

LESSON 14 Scale Drawings

PLUG IN

Writing and Solving Proportions

A pet store has 3 dogs for every 5 cats. If the ratio is constant, how many dogs are there when there are 20 cats in the pet store?

Write a **proportion** to represent the situation.

$$\frac{3 \text{ dogs}}{5 \text{ cats}} = \frac{d \text{ dogs}}{20 \text{ cats}}$$

Cross multiply.

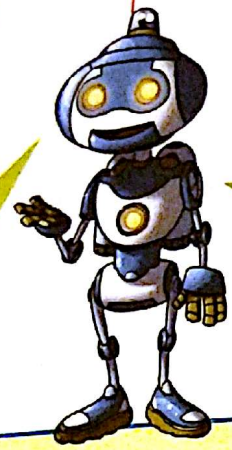
$$\begin{aligned} \frac{3}{5} &= \frac{d}{20} \\ 3 \cdot 20 &= 5 \cdot d \\ 60 &= 5d \end{aligned}$$

Solve the equation.

$$\begin{aligned} 60 &= 5d \\ \frac{60}{5} &= \frac{5d}{5} \\ 12 &= d \end{aligned}$$

There are 12 dogs at the store when there are 20 cats.

Let d represent the number of dogs.



The products of cross multiplication are equal.

I see! $\frac{3}{5}$ and $\frac{12}{20}$ are equivalent ratios.

Words to Know

proportion
two ratios that are equivalent

DISCUSS

How can you use a proportion to find the number of cats if there is a total of 80 dogs and cats at the pet store?

A You can use equivalent ratios to write and solve a proportion.

DO

Jose does 20 sit-ups in 1 minute. At this rate, how many sit-ups can he do in 4 minutes?

- 1 Write a proportion.
- 2 Cross multiply.
- 3 Solve the equation.

Let n represent the number of sit-ups Jose can do in 4 minutes.

$$\frac{20 \text{ sit-ups}}{1 \text{ minute}} = \frac{\square \text{ sit-ups}}{\square \text{ minutes}}$$

$$\begin{aligned} \underline{\hspace{1cm}} \cdot \underline{\hspace{1cm}} &= \underline{\hspace{1cm}} \cdot \underline{\hspace{1cm}} \\ \underline{\hspace{1cm}} &= \underline{\hspace{1cm}} \end{aligned}$$

Jose can do sit-ups in 4 minutes.

B You can use a proportion to write and solve an equation.



In Charlene's class, there are 7 girls and 5 boys. If this ratio is the same throughout her school, how many girls are in a school with 144 students?

To set up the proportion, I need to find the ratio of girls to all students (girls + boys) in Charlene's class.



- 1 Write a proportion.
- 2 Cross multiply.
- 3 Solve the equation.

Let g represent the number of girls in the school.

$$\frac{7 \text{ girls}}{12 \text{ students}} = \frac{\square \text{ girls}}{\square \text{ students}}$$

$$\begin{aligned} \underline{\quad} \cdot \underline{\quad} &= \underline{\quad} \cdot \underline{\quad} \\ \underline{\quad} &= \underline{\quad} \\ \underline{\quad} &= \underline{\quad} \end{aligned}$$

There are $\underline{\quad}$ girls in a school that has 144 students.



What are two different ways you could find the number of boys in Charlene's school by using your answer to the above problem?

PRACTICE

Solve the proportion for the variable.

1 $\frac{6}{8} = \frac{x}{12}$

$$\frac{6}{8} \cdot \frac{12}{12} = \frac{8}{8} \cdot \frac{x}{12}$$

$$\underline{\quad} = \underline{\quad}$$

$$\underline{\quad} = \underline{\quad}$$

2 $\frac{p}{2} = \frac{6}{3}$

$$\frac{p}{2} \cdot \frac{3}{3} = \frac{6}{3} \cdot \frac{3}{3}$$

$$\underline{\quad} = \underline{\quad}$$

$$\underline{\quad} = \underline{\quad}$$

Write a proportion to solve the problem.

3 How much will 6 pencils cost if 3 pencils cost 75¢?

$$\frac{\square \text{ pencils}}{\square \text{ ¢}} = \frac{6 \text{ pencils}}{x \text{ ¢}}$$

4 Maria earned \$42 for 6 hours of work. How much will she get for 15 hours of work?

$$\frac{\square \text{ hours}}{\$ \square} = \frac{\square \text{ hours}}{\$ \square}$$

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Using Proportions to Find Lengths of Sides

POWER UP

Think of a small square and a large square, or a small circle and a large circle — these figures have the same shape, but are different in size. If two figures have the same shape, their **corresponding angles** are equal in measure. Also, the **corresponding sides** of the two figures are proportional. The lengths of **proportional sides** form equal ratios.

$\triangle ABC$ and $\triangle DEF$ are the same shape. What is the length of \overline{EF} ?

1 Write a proportion.

$$\frac{AB}{DE} = \frac{BC}{EF}$$

$$\frac{3}{6} = \frac{4}{x}$$

2 Cross multiply to solve for x .

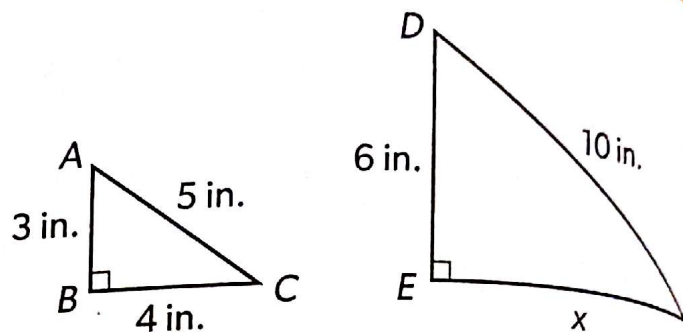
$$3 \cdot x = 6 \cdot 4$$

$$3x = 24$$

$$\frac{3x}{3} = \frac{24}{3}$$

$$x = 8$$

The length of \overline{EF} is 8 inches.



I get it! If $\triangle ABC$ and $\triangle DEF$ have the same shape, then I know that the corresponding angles have the same measure and that the corresponding sides are proportional!



Words to Know

corresponding angles

angles of two figures that are in the same relative positions

$\angle M$ and $\angle X$

$\angle N$ and $\angle Y$

$\angle O$ and $\angle Z$

corresponding sides

sides of two figures that are in the same relative positions

MN and XY

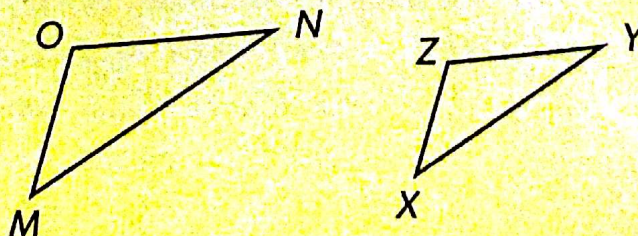
NO and YZ

OM and ZX

proportional sides

corresponding sides with lengths that form equal ratios

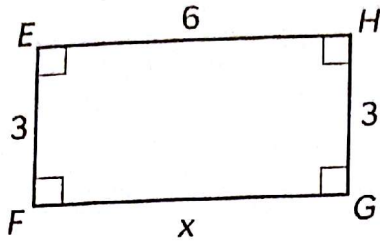
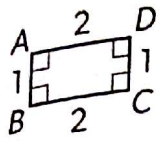
$$\frac{MN}{XY} = \frac{NO}{YZ} = \frac{OM}{ZX}$$



A You can use proportions to find missing side lengths.

DO

Rectangles $ABCD$ and $EFGH$ have the same shape. What is the length of \overline{FG} ?



Since the figures have the same shape, I could have written a proportion by using any two pairs of corresponding sides!



1 Write a proportion.

$$\frac{EF}{AB} = \frac{FG}{BC}$$

$$\frac{\boxed{}}{\boxed{}} = \frac{\boxed{x}}{\boxed{2}}$$

2 Cross multiply to solve for x .

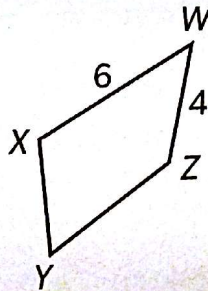
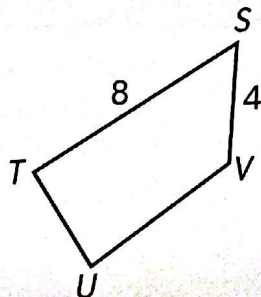
$$\underline{} \cdot \underline{} = \underline{} \cdot \underline{}$$

$$\underline{} = x$$

The length of \overline{FG} is $\underline{}$.

DISCUSS

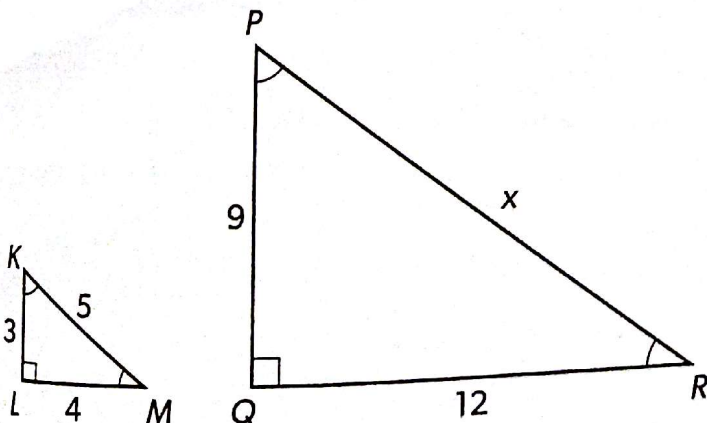
Alyssa says that quadrilaterals $STUV$ and $WXYZ$ have the same shape. Is she correct? Explain.



PRACTICE

The triangles have the same shape. Write and solve a proportion to find the unknown side length.

0



$$\frac{QR}{LM} = \frac{PR}{KM}$$

$$\frac{\boxed{}}{\boxed{}} = \frac{\boxed{x}}{\boxed{5}}$$

$$\underline{} \cdot \underline{} = \underline{} \cdot \underline{}$$

$$\underline{} = \underline{}$$

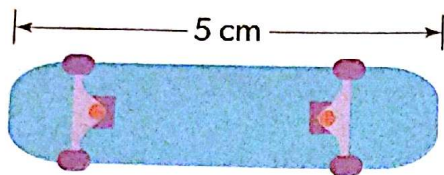
$$x = \underline{}$$

The length of \overline{PR} is $\underline{}$.

READY TO GO Scale Drawings

A **scale drawing** represents an actual object. The **scale** compares the actual size of an object and the size of its drawing.

What is the length of the actual skateboard?



Scale: 1 cm = 15 cm

- 1 Find the length of the skateboard in the scale drawing. The length of the skateboard in the drawing is 5 cm.
- 2 Write and solve a proportion.

The scale is the ratio $\frac{\text{actual measure}}{\text{drawing measure}}$

$$\frac{x}{5} = \frac{15}{1}$$

$$x = 15 \times 5$$

$$x = 75$$

The actual length of the skateboard is 75 centimeters.



I get it! I can use the scale to write one ratio of a proportion.

Words to Know

scale

how much the actual object has been reduced or enlarged in a scale drawing

scale drawing

a representation of an object that is proportional to the actual object

DISCUSS

A scale drawing of an ant is 4 cm long. It has a scale of 1 cm = 0.5 cm. Explain how you would find the actual length of the ant.

LESSON LINK

PLUG IN

Finding equivalent ratios helps you to write proportions.

$$\frac{2}{3} = \frac{x}{15}$$

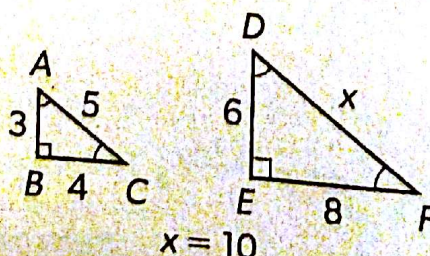
$$2 \cdot 15 = 3 \cdot x$$

$$30 = 3x$$

$$10 = x$$

POWER UP

Use ratios of corresponding sides of figures that have the same shape to solve problems.



GO!

I see! I can use what I know about proportions and figures that have the same shape to solve problems about scale drawings.



WORK TOGETHER

You can sketch a scale drawing by finding the proportions of corresponding sides of figures that have the same shape.

- Write proportions to find the length and width of the scale drawing.
- The sketch shows the scale drawing of the room.

The actual dimensions of a room are 40 feet by 20 feet. Sketch a scale drawing of the room with a scale of 1 cm = 4 feet.

Scale drawing length:

$$\frac{1 \text{ cm}}{4 \text{ ft}} = \frac{l}{40}$$

$$1 \cdot 40 = 4 \cdot l$$

$$40 = 4l$$

$$10 = l$$

Scale drawing width:

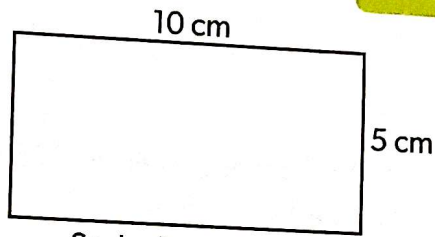
$$\frac{1 \text{ cm}}{4 \text{ ft}} = \frac{w}{20}$$

$$1 \cdot 20 = 4 \cdot w$$

$$20 = 4w$$

$$5 = w$$

I get it! I use the scale and the actual length and width to find the length and width of a scale drawing.



Scale: 1 cm = 4 ft



A You can find the actual measures of an object from a scale drawing.

DO

Christopher makes a scale drawing of his favorite car. The car is 15 cm long and 8 cm high. If the scale is 1 cm = 0.75 ft, what are the measurements of the actual car?

- 1 List the measures of the length and height of the scale drawing.
- 2 Write proportions to find the actual length and height of the car.

Length of scale drawing: _____

Height of scale drawing: _____

Length of actual car:

$$\frac{\boxed{} \text{ cm}}{\boxed{} \text{ ft}} = \frac{\boxed{} \text{ cm}}{\boxed{} \text{ ft}}$$

$$\underline{} \cdot \underline{} = \underline{} \cdot \underline{}$$

$$\underline{} = \underline{}$$

The length of the actual car is _____ ft.

Height of actual car:

$$\frac{\boxed{} \text{ cm}}{\boxed{} \text{ ft}} = \frac{\boxed{} \text{ cm}}{\boxed{} \text{ ft}}$$

$$\underline{} \cdot \underline{} = \underline{} \cdot \underline{}$$

$$\underline{} = \underline{}$$

The height of the actual car is _____ ft.

DISCUSS

Suppose the scale for the scale drawing is 1 cm = 1 ft. Without computing, what are the length and width of the actual car?

PRACTICE

Write and solve a proportion to find the length of the actual object.

1 Scale: 1 in. = 3 ft
Length on a scale drawing: 6 in.

$$\frac{\boxed{} \text{ in.}}{\boxed{} \text{ ft}} = \frac{\boxed{} \text{ in.}}{\boxed{} \text{ ft}}$$

The actual length is _____ feet.

2 Scale: 5 cm = 15 km

Length on a scale drawing: 7 cm

$$\frac{\boxed{} \text{ cm}}{\boxed{} \text{ km}} = \frac{\boxed{} \text{ cm}}{\boxed{} \text{ km}}$$

The actual length is _____ kilometers.

3 A room has a length of 35 feet and a width of 25 feet. Make a scale drawing of the room with the scale 1 cm = 5 ft.

Length of scale drawing:

$$\frac{\boxed{1} \text{ cm}}{\boxed{5} \text{ ft}} = \frac{\boxed{l} \text{ cm}}{\boxed{} \text{ ft}}$$

Solve for *l*.

Width of scale drawing:

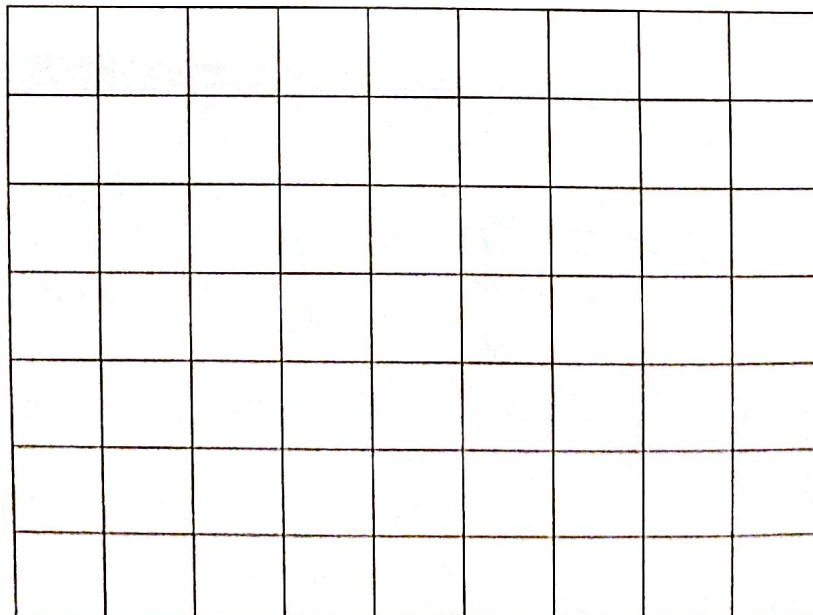
$$\frac{\boxed{} \text{ cm}}{\boxed{} \text{ ft}} = \frac{\boxed{} \text{ cm}}{\boxed{} \text{ ft}}$$

Solve for *w*.

REMEMBER
Write a proportion using the ratios of scale measure to actual measure.

The length of the scale drawing is _____ centimeters.

The width of the scale drawing is _____ centimeters.



Solve.

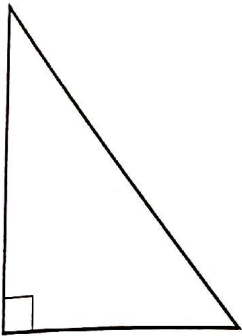
4 A road is 9 inches long on a road map. If the scale on the map is 1 inch = 6 miles, what is the actual length of the road?

_____ miles

I know I can use the scale to write a ratio!

5 The scale drawing shows a logo design for a scoreboard. What will be the perimeter of the actual logo? Use a ruler to measure the drawing.

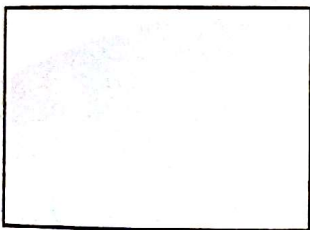
_____ cm



Scale: 1 cm = 20 cm

6 The scale drawing shows a rectangular garden. Mike plans to build a fence around it. How many feet of fencing does he need to go around the garden? Use a ruler to measure the drawing.

_____ feet



Scale: 1 in. = 10 ft

Writing a proportion can help me to understand a problem with scale drawings better.



DISCUSS

Make Sense of Problems

Sarah and Matt both make scale drawings of the classroom. Sarah makes the scale of her drawing 2 cm = 1 ft. Matt makes the scale of his drawing 3 cm = 1.5 ft. How will the sizes of their scale drawings compare? Explain.