

Measurements

Measurements are comparisons of properties against accepted standards, called units.

English/US units:

$$1 \text{ foot} = 12 \text{ inches}$$

$$1 \text{ yard} = 3 \text{ ft}$$

$$1 \text{ mile} = 1760 \text{ yd}$$

$$5280 \text{ ft} = 1 \text{ mile}$$

So what's the problem? Units are not consistent. Difficult to learn and use.

English units are nonstandard and difficult to use. Solution?

THE METRIC SYSTEM

Metric Base Units:

Length	meter	m
Mass	kilogram*	kg
Temperature	Kelvin	K
Time	second	s

All metric units are made up of COMBINATIONS of BASE UNITS!

*we usually treat the gram as if it's the base unit for mass!

- One meter is approximately 3.3 feet.
- One kilogram is approximately 2.2 pounds.

What about SIZE?

Metric units may be made larger or smaller by adding PREFIXES.

Metric Prefixes:

mega-	10^6	M
kilo-	10^3	k
centi-	10^{-2}	c
milli-	10^{-3}	m
micro-	10^{-6}	μ

Bigger units

smaller units

Memorize
these
prefixes!

Applying prefixes

$$1 \text{ _____ m} = \text{_____ m}$$

$$1 \text{ km} = 10^3 \text{ m} \quad (1000 \text{ m}) \quad 10 \times 10 \times 10$$

$$1 \text{ cm} = 10^{-2} \text{ m} \quad \left(\frac{1}{100} \text{ m} \right) \quad \frac{1}{10} \times \frac{1}{10}$$

Scaling units with metric prefixes ... examples

The distance between here and Columbia, SC is about 107,000 meters.
What metric unit would be best suited for a distance like this?

$$107000 \text{ m} \quad \text{km?}$$
$$\text{km} = 10^3 \text{ m} = 1000 \text{ m}$$

$$107 \text{ km}$$

A piece of chalk is 0.080 meters long. What metric unit would be best suited for this length?

$$0.080 \text{ m} \quad \text{cm?}$$
$$\text{cm} = 10^{-2} \text{ m} = \frac{1}{100} \text{ m}$$

$$8 \text{ cm}$$

Derived Units

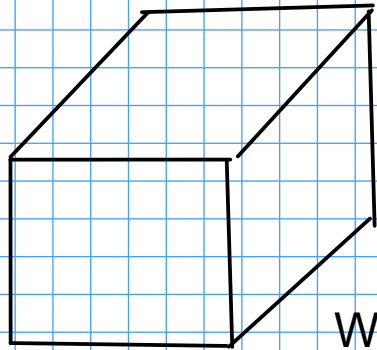
- are units that are made up of combinations of metric base units with each other and/or with prefixes

Two derived units are particularly important in introductory chemistry:

1) VOLUME

2) DENSITY

VOLUME



L
m

W
m

H
m

$$\text{VOLUME} = L \times W \times H$$

What are the units of volume in the metric system?

UNITS?

L = length, metric unit of length
is ... meter

$$\begin{aligned} \text{VOLUME} &= \text{meter} \times \text{meter} \times \text{meter} \\ &= \text{meter}^3 \left(\text{m}^3 \right) \text{ "cubic meters" } \end{aligned}$$

... A little big for lab work

Practical issues for volume units

- Cubic meters are too large! A meter is very similar in length to a yard, so a cubic meter is a cube that is approximately a yard long on each side!

A smaller unit for volume?

Cubic decimeters!

(decimeter = $\frac{1}{10}$ meter)

Cubic decimeters are given the name "liters", abbreviation "L"

In the lab, we typically need an even smaller unit than the liter, so we use milliliters (mL)

cm^3
cubic centimeter
=
milliliter

$$1 \text{ mL} = 10^{-3} \text{ L}$$

- or -

$$1000 \text{ mL} = 1 \text{ L}$$