Name _____

Teacher Note:

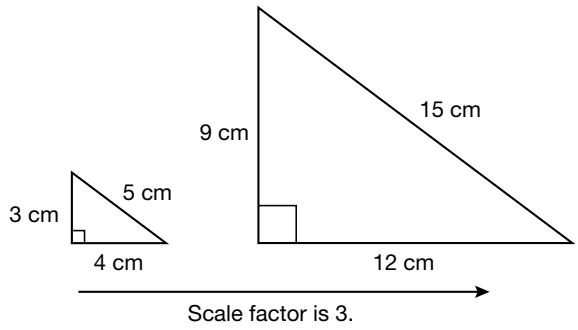
- Review "Proportion (Rate) Problems" on page 9 of the *Student Reference Guide.*

page 684

Focus on

• Scale Factor: Scale Drawings and Models

- The **scale** is the ratio of a drawing or model to the actual object. **Scale drawings** and **scale models** use a scale to reproduce the dimensions of an object at a different size.
- The **scale factor** is a number that tells how much smaller or larger part of an object is than the corresponding part on a similar object or model. If, for example, the base of a triangle is 12 cm, and the base of a model of that triangle is 4 cm, then the scale factor is 3, because 12 cm is 3 times larger than 4 cm.



- Similar figures are often used by manufacturers to design products and by architects to design buildings.
- Scale drawings are two-dimensional pictures of larger and smaller objects. A road map is an example of a scale drawing. A scale drawing is a convenient substitute for the actual object, such as a building, bridge, or airplane.
- Scale models are three-dimensional copies of three-dimensional objects. A scale model usually shows a small representation of a large object, such as a model car. Sometimes a scale model can be a big model of a very small object, such as a large model of a blood cell.

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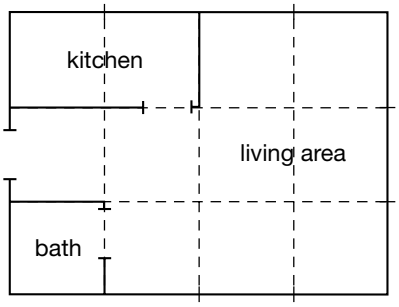
- A **legend** tells how much a certain measure represents.
- Below is a scale drawing of Angela's apartment. The legend says that every $\frac{1}{2}$ inch on the drawing equals 5 feet in the real apartment.
- Because $\frac{1}{2}$ inch = 5 ft,

  1 inch = 10 ft

  $1\frac{1}{2}$ inches = 15 ft

  2 inches = 20 ft

- The drawing of Angela's apartment is 2 inches long and $1\frac{1}{2}$ inches wide. (The dashed grid lines are every $\frac{1}{2}$ inch.) So the real apartment is 20 feet long and 15 feet wide.



$\frac{1}{2}$ inch = 5 feet

1. What are the actual length and width of the kitchen shown above? _____ , _____

   Count the grid marks. Each grid line marks $\frac{1}{2}$ inch. So each grid line mark equals 5 feet.

2. In the scale drawing each doorway measures $\frac{1}{4}$ inch. Since $\frac{1}{4}$ inch is half of $\frac{1}{2}$ inch, what is the actual width of each doorway?

   _____

   Drawing width: $\frac{1}{2}$ in. $\times$ $\frac{1}{2}$ Actual width: 5 ft $\times$ _____

3. A dollhouse was built as a scale model of an actual house so that 1 inch = 1.5 feet. What are the dimensions of a room in the actual house if the corresponding dollhouse room measures 8 in. by 10 in.?

   _____ by _____

   Multiply the loop.

   $\frac{\text{inches}}{\text{feet}}$ $\frac{1}{1.5} = \frac{8}{?}$ $\frac{\text{inches}}{\text{feet}}$ $\frac{1}{1.5} = \frac{10}{?}$

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4. A scale model of an airplane is built so that 1 inch = 2 feet. The wingspan of the model airplane is 24 inches. What is the wingspan of the actual airplane in feet?

_____

Multiply the loop.

$\frac{\text{inches}}{\text{feet}}$ $\frac{1}{2} = \frac{\quad}{\quad}$

- A good way to solve these types of problems is with a **ratio box.**

  For problems **5–8,** complete the ratio box, set up a proportion, and find the answer.

5. A scale model of a sports car is 7 inches long. The car itself is 14 feet long. If the model is 3 inches wide, how wide is the actual car?

	Drawing	Actual
Length		
Width		?

_____

6. For the sports car in problem **5,** suppose the actual height is 4 feet. What is the height of the model?

	Drawing	Actual
Length		
Height	?	

_____

7. The femur is the large bone that runs from the knee to the hip. In a scale drawing of a human skeleton the length of the femur is 3 cm, and the full skeleton measures 12 cm. If the drawing represents a 6-ft-tall person, what is the actual length of the person's femur?

	Drawing	Actual
Femur		?
Human		

_____

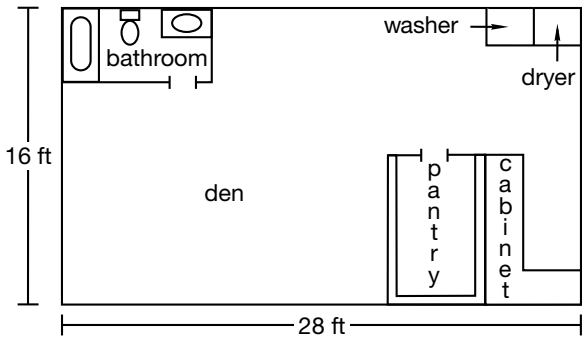
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8. The humerus is the bone that runs from the elbow to the shoulder. Suppose the humerus of a 6-ft-tall person is 1 ft long. How long should the humerus be on the scale drawing of the skeleton in problem **7?**

	Drawing	Actual
Humerus	?	
Human		

_____

9. A scale drawing of a room addition that measures 28 ft by 16 ft is shown below. The scale drawing measures 7 cm by 4 cm.



a. Complete this legend for the scale drawing:

1 cm = _____ ft

Use one pair of numbers to set up a ratio; then reduce.

	Drawing	Actual
Length	7 cm	28 ft
Width	4 cm	16 ft

$\frac{\text{cm}}{\text{ft}} \quad \frac{7}{28} = \frac{\quad}{\quad}$

b. What is the actual length and width of the bathroom, rounded to the nearest foot? _____, _____

Use your ruler and the legend to complete the ratio box.

Bathroom Dimensions

	Drawing	Actual
Length	cm	ft
Width	cm	ft

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10. Noe will drive from San Francisco to Los Angeles.



a. On this map, each inch represents how many miles? _____

Use your inch ruler.

$\frac{1}{2}$ inch = _____ miles 1 inch = _____ miles

b. Estimate the driving distance from San Francisco to Los Angeles.

What highway should Noe take? _____

Multiply the loop. inches / miles $\frac{1}{__} = \frac{__}{__}$

The most direct route from San Francisco to Los Angeles is Interstate _____.

c. Noe will stop in Visalia on his way to Los Angeles, taking California highway 198 to Visalia and back to Interstate 5.

What distance does this add to the trip? _____

inches / miles $\frac{1}{__} = \frac{__}{__}$

The trip is _____ miles longer than the answer in part b.

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11. A natural history museum contains a 44-inch-long scale model of a *Stegosaurus* dinosaur. The actual length of the *Stegosaurus* was 22 feet. What should be the legend for the scale model of the dinosaur? (*Write the answer as a decimal.*)

    1 inch = _____ feet $\frac{\text{inches}}{\text{feet}}$ $\frac{44}{22} = \frac{1}{?}$

- **Renderings** are two-dimensional *scale drawings* such as maps and blueprints. If the rendering is three-dimensional we call it a scale model.
- The **scale** is the fraction of how large the rendering is compared to the actual object.
- To find the scale of a rendering we make a fraction like this:

  $$\text{scale} = \frac{\text{dimension of rendering}}{\text{dimension of object}}$$

- In the case of the *Stegosaurus* in problem **11,** the corresponding lengths are 44 inches and 22 feet. Before we can reduce the fraction we change the feet to inches.

  $$\text{scale} = \frac{44 \text{ in.}}{22 \text{ ft}} = \frac{44 \text{ in.}}{264 \text{ in.}} = \frac{1}{6}$$

- This tells us that the model is a $\frac{1}{6}$ scale model.
- The **scale factor** is the reciprocal of the scale. So the scale factor from the model to the actual *Stegosaurus* is 6. That means that to get a dimension of the actual object we can multiply the dimension of the model by 6.

12. What is the scale of the model car in problem **5?**

    $\frac{\text{model}}{\text{actual}} = \frac{\text{____ in.}}{\text{ft}} = \frac{\text{____ in.}}{\text{in.}} =$

    What is the scale factor? _____ *Think reciprocal.*

13. A scale may be written as a ratio that uses a colon. For example, the scale of the *Stegosaurus* model is 1:6. Suppose that a toy company makes action figures of sports stars using a scale of 1:10. How many inches tall will a figure of a 6-ft-8-in. basketball player be?

    6 ft 8 in. = _____ in. _____

14. In a scale drawing of a wall mural, the scale factor is 6. If the scale drawing is 3 feet long by 1.5 feet wide, what are the dimensions of the actual mural?

    _____ by _____

    3 × _____ = _____

    1.5 × _____ = _____

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