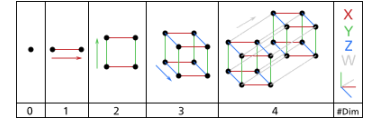# Spatial (space) dimensions & units
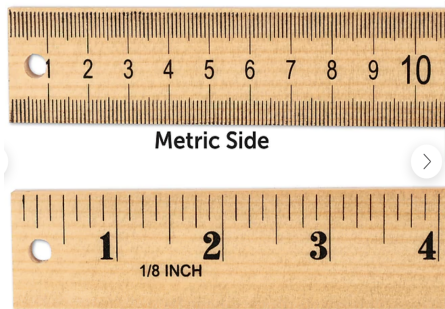

1 dimension (1D) $\Rightarrow$ Length (l)

Units: $2\text{ m} + 3\text{ m} = 5\text{ m}$ $2\text{ m} + 3\text{ m} \neq 5\text{ m}^2$

Metric (International system, SI) units	Imperial (British imperial) units
Millimeter (mm) Centimeter (cm) $\Rightarrow$ 10 mm in 1 cm Meter (m) $\Rightarrow$ 1000 mm in 1 m $\Rightarrow$ 100 cm in 1 m Kilometer (km) $\Rightarrow$ 1000 m in 1 km	Inch (in, ″) Foot (ft, ′) $\Rightarrow$ 12 inches in 1 foot Yard (yd) $\Rightarrow$ 3 feet in 1 yard Mile (mi) $\Rightarrow$ 5280 feet in 1 mile

Metric Side

1/8 INCH

Metric $\leftrightarrow$ Imperial length conversion
•   1 cm $\approx$ 0.4 inch ($\frac{4}{10}$ inch)   •   1 inch = 2.54 cm $\approx 2\frac{1}{2}$ cm   •   1 meter $\approx$ 3.28 feet $\approx 3\frac{1}{3}$ feet   •   1 kilometer $\approx$ 0.62 miles $\approx \frac{3}{5}$ miles   •   1 mile $\approx$ 1.6 km $\approx 1\frac{3}{5}$ km

2 dimensions (2D) $\Rightarrow$ Area (A)

Units: $2\text{ m} \times 3\text{ m} = 6$ square meters (6 m²) $2\text{ m} \times 3\text{ m} \neq 6\text{ m}$
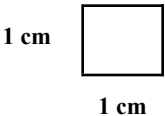
Metric units	Imperial units
Square millimeter (mm²) Square centimeter (cm $\times$ cm = cm²) (cm squared) Square meter (m²) Square kilometer (km²)	Square inch (in $\times$ in = in²) Square foot (ft²) Square yard (yd²) Square mile (mi²)

Area of a rectangle formula $\Rightarrow$ Area equals length times width. Area is measured in square units.

Width (w)

Length (l)

$$A = l \times w$$

** Remember and double check**

Units are *also multiplied*, and therefore ($\therefore$) *change*.
Area is measured in *square units*. Always check the units!

$2\text{ cm} \times 4\text{ cm} = 8$ square cm (8 cm²) (8 cm squared)

$2\text{ cm} \times 4\text{ cm} \neq 8\text{ cm}$

"Square" & "squared" mean multiplying something by itself, $\therefore$
$0 \times 0 = 0^2 = 0$ … $1 \times 1 = 1^2 = 1$ … $2 \times 2 = 2^2 = 4$
$3 \times 3 = 3^2 = 9$ … $10 \times 10 = 10^2 = 100$… $\infty \times \infty = \infty^2 = \infty$

Ex. 1) Alice makes the rectangle below with 4 square cm tiles. What is the: length? width? area?

1 cm

1 cm

$l = 1$ cm $+ 1$ cm $= 2$ cm

$l = 2$ cm
$w = 2$ cm
$A = l \times w$
$A = 2$ cm $\times 2$ cm $= 4$ cm^2

The area is 4 square cm. (or: The area is 4 cm^2.)

Ex. 2) Bob makes the rectangle below with 4 square cm tiles. What is the: length? width? area?

$l = 1$ cm $+ 1$ cm $+ 1$ cm $+ 1$ cm $= 4$ cm

$l = 4$ cm
$w = 1$ cm
$A = 4$ cm $\times 1$ cm $= 4$ cm^2

The area is 4 square cm. (or: The area is 4 cm^2.)

Ex. 3) Alice & Bob make a rectangle with 48 square cm tiles   If there are 6 equal rows:
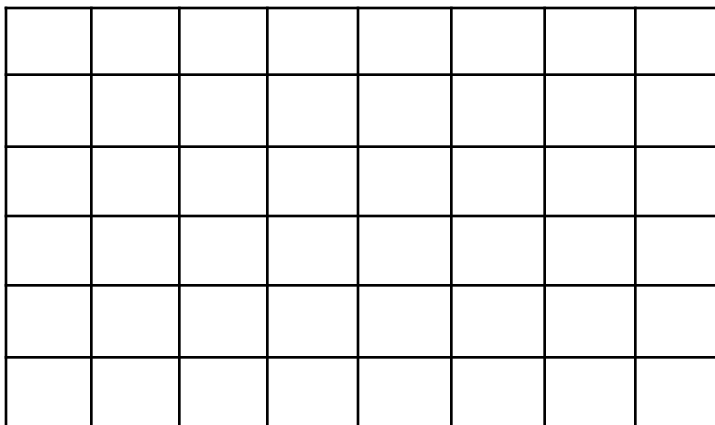
What is the length? $\Rightarrow l = 8$ cm
What is the width? $\Rightarrow w = 6$ cm
What are the dimensions? $\Rightarrow 8$ cm $\times 6$ cm
What is the area? $\Rightarrow A = l \times w$
          $\Rightarrow A = 8$ cm $\times 6$ cm
          $\Rightarrow A = 48$ cm^2

The area is 48 square cm.
or
The area is 48 cm^2.
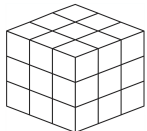
<mark>3 dimensions (3D) $\Rightarrow$ Volume (V)</mark>

Volume is measured in cubic units.
"Cubed" or "cubic" means multiplying something by itself twice, $\therefore$
$1 \times 1 \times 1 = 1^3 = 1$ … $2 \times 2 \times 2 = 2^3 = 8$
$3 \times 3 \times 3 = 3^3 = 27$ … $10 \times 10 \times 10 = 10^3 = 1000$ …

<mark>$V = l \times w \times h$</mark>

Metric units	Imperial units
Cubic millimeter (mm^3) Cubic cm (cm $\times$ cm $\times$ cm $=$ cm^3) (cm cubed) Cubic meter (m^3) Cubic kilometer (km^3)	Cubic in (in $\times$ in $\times$ in $=$ in^3) Cubic foot (ft^3) Cubic yard (yd^3) Cubic mile (mi^3)