

Scale Drawings: Lengths, Areas and Scale Factors

Grade 7 math · Lesson · Standards: 7.G.A.1

Quick answer: A scale drawing multiplies every actual length by the same scale factor, so shapes stay the same while sizes change. To find an actual length, multiply the drawing length by the scale. Areas change by the square of the scale: a scale of 1 inch to 4 feet makes each square inch stand for 16 square feet.

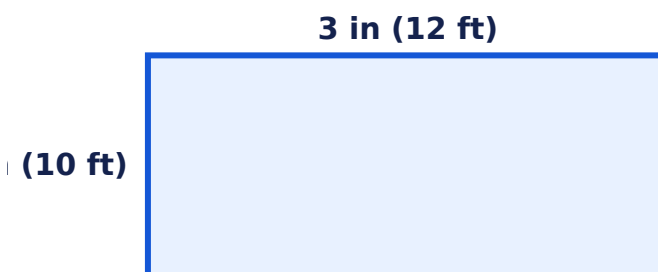
Standards: 7.G.A.1 · **Level:** Grade 7

What is a scale drawing?

A scale drawing shows a real object with every length multiplied by the same number. The scale, such as 1 inch = 4 feet, tells how a length on paper compares with the real length.

Scale and scale factor

The **scale factor** is drawing length $\div$ actual length, with both in the same unit. Since 4 feet = 48 inches, the scale 1 in = 4 ft has scale factor $\frac{1}{48}$.



Scale 1 in = 4 ft: a 3 in by 2.5 in drawing shows a 12 ft by 10 ft room.

How do you find an actual length from a drawing?

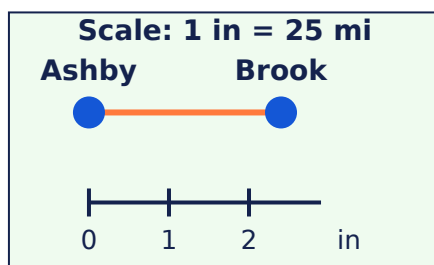
Method with a proportion

1. Write the scale as a ratio, drawing : actual.
2. Set up the proportion drawing $\div$ actual = scale ratio.
3. Solve for the missing length.
4. Label the answer with the actual unit.

Worked example

On a map, 1 in = 25 mi. Two towns are 2.4 in apart.

$$2.4 \times 25 = \mathbf{60 \text{ miles}}$$



The segment is 2.4 in long, so the towns are $2.4 \times 25 = 60$ miles apart.

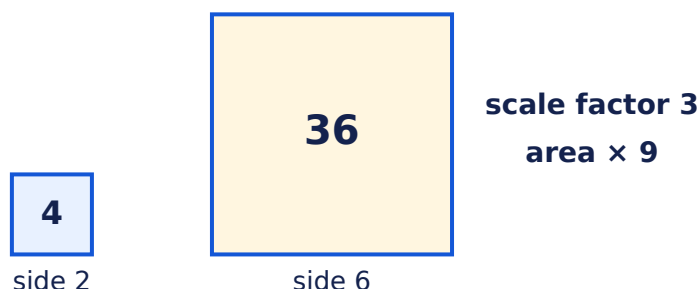
How does area change with the scale?

Length is one-dimensional, but area has two dimensions. If every length is multiplied by k , every area is multiplied by k^2 .

Area and scale

$$\text{actual area} = \text{drawing area} \times (\text{length scale})^2$$

With the scale 1 in = 4 ft, one square inch of drawing covers $4 \times 4 = 16$ square feet. The 3 in by 2.5 in room has a drawing area of 7.5 square inches, so the real room has $7.5 \times 16 = 120$ square feet. Check: $12 \times 10 = 120$.



Lengths grow by a factor of 3, but the area grows by $3 \times 3 = 9$.

How do you redraw a figure at a different scale?

Find each actual length, then divide by the new scale. Going from 1 in = 4 ft to 1 in = 8 ft multiplies every drawing length by $4 \div 8 = \text{one half}$.

Actual length	Scale 1 in = 4 ft	Scale 1 in = 8 ft
12 ft	3 in	1.5 in

Actual length	Scale 1 in = 4 ft	Scale 1 in = 8 ft
10 ft	2.5 in	1.25 in

Check the units first

A scale of 1 in = 4 ft mixes inches and feet. Convert to one unit before you compute a scale factor, and square the factor, not the answer, for area.

Mathbot's tip

Sketch a quick unit box: if one square inch stands for 16 square feet, any area answer must be a multiple of 16.

Key points to remember

- A scale such as 1 in = 4 ft means every inch on the drawing stands for 4 feet in real life.
- The scale factor equals drawing length divided by actual length in the same unit.
- Lengths change by the scale factor, but areas change by the square of the scale factor.
- Redrawing at a new scale multiplies each drawing length by old scale $\div$ new scale.

Scale Drawings: Lengths, Areas and Scale Factors: frequently asked questions

What is the difference between a scale and a scale factor?

A scale such as 1 in = 4 ft compares two different units. A scale factor is a plain number, like $1/48$, found when both lengths use the same unit.

How do I find the actual area from a drawing?

Find the actual length and width and multiply them, or multiply the drawing area by the square of the scale. Both methods give the same answer.

Why is the area factor the square of the length factor?

Area multiplies two lengths, and each length is scaled. A scale factor of 3 on length and width gives $3 \times 3 = 9$ times the area.

Is a scale factor less than 1 an enlargement?

No. A scale factor below 1 makes a reduction and one above 1 makes an enlargement. Maps and blueprints are reductions, so their scale factors are fractions.

Can I use any unit in the scale?

Yes, but both parts must be clear. Keep the units attached when you compute, and convert to a

single unit when you need a pure scale factor.