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Unit 1, Lesson 12: Units in Scale Drawings

Let's use different scales to describe the same drawing.

5 mins

12.1: Centimeters in a Mile

There are 2.54 cm in an inch, 12 inches in a foot, and 5,280 feet in a mile. Which expression gives the number of centimeters in a mile? Explain your reasoning.

A. $\frac{2.54}{12 \cdot 5{,}280}$

$12 \frac{in}{ft} \times 2.54 \frac{cm}{in} \times 5280 ft$ (in a foot) (in a mile)

B. $5{,}280 \cdot 12 \cdot (2.54)$

C. $\frac{1}{5{,}280 \cdot 12 \cdot (2.54)}$ ← what does this represent? scale factor to convert from mi. to cm.

D. $5{,}280 + 12 + 2.54$

E. $\frac{5{,}280 \cdot 12}{2.54}$

12.2: Scales Card Sort

Demonstrate partner work expectations

Your teacher will give you some cards with a scale on each card.

1. Sort the cards into sets of equivalent scales. Be prepared to explain how you know that the scales in each set are equivalent. Each set should have at least two cards.

5-6 mins

2. Trade places with another group and check each other's work. If you disagree about how the scales should be sorted, work to reach an agreement.

2-3 mins

Pause here so your teacher can review your work. Whole class discussion

3. Next, record one of the sets with three equivalent scales and explain why they are equivalent.

5-6 mins

* 1 cm : 1 m = 1 to 100
* 1 cm & 1 km = $\frac{1}{2}$ cm & 500 m = 1 & 100,000
* 1 in : 8 ft = $\frac{1}{8}$ in : 1 ft = 1 : 96
* 1 cm : 10 m = 1 in : 100 in = 1 mm : 1 m
* 1 ft : 1 mi = 1 : 5280
* 1 in : 1 mi = 1 : 63,360

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12.3: The World's Largest Flag

4-5 mins quiet work time; 5 mins. to collaborate in groups

As of 2016, Tunisia holds the world record for the largest version of a national flag. It was almost as long as four soccer fields. The flag has a circle in the center, a crescent moon inside the circle, and a star inside the crescent moon.

1. Complete the table. Explain or show your reasoning.

cm/meters ↓ actual / 2000 × 100

actual length ↑

	flag length	flag height	height of crescent moon
actual	396 m	264 m	99 m
at 1 to 2,000 scale	19.8 cm	13.2 cm	4.95 cm

(13.2) · 2000 = 26400 ÷ 100 = 264

2. Complete each scale with the value that makes it equivalent to the scale of 1 to 2,000. Explain or show your reasoning.

also or 1 : ___ each would present using 10

a. 1 cm to 2000 cm

b. 1 cm to 20 m $\frac{2000}{100} = 20$

c. 1 cm to 0.02 km $\frac{2000}{100,000} = 0.02$

d. 2 m to 4000 m $2000 \cdot 2 = 4000$

1 m : 20 m

e. 5 cm to 100 m $5 \cdot 20 =$

f. 50 cm to 1,000 m $1000 \div 2000 = 0.5$ m or 50 cm

g. 10 mm to 20 m

10 m = 1 cm

3. a. What is the area of the large flag?

396 m × 264 m = 104,544 m²

b. What is the area of the smaller flag?

19.8 cm × 13.2 cm = 261.36 cm²

c. The area of the large flag is how many times the area of the smaller flag?

Scale factor for height is 2000
for length is 2000

→ It should have work our dimensions explicitly

So area of actual flag is

2000 × 2000 or

= 4,000,000 times the area of the scale drawing

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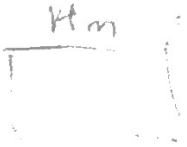
12.4: Pondering Pools

Your teacher will give you a floor plan of a recreation center.

1. What is the scale of the floor plan if the actual side length of the square pool is 14 m? Express your answer both as a scale with units and without units.

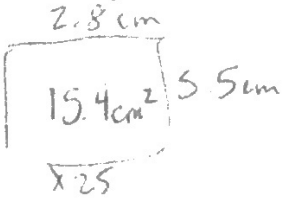


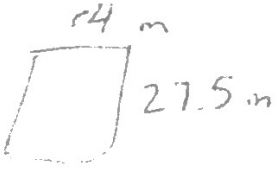
Scale is 1:500 or 1cm to 5m or 2.8cm to 14m

2. Find the actual area of the large rectangular pool. Show your reasoning.

multiply scaled area by 5^2 = 25!

≈ 385 m^2





3. The kidney-shaped pool has an area of 3.2 cm^2 on the drawing. What is its actual area? Explain or show your reasoning.

≈ 80 m^2

$1 cm^2 = 25 m^2$

$3.2 cm^2 \times 25 =$

$80 m^2$

Are you ready for more?

1. Square A is a scaled copy of Square B with scale factor 2. If the area of Square A is 10 $units^2$, what is the area of Square B? $\frac{10}{2^2}$
2. Cube A is a scaled copy of Cube B with scale factor 2. If the volume of Cube A is 10 $units^3$, what is the volume of Cube B? $\frac{10}{2^3}$
3. The 4-dimensional Hypercube A is a scaled copy of Hypercube B with scale factor 2. If the "volume" of

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Lesson 12 Summary

Sometimes scales come with units, and sometimes they don't. For example, a map of Nebraska may have a scale of 1 mm to 1 km. This means that each millimeter of distance on the map represents 1 kilometer of distance in Nebraska. The same scale without units is 1:1,000,000, which means that each unit of distance on the map represents 1,000,000 units of distance in Nebraska. This is true for *any* choice of unit.

To see that these two scales are equivalent, notice there are 1,000 millimeters in 1 meter and 1,000 meters in 1 kilometer. This means there are $1{,}000 \cdot 1{,}000$ or 1,000,000 millimeters in 1 kilometer. So the actual distances in Nebraska are 1,000,000 times as far as the distances on the map.

A scale tells us how a length on a drawing corresponds to an actual length, and it also tells us how an area on a drawing corresponds to an actual area.

For example, if 1 centimeter on a scale drawing represents 2 meters in actual distance, what does 1 *square* centimeter on the drawing represent in actual area? The square on the left shows a square with side lengths 1 cm, so its area is 1 square cm.

The square on the right shows the actual dimensions represented by the square on the left. Because each side length in the actual square is 2 m, the actual square has an area of 2^2 or 4 square meters.

We can use this relationship to find the actual area of any region represented on this drawing. If a room has an area of 18 cm^2 on the drawing, we know that it has an actual area of $18 \cdot 4 = 72$ or 72 m^2.

In general, if 1 unit on the drawing represents n actual units, then one square unit on the drawing represents n^2 actual square units.