Lesson 16: Relating Scale Drawings to Ratios and Rates

Classwork

Intro Activity: Can You Guess the Image? Is it a reduction or enlargement?

1. Image: _______________________________  _______________________________

2. Image: _______________________________  _______________________________

Example 1

For the following problems, (a) is the actual picture and (b) is the scale drawing. Is the scale drawing an enlargement or a reduction of the actual picture?

1. a. b.  

Example 2

Derek’s family took a day trip to a modern public garden. Derek looked at his map of the park that was a reduction of the map located at the garden entrance. The dots represent the placement of rare plants. The diagram below is the top-view as Derek held his map while looking at the posted map.

What are the corresponding points of the scale drawings of the maps?
Exercise 1
Create scale drawings of your own modern nesting robots using the grids provided.

Example 3
Celeste drew an outline of a building for a diagram she was making and then drew a second one mimicking her original drawing. State the coordinates of the vertices and fill in the table.

<table>
<thead>
<tr>
<th>#1</th>
<th>#2</th>
<th>Height</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Drawing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Drawing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
a) Is the second image a reduction or enlargement of the first image? How do you know?

b) What do you notice about the information on the table?

c) Does a constant of proportionality exist? How do you know?

d) What is the constant of proportionality, and why is it important in scale drawings?

Exercise 2

Luca drew and cut out small right triangle for a mosaic piece he was creating for art class. His mother really took a liking and asked if he could create a larger one for their living room and Luca made a second template for his triangle pieces.

<table>
<thead>
<tr>
<th>Lengths of the original image</th>
<th>Lengths of the second image</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Does a constant of proportionality exist? If so, what is it? If not, explain.

b. Is Luca’s enlarged mosaic a scale drawing of the first image? Explain why or why not.
HOMEWORK: Problem Set

For Problems 1–3, identify if the scale drawing is a reduction or enlargement of the actual picture.

1. ______________________

2. ______________________

3. ______________________
   a. Actual Picture
   b. Scale Drawing

4. Using the grid and the abstract picture of a face, answer the following questions:

   A  B  C  D

   F
   G
   H
   I
a. On the grid, where is the eye? ______________________

b. What is located in DH? ______________________

c. In what part of the square BI is the chin located? ______________________

5. Use the graph provided to decide if the rectangular cakes are scale drawings of each other. Use red for cake 1 and blue for cake 2.
Cake 1: (5,3), (5,5), (11,3), (11, 5) (red)
Cake 2: (1,6), (1, 12),(13,12), (13, 6) (blue)
How do you know?

Lesson 17: The Unit Rate as the Scale Factor

Classwork

Example 1: Rubin’s Icon
Rubin created a simple game on his computer and shared it with his friends to play. They were instantly hooked and the popularity of his game spread so quickly that Rubin wanted to create a distinctive icon, so players could easily identify his game. He drew a simple sketch. From the sketch, he created stickers to promote his game, but Rubin wasn’t quite sure if the stickers were proportional to his original sketch.
Exercise 1: App Icon

Steps to check for proportionality for scale drawing and original picture:

1. 
2. 
3. 
Example 2
Use a Scale Factor of 3 to create a scale drawing of the picture below.
Picture of the Flag of Columbia:

Exercise 2
Scale Factor= __________________________                  Picture of the Flag of Columbia:
Sketch and notes:

Example 3
Your family recently had a family portrait taken. Your aunt asked you to take a picture of the portrait using your cell phone and send it to her. If the original portrait is 3 feet by 3 feet and the scale factor is $\frac{1}{18}$, draw the scale drawing that would be the size of the portrait on your phone.
Sketch and notes:
Exercise 3

John is building his daughter a doll house that is a miniature model of their house. The front of their house has a circular window with a diameter of 5 feet. If the scale factor for the model house is 1/30, make a sketch of the circular doll house window.

HOMEWORK: Problem Set

1. Giovanni went to Los Angeles, California for the summer to visit his cousins. He used a map of bus routes to get from the airport to the nearest bus station from his cousin’s house. The distance from the airport to the bus station is 56 km. On his map, the distance was 4 cm. What is the scale factor?

2. Nicole is running for school president and her best friend designed her campaign poster which measured 3 feet by 2 feet. Nicole liked the poster so much she reproduced the artwork on rectangular buttons measuring 2 inches by $1\frac{1}{3}$ inches. What is the scale factor?

3. Use a ruler to measure and find the scale factor.
   Scale Factor: _________________________

<table>
<thead>
<tr>
<th>Actual Picture</th>
<th>Scale Drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Actual Picture" /></td>
<td><img src="image2" alt="Scale Drawing" /></td>
</tr>
</tbody>
</table>
4. Find the scale factor using the given scale drawings and measurements below.
   Scale Factor: _________________________

   ![Actual Picture](image1)
   ![Scale Drawing](image2)

5. Using the given scale factor, create a scale drawing from the actual pictures in centimeters:
   a. Scale factor: 3

   ![Envelope](image3)

   b. Scale factor: \( \frac{3}{5} \)

   ![Tag](image4)

6. Hayden likes building radio-controlled sailboats with her father. One of the sails, shaped like a right triangle, has side lengths measuring 6 inches, 8 inches and 10 inches. To log her activity, Hayden creates and collects drawings of all the boats she and her father built together. Using the scale factor of \( \frac{1}{4} \), draw a scale drawing of sail.
Lesson 18: Computing Actual Lengths from a Scale Drawing

Classwork

Example 1: Basketball at Recess?

Vincent proposes an idea to the Student Government to install a basketball hoop along with a court marked with all the shooting lines and boundary lines at his school for students to use at recess. He presents a plan to install a half-court design as shown below. After checking with school administration, he is told it will be approved if it will fit on the empty lot that measures 25 feet by 75 feet on the school property. Will the lot be big enough for the court he planned? Explain.

Scale Drawing: 1 inch on drawing corresponds to 15 feet of actual length

Example 2

The diagram shown represents a garden. The scale is 1 cm for every 20 meters of actual length. Find the actual length and width of the garden based upon the given drawing. Each square in the drawing measures 1 cm by 1 cm.
Example 3
A graphic designer is creating an advertisement for a tablet. She needs to enlarge the picture given here so that 0.25 inches on the scale picture will correspond to 1 inch on the actual advertisement. What will be the length and width of the tablet on the advertisement?

Exercises
1. Students from the high school are going to perform one of the acts from their upcoming musical at the atrium in the mall. The students want to bring some of the set with them so that the audience can get a better feel of the whole production. The backdrop that they want to bring has panels that measure 10 feet by 10 feet. The students are not sure if they will be able to fit these panels through the entrance of the mall since the panels need to be transported flat (horizontal). They obtain a copy of the mall floor plan, shown below, from the city planning office. Use this diagram to decide if the panels will fit through the entrance. Use a ruler to measure.
Answer the following questions.

a. Find the actual distance of the mall entrance and determine whether the set panels will fit.

b. What is the scale factor? What does it tell us?

c. What does the scale factor tell us about the relationship between the actual picture and the scale drawing?

d. How does a scale drawing differ from other drawings?

HOMEWORK: Problem Set

1. A toy company is redesigning their packaging for model cars. The graphic design team needs to take the old image shown below and resize it so that \( \frac{1}{2} \) inch on the old packaging represents \( \frac{1}{3} \) inch on the new package. Find the length of the image on the new package.

2. The city of St. Louis is creating a welcome sign on a billboard for visitors to see as they enter the city. The following picture needs to be enlarged so that \( \frac{1}{2} \) inch represents 7 feet on the actual billboard. Will it fit on a billboard that measures 14 feet in height?
3. Your mom is repainting your younger brother’s room. She is going to project the image shown below onto his wall so that she can paint an enlarged version as a mural. How long will the mural be if the projector uses a scale where 1 inch of the image represents $2\frac{1}{2}$ feet on the wall?

![Image of a mural](image)

4. A model of a skyscraper is made so that 1 inch represents 75 feet. What is the height of the actual building if the height if the model is $18\frac{3}{5}$ inches?

5. The portrait company that takes little league baseball team photos is offering an option where a portrait of your baseball pose can be enlarged to be used as a wall decal (sticker). Your height in the portrait measures $3\frac{1}{2}$ inches. If the company uses a scale where 1 inch on the portrait represents 20 inches on the wall decal, find the height on the wall decal. Your actual height is 55 inches. If you stand next to the wall decal, will it be larger or smaller than you?

6. The sponsor of a 5K run/walk for charity wishes to create a stamp of its billboard to commemorate the event. If the sponsor uses a scale where 1 inch represents 4 feet and the billboard is a rectangle with a width of 14 feet and a length of 48 feet, what will be the shape and size of the stamp?

7. Danielle is creating a scale drawing of her room. The rectangular room measures $20\frac{1}{2}$ feet by 25 ft. If her drawing uses the scale 1 inch represents 2 feet of the actual room, will her drawing fit on an $8\frac{1}{2}$ in. by 11 in. piece of paper?

8. A model of an apartment is shown below where $\frac{1}{4}$ inch represents 4 feet in the actual apartment. Use a ruler to measure the drawing and find the actual length and width of the bedroom.

![Diagram of an apartment](image)
Lesson 19: Computing Actual Areas from a Scale Drawing

Classwork

Examples 1–3: Exploring Area Relationships

Use the diagrams below to find the scale factor and then find the area of each figure.

Example 1

Scale factor: _________

Actual Area = ______________

Scale Drawing Area = ________________

Ratio of Scale Drawing Area to Actual Area:

Example 2

Scale factor: _________

Actual Area = ______________

Scale Drawing Area = ________________

Ratio of Scale Drawing Area to Actual Area: ________
Example 3

Scale factor: _________

Actual Area = ______________

Scale Drawing Area = ______________

Ratio of Scale Drawing Area to Actual Area: _________

Results: What do you notice about the ratio of the areas in Examples 1-3? Complete the statements below.

When the scale factor of the sides was 2, then the ratio of area was ______________.

When the scale factor of the sides was $\frac{1}{3}$, then the ratio of area was ______________.

When the scale factor of the sides was $\frac{4}{3}$, then the ratio of area was ______________.

Based on these observations, what conclusion can you draw about scale factor and area?

If the scale factor of the sides is $r$, then the ratio of area will be ______________.

Example 4: They Said Yes!
The Student Government liked your half-court basketball plan. They have asked you to calculate the actual area of the court so that they can estimate the cost of the project. Based on your drawing below, what is the area of the planned half-court going to be?
Does the actual area you found reflect the results we found from Examples 1–3? Explain how you know.

Exercises
1. The triangle depicted by the drawing has an actual area of 36 square units. What is the scale of the drawing? (Note: each square on grid has a length of 1 unit)
2. Use the scale drawings of two different apartments to answer the questions. The measurements have been done for you.

a. Find the scale drawing area for both apartments, and then use it to find the actual area of both apartments.

b. Which apartment has the closet floor with more square footage? Justify your thinking.

c. Which apartment has the largest bathroom? Justify your thinking.

d. A one-year lease for the suburban apartment costs $750 per month. A one-year lease for the city apartment costs $925. Which apartment offers the greater value in terms of the cost per square foot?
1. The shaded rectangle shown below is a scale drawing of a rectangle whose area is 288 square feet. What is the scale factor of the drawing? (Note: each square on grid has a length of 1 unit)

2. A floor plan for a home is shown below where \( \frac{1}{2} \) inch corresponds to 6 feet of the actual home. Bedroom 2 belongs to 13-year old Kassie, and bedroom 3 belongs to 9-year old Alexis. Kassie claims that her younger sister, Alexis, got the bigger bedroom, is she right? Explain.

3. The greenhouse club is purchasing seed for the lawn in the school courtyard. They need to determine how much to buy. Unfortunately, the club meets after school, and students are unable to find a custodian to unlock the door. Anthony suggests they just use his school map to calculate the amount of area that will need to be covered in seed. He measures the rectangular area on the map and finds the length to be 10 inches and the width to be 6 inches. The map notes the scale of 1 inch representing 7 feet in the actual courtyard. What is the actual area in square feet?

4. The company installing the new in-ground pool in your back yard has provided you with the scale drawing shown below. If the drawing uses a scale of 1 inch to \( 1 \frac{3}{4} \) feet, calculate the total amount of two-dimensional space needed for the pool and its surrounding patio.
Changing Scale Factors:

- To produce a scale drawing at a different scale, you must determine the new scale factor. The new scale factor is found by dividing the different (new drawing) scale factor by the original scale factor.
- To find each new length, you can multiply each length in the original scale drawing by this new scale factor.

Steps:

- Find each scale factor.
- Divide new scale factor by original scale factor.
- Divide the given length by the new scale factor (the quotient from the prior step).

How does your scale drawing change when a new scale factor is presented?

1. Jake reads the following problem: If the original scale factor for a scale drawing of a square swimming pool was \( \frac{1}{90} \) and length of the original drawing measured to be 8 inches, what is the length on the new scale drawing if the scale factor of the new scale drawing length to actual length is \( \frac{1}{144} \)?

   He works out the problem like so:

   \[ 8 \div \frac{1}{90} = 720 \text{ inches}. \]

   \[ 720 \times \frac{1}{144} = 5 \text{ inches}. \]

   Is he correct? Explain why or why not.

2. What is the scale factor of the new scale drawing to the original scale drawing (SD2 to SD1)?
3. If the length of the pool measures 10 cm on the new scale drawing:

   a. What is the actual length of the pool in meters?

   b. What is the surface area of the actual pool?

   c. If the pool has a constant depth of 4 feet, what is the volume of the pool?

   d. If 1 cubic meter of water is equal to 264.2 gallons, how much water will the pool contain when completely filled?