

Scale Drawings and Models



ISG Interactive Study Guide

See pages 113–114 for:

- Getting Started
- Vocabulary Start-Up
- Notes

EQ Essential Question

How can you identify and represent proportional relationships?

CCSS Common Core State Standards

Content Standards
7.G.1

Mathematical Practices
1, 3, 4

abc Vocabulary

scale drawing
scale model
scale
scale factor

What You'll Learn

- Use scale drawings.
- Construct scale drawings.



Real-World Link

Baseball Among other attractions in Louisville, Kentucky, the town is home to the world's largest baseball bat. The bat is 120 feet long and about 9 feet in diameter. It is modeled after the 34-inch long bat that Babe Ruth used in the early 1920s.

Use Scale Drawings and Models

A **scale drawing** or a **scale model** is used to represent an object that is too large or too small to be drawn or built at actual size. The lengths and widths of objects on a scale drawing or model are proportional to the lengths and widths of the actual object.

The **scale** is determined by the ratio of a given length on the drawing or model to its corresponding length on the actual object. Consider the following scales.

$$1 \text{ in.} = 3 \text{ ft}$$

1 inch represents an actual distance of 3 feet.

$$1 \text{ cm} = 2 \text{ mm}$$

1 centimeter represents an actual distance of 2 millimeters.

Scales are written so that a unit length on the drawing or model is listed first.



Example 1

Tutor

Suppose a model of a dragonfly has a wing length of 4 centimeters. If the length of the insect's actual wing is 6 centimeters, what is the scale of the model?

Let x represent the actual length.

Write and solve a proportion.

$$\frac{\text{model length}}{\text{actual length}} = \frac{4 \text{ cm}}{6 \text{ cm}} = \frac{1 \text{ cm}}{x \text{ cm}}$$

$$4 \cdot x = 6 \cdot 1 \quad \text{Find the cross products.}$$

$$4x = 6 \quad \text{Simplify.}$$

$$x = 1.5 \quad \text{Divide each side by 4.}$$

So, the scale is 1 centimeter = 1.5 centimeters.

Got It? Do these problems to find out.

- The pillars of the World War II memorial in Washington, D.C., are 17 feet tall. A scale model of the memorial has pillars that are 5 inches tall. What is the scale of the model?
1 in. = 3.4 ft
- The length of a model of a bridge is 16 inches. The actual length of the bridge is 50 yards. What is the scale of the model? **1 in. = 3.125 yd or 1 in. = 3 $\frac{1}{8}$ yd**

If the scale drawing and model have the same unit of measure, the scale can be written without units. This is called the **scale factor**. Suppose a scale model has a scale of 1 inch = 2 feet.

$$\text{scale} \rightarrow 1 \text{ inch} = 2 \text{ feet} \rightarrow \frac{1 \text{ inch}}{2 \text{ feet}} \rightarrow \frac{1 \text{ inch}}{24 \text{ inches}} \rightarrow 1:24 \leftarrow \text{scale factor}$$

One unit on the model represents an actual distance of 24 units. So, the model is $\frac{1}{24}$ the size of the actual object.



Example 2

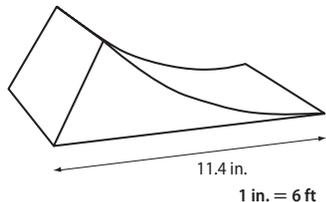


Alternative Method

You can also solve the proportion

$$\frac{\text{plan}}{11.4 \text{ in.}} = \frac{\text{actual}}{x \text{ ft}}$$

The blueprint of a skateboard ramp shows that its length is 11.4 inches. If the scale on the blueprint is 1 inch = 6 feet, what is the length of the actual skateboard ramp?



Method 1 Use a proportion.

Let x represent the actual length of the ramp. Write and solve a proportion.

$$\begin{array}{l} \text{plan length} \rightarrow \frac{1 \text{ inch}}{6 \text{ feet}} \\ \text{actual length} \rightarrow \frac{11.4 \text{ inches}}{x \text{ feet}} \end{array} \quad \begin{array}{l} \leftarrow \text{plan length} \\ \leftarrow \text{actual length} \end{array}$$

$$1 \cdot x = 6 \cdot 11.4 \quad \text{Find the cross products.}$$

$$x = 68.4 \quad \text{Simplify.}$$

Method 2 Use the scale factor.

The actual length is proportional to the length on the scale drawing with a ratio of $\frac{1 \text{ inch}}{6 \text{ feet}}$. Find the scale factor.

$$\frac{1 \text{ inch}}{6 \text{ feet}} = \frac{1 \text{ inch}}{72 \text{ inches}} \text{ or } \frac{1}{72} \quad \text{Convert 6 feet to inches and divide out units.}$$

The scale factor is $\frac{1}{72}$.

So, the actual length is 72 times the blueprint length.

Words

The actual length equals 72 times the blueprint length.



Variable

Let a represent the actual length.
Let b represent the blueprint length.



Equation

$$a = 72b$$

$$\begin{array}{l} a = 72b \quad \text{Write the equation.} \\ = 72(11.4) \quad \text{Replace } b \text{ with } 11.4. \\ = 820.8 \quad \text{Simplify.} \end{array}$$

The actual length of the ramp is 820.8 inches or 68.4 feet.

Got It? Do this problem to find out.

- A map of a natural history museum shows that the dinosaur exhibit room is 7.25 inches wide. If the scale on the map is 1 inch = 8 feet, what is the width of the actual exhibit room? **58 ft**

Construct Scale Drawings

To construct a scale drawing of an object, use the actual measurements of the object and the scale to which the object is to be drawn.

Vocabulary Link

Scale

Everyday Use a weighing machine

Math Use the ratio of the length in a drawing to the length of the actual object.



Example 3



Lila is painting a mural at the community center on a wall that measures 18 feet long and 12 feet tall. Make a scale drawing of the mural. Use a scale of $\frac{1}{4}$ inch = 3 feet. Use $\frac{1}{4}$ -inch grid paper.

- Step 1** Find the measure of the wall's length on the drawing. Let ℓ represent the length.

$$\begin{array}{l} \text{drawing length} \quad \cdots \rightarrow \quad \frac{1}{4} \text{ inch} \\ \text{actual length} \quad \cdots \rightarrow \quad 3 \text{ feet} \end{array} = \frac{\ell \text{ inches}}{18 \text{ feet}} \begin{array}{l} \leftarrow \cdots \text{ drawing length} \\ \leftarrow \cdots \text{ actual length} \end{array}$$

$$\frac{1}{4} \cdot 18 = 3 \cdot \ell \quad \text{Find the cross products.}$$

$$4.5 = 3\ell \quad \text{Simplify.}$$

$$\frac{4.5}{3} = \frac{3\ell}{3} \quad \text{Divide each side by 3.}$$

$$1.5 = \ell \quad \text{Simplify.}$$

On the drawing, the length is 1.5 or $1\frac{1}{2}$ inches.

- Step 2** Find the measure of the wall's height on the drawing. Let w represent the width.

$$\begin{array}{l} \text{drawing width} \quad \cdots \rightarrow \quad \frac{1}{4} \text{ inch} \\ \text{actual width} \quad \cdots \rightarrow \quad 3 \text{ feet} \end{array} = \frac{w \text{ inches}}{12 \text{ feet}} \begin{array}{l} \leftarrow \cdots \text{ drawing width} \\ \leftarrow \cdots \text{ actual width} \end{array}$$

$$\frac{1}{4} \cdot 12 = 3 \cdot w \quad \text{Find the cross products.}$$

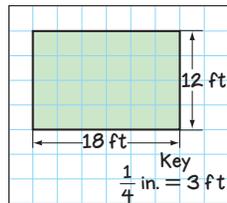
$$3 = 3w \quad \text{Simplify.}$$

$$\frac{3}{3} = \frac{3w}{3} \quad \text{Divide each side by 3.}$$

$$1 = w \quad \text{Simplify.}$$

On the drawing, the height is 1 inch.

- Step 3** Make the scale drawing.
Use $\frac{1}{4}$ -inch grid paper.
Since $1\frac{1}{2}$ inches = 6 squares and
1 inch = 4 squares, draw a rectangle
that is 4 squares by 6 squares.



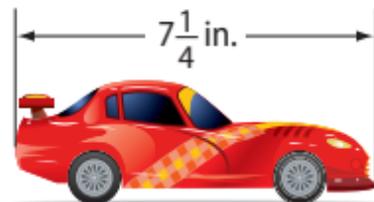
Got It? Do this problem to find out.

3. An architect is designing a school courtyard that is 45 feet long and 30 feet wide. Make a scale drawing of the courtyard. Use a scale of 0.5 inch = 10 feet. Use $\frac{1}{4}$ -inch grid paper. **See margin.**



Guided Practice

1. The model of a car is shown at the right. The actual car is $14\frac{1}{2}$ feet long. What is the scale of the model car? (Example 1) **1 in. = 2 ft**



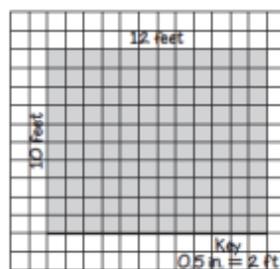
2. On the map, the scale is 1 inch = 20 miles. What is the actual distance between Kansas City and St. Louis? (Example 2) **260 mi**



3. Marco is designing a flower garden in his backyard that is 12 feet long and 10 feet wide. Make a scale drawing of the garden. Use a scale of 0.5 inch = 2 feet. Use $\frac{1}{4}$ -inch grid paper. (Example 3)

Page 227 Lesson 5-8 Guided Practice

3.



(not shown to actual size)