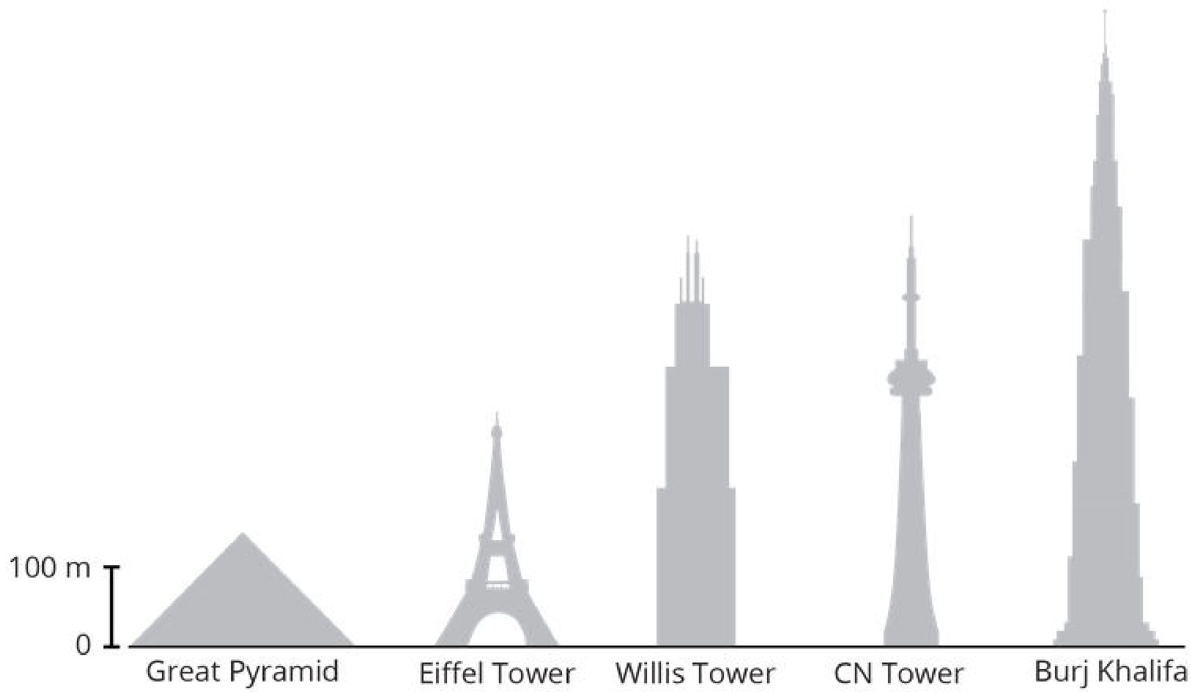
Tall Structures

Here is a scale drawing of some of the world's tallest structures.
Click here to explore the structures.



1. About how tall is the actual Willis Tower? About how tall is the actual Great Pyramid?

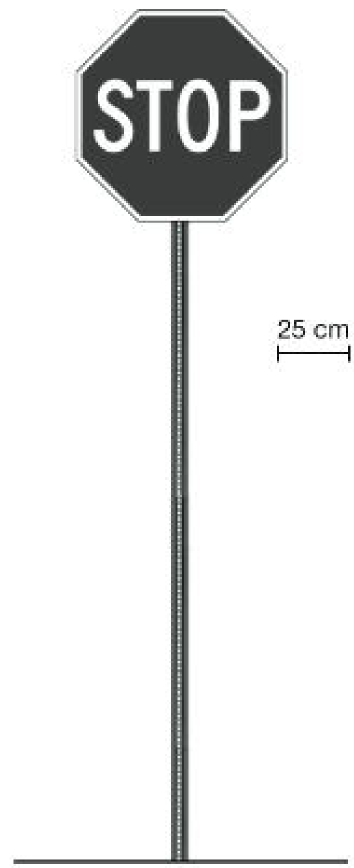
1. About how much taller is the Burj Khalifa than the Eiffel Tower? Explain your reasoning.

Lesson 7 Summary

Scale drawings are two-dimensional representations of actual objects or places. Floor plans and maps are some examples of scale drawings. On a scale drawing:

- Every part corresponds to something in the actual object.
- Lengths on the drawing are enlarged or reduced by the same scale factor.
- A **scale** tells us how actual measurements are represented on the drawing. For example, if a map has a scale of "1 inch to 5 miles" then a $\frac{1}{2}$-inch line segment on that map would represent an actual distance of 2.5 miles

Sometimes the scale is shown as a segment on the drawing itself. For example, here is a scale drawing of a stop sign with a line segment that represents 25 cm of actual length.



The width of the octagon in the drawing is about three times the length of this segment, so the actual width of the sign is about $3 \cdot 25$, or 75 cm.

Because a scale drawing is two-dimensional, some aspects of the three-dimensional object are not represented. For example, this scale drawing does not show the thickness of the stop sign.

A scale drawing may not show every detail of the actual object; however, the features that are shown correspond to the actual object and follow the specified scale.

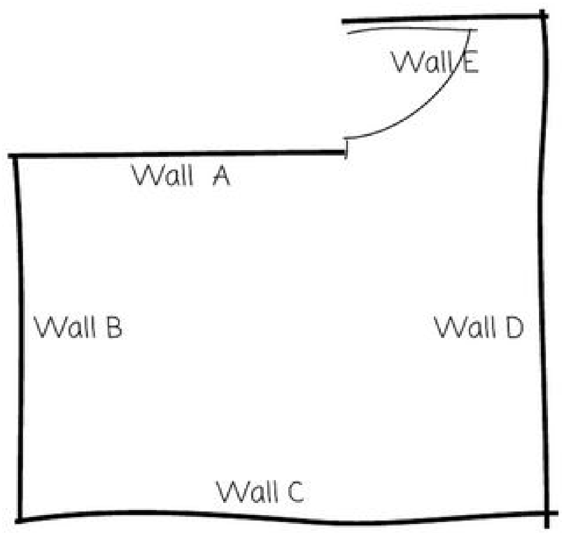
Lesson 9

Lesson 9: Creating Scale Drawings

Bedroom Floor Plan

A floor plan is a top-view drawing that shows a layout of a room or a building.
Floor plans are usually scale drawings.
Sometimes the scale isn't noted, but we can find it if we know the scaled and actual lengths.

Below is a rough sketch of Noah's bedroom (not a scale drawing).



1. Noah wants to create a floor plan that is a scaled drawing. The actual length of Wall C is 4 m. Noah draws a segment 16cm long to represent Wall C. What scale is he using? Explain or show your reasoning.

2. Find another way to express the scale.

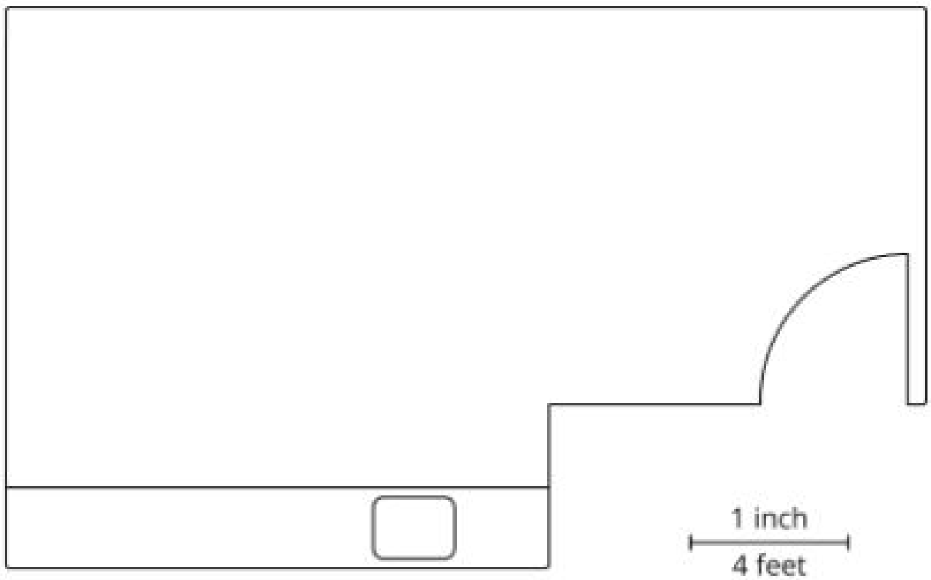
3. How do your scales compare?

4. The actual lengths of Wall A, Wall B, and Wall D are 2.5 m, 2,75 m, and 3.75 m. Determine how long these walls will be on Noah's floor plan.

You can use this applet to explore and create a scale of Noah's bedroom.

Lesson 9 Summary

If we want to create a scale drawing of a room's floor plan that has the scale “1 inch to 4 feet,” we can divide the actual lengths in the room (in feet) by 4 to find the corresponding lengths (in inches) for our drawing.



Suppose the longest wall is 15 feet long. We should draw a line 3.75 inches long to represent this wall, because $15 \div 4 = 3.75$.

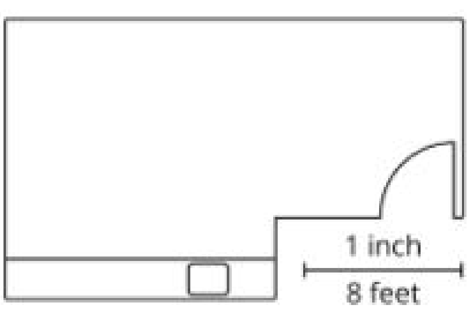
There is more than one way to express this scale.

These three scales are all equivalent, since they represent the same relationship between lengths on a drawing and actual lengths:

- 1 inch to 4 feet
- $\frac{1}{2}$ inch to 2 feet
- $\frac{1}{4}$ inch to 1 foot

Any of these scales can be used to find actual lengths and scaled lengths (lengths on a drawing). For instance, we can tell that, at this scale, an 8-foot long wall should be 2 inches long on the drawing because $\frac{1}{4} \cdot 8 = 2$.

The size of a scale drawing is influenced by the choice of scale. For example, here is another scale drawing of the same room using the scale 1 inch to 8 feet.



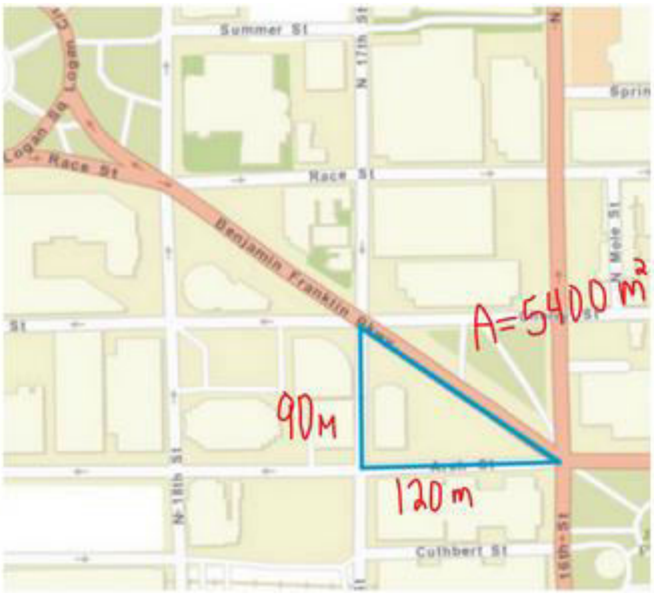
Notice this drawing is smaller than the previous one. Since one inch on this drawing represents twice as much actual distance, each side length only needs to be half as long as it was in the first scale drawing.

Lesson 10

Lesson 10: Changing Scales in Scale Drawings

Same Plot, Different Drawings.

Here is a map showing a plot of land in the shape of a right triangle.



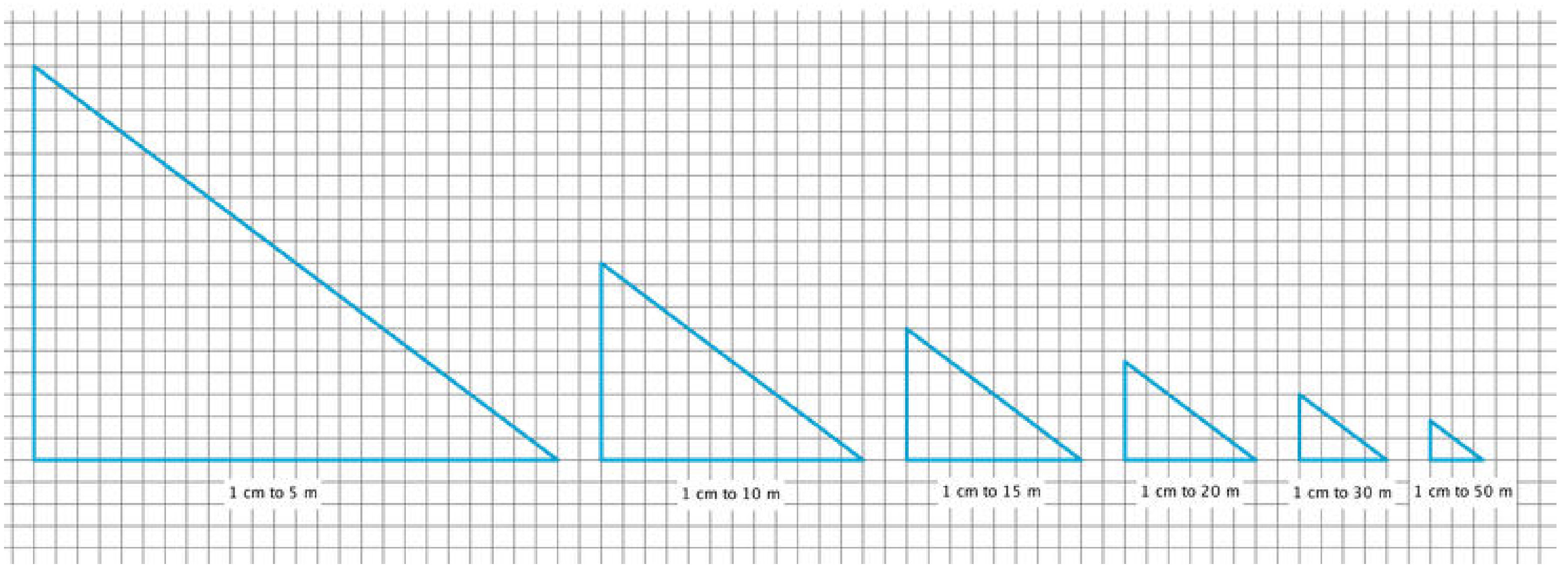
On the centimeter graph paper, you will make a scale drawing of the plot of land. Make sure to write your scale on the drawing.

You can choose two (2) scales from the following scales.

- 1 cm to 5 m
- 1 cm to 10 m
- 1 cm to 15 m
- 1 cm to 20 m
- 1 cm to 30 m
- 1 cm to 50 m

2. What is the area of the triangle you drew? Explain or show your reasoning.

3. How many square meters are represented by 1 square centimeter in your drawing?

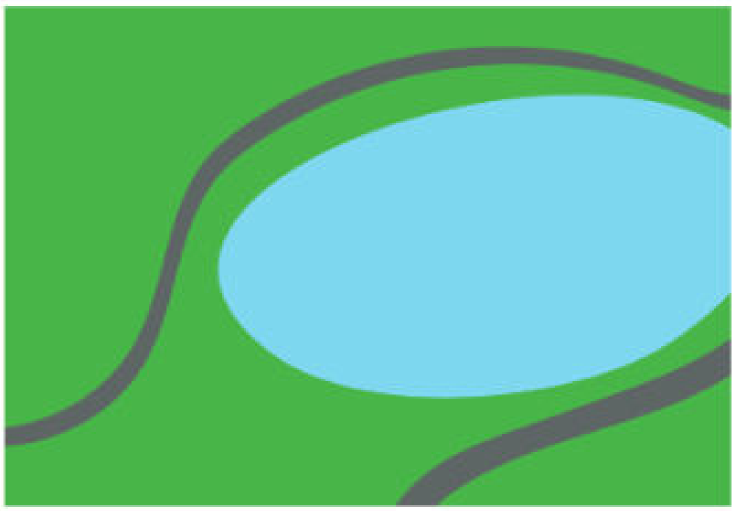


4. What do you notice about the scales when they are placed in this order?

Lesson 10 Summary

Sometimes we have a scale drawing of something, and we want to create another scale drawing of it that uses a different scale. We can use the original scale drawing to find the size of the actual object. Then we can use the size of the actual object to figure out the size of our new scale drawing.

For example, here is a scale drawing of a park where the scale is 1 cm to 90 m.



The rectangle is 10 cm by 4 cm, so the actual dimensions of the park are 900 m by 360 m, because $10 \cdot 90 = 900$ and $4 \cdot 90 = 360$.

Suppose we want to make another scale drawing of the park where the scale is 1 cm to 30 meters. This new scale drawing should be 30 cm by 12 cm, because $900 \div 30 = 30$ and $360 \div 30 = 12$.

Another way to find this answer is to think about how the two different scales are related to each other. In the first scale drawing, 1 cm represented 90 m. In the new drawing, we would need 3 cm to represent 90 m. That means each length in the new scale drawing should be 3 times as long as it was in the original drawing. The new scale drawing should be 30 cm by 12 cm, because $3 \cdot 10 = 30$ and $3 \cdot 4 = 12$.

Since the length and width are 3 times as long, the area of the new scale drawing will be 9 times as large as the area of the original scale drawing, because $3^2 = 9$.

Lesson 11

Lesson 11: Scales without Units

Apollo Lunar Module

Neil Armstrong and Buzz Aldrin were the first people to walk on the surface of the moon. The Apollo Lunar Module was the spacecraft they used when they landed on the moon in 1969. The landing module was one part of a larger spacecraft that was launched from Earth.

Click here to get the drawing of the Apollo Lunar Module. It is drawn to a scale of 1 to 50.

1. The “legs” of the spacecraft are its landing gear. Use the drawing to estimate the actual length of each leg on the sides. Write your answers to the nearest 10 centimeters. Explain or show your reasoning.

1. Use the drawing to estimate the actual height of the Apollo Lunar Module to the nearest 10 centimeters. Explain or show your reasoning.

1. Neil Armstrong was 71 inches tall when he went to the surface of the moon in the Apollo Lunar Module. How tall would he be in the drawing if he were drawn with his height to scale? Show your reasoning.

Lesson 11 Summary

In some scale drawings, the scale specifies one unit for the distances on the drawing and a different unit for the actual distances represented. For example, a drawing could have a scale of 1 cm to 10 km.

In other scale drawings, the scale does not specify any units at all. For example, a map may simply say the scale is 1 to 1,000. In this case, the units for the scaled measurements and actual measurements can be any unit, so long as the same unit is being used for both. So if a map of a park has a scale 1 to 1,000, then 1 inch on the map represents 1,000 inches in the park, and 12 centimeters on the map represent 12,000 centimeters in the park. In other words, 1,000 is the scale factor that relates distances on the drawing to actual distances, and $\frac{1}{1000}$ is the scale factor that relates an actual distance to its corresponding distance on the drawing.

A scale with units can be expressed as a scale without units by converting one measurement in the scale into the same unit as the other (usually the unit used in the drawing). For example, these scales are equivalent:

- 1 inch to 200 feet
- 1 inch to 2,400 inches (because there are 12 inches in 1 foot, and $200 \cdot 12 = 2{,}400$)
- 1 to 2,400

This scale tells us that all actual distances are 2,400 times their corresponding distances on the drawing, and distances on the drawing are $\frac{1}{2400}$ times the actual distances they represent.

Lesson 12

Lesson 12: Units in Scale Drawings

Centimeters in a Mile

There are 2.54 cm in an inch, 12 inches in a foot, and 5,280 feet in a mile. Which expression gives the number of centimeters in a mile? Explain your reasoning.

A. $\frac{2.54}{12 \cdot 5{,}280}$

B. $5{,}280 \cdot 12 \cdot (2.54)$

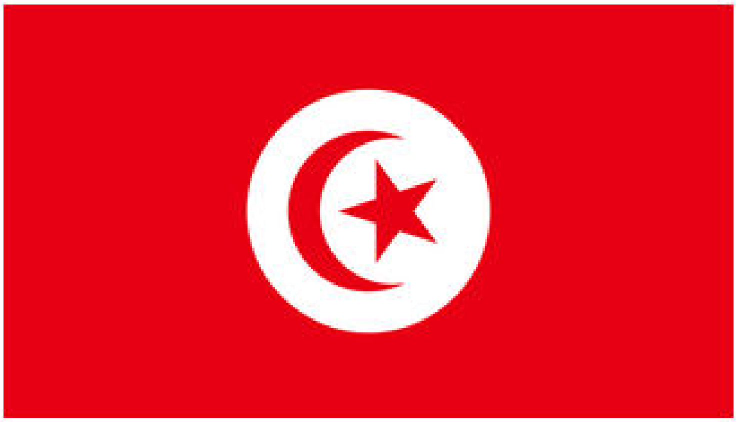
C. $\frac{1}{5{,}280 \cdot 12 \cdot (2.54)}$

D. $5{,}280 + 12 + 2.54$

E. $\frac{5{,}280 \cdot 12}{2.54}$

The World's Largest Flag

As of 2016, Tunisia holds the world record for the largest version of a national flag. It is almost as long as four soccer fields! The flag has a circle in the center, a crescent moon inside the circle, and a star inside the crescent moon.



1. Complete the table. Explain or show reasoning.

	flag length	flag height	height of crescent moon
actual	396 m		99 m
at 1 to 2,000 scale		13.2 cm	

2. Complete each scale with the value that makes it equivalent to the scale of 1 to 2,000. Explain or show your reasoning.

a. 1 cm to __________ cm

b. 1 cm to __________ m

c. 1 cm to __________ km

d. 2 m to __________ m

e. 5 cm to __________ m

f. __________ cm to 1,000 m

g. __________ mm to 20 m

3. a. What is the area of the large flag?

b. What is the area of the smaller flag?

c. The area of the large flag is how many times the area of the smaller flag?

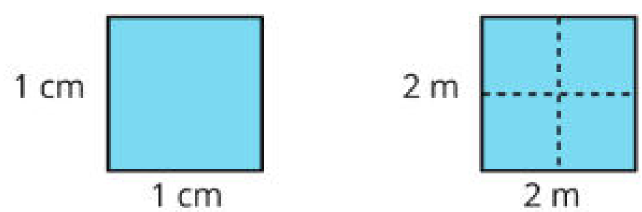
Lesson 12 Summary

Sometimes scales come with units, and sometimes they don't. For example, a map of Nebraska may have a scale of 1 mm to 1 km. This means that each millimeter of distance on the map represents 1 kilometer of distance in Nebraska. The same scale without units is 1:1,000,000, which means that each unit of distance on the map represents 1,000,000 units of distance in Nebraska. This is true for *any* choice of unit.

To see that these two scales are equivalent, notice that there are 1,000 millimeters in 1 meter and 1,000 meters in 1 kilometer. This means there are $1{,}000 \cdot 1{,}000$ or 1,000,000 millimeters in 1 kilometer. So the actual distances in Nebraska are 1,000,000 times as far as the distances on the map.

A scale tells us how a length on a drawing corresponds to an actual length, and it also tells us how an area on a drawing corresponds to an actual area.

For example, if 1 centimeter on a scale drawing represents 2 meters in actual distance, what does 1 *square* centimeter on the drawing represent in actual area? The square on the left shows a square with side lengths 1 cm, so its area is 1 square cm.



The square on the right shows the actual dimensions represented by the square on the left. Because each side length in the actual square is 2 m, the actual square has an area of 2^2 or 4 square meters.

We can use this relationship to find the actual area of any region represented on this drawing. If a room has an area of 18 cm^2 on the drawing, we know that it has an actual area of $18 \cdot 4 = 72$ or 72 m^2.

In general, if 1 unit on the drawing represents n actual units, then one square unit on the drawing represents n^2 actual square units.