

# Measurements

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

## ENGLISH / US SYSTEM OF UNITS:

$$\begin{aligned} 1 \text{ foot} &= 12 \text{ inches} & 1 \text{ yard} &= 3 \text{ feet} & 1 \text{ mile} &= 1760 \text{ yards} \\ & & & & & 5280 \text{ feet} = 1 \text{ mile} \end{aligned}$$

So what's the problem?

The English system of units is cumbersome and difficult to use. The system contains many units which were developed independently, and because of this we have to MEMORIZE many relationships between different-sized units for the same quantity..

Different KINDS of units often have completely different relationships - meaning we either have to have a list of conversions handy or do a LOT of memorizing.

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.

A few common metric prefixes:

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

Bigger units



smaller units

MEMORIZE the common metric prefixes listed in the study guide

Applying prefixes

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

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

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

## 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?

$$K = 10^3 (1000)$$

$$km = 1000m$$

107 km

By "best suited", we mean a metric unit that would represent the number without many beginning or end zeros. These kinds of numbers are easier for us to remember!

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

$$c = 10^{-2} (1/100)$$

$$cm = \frac{1}{100} m$$

8.0 cm

## Derived Units

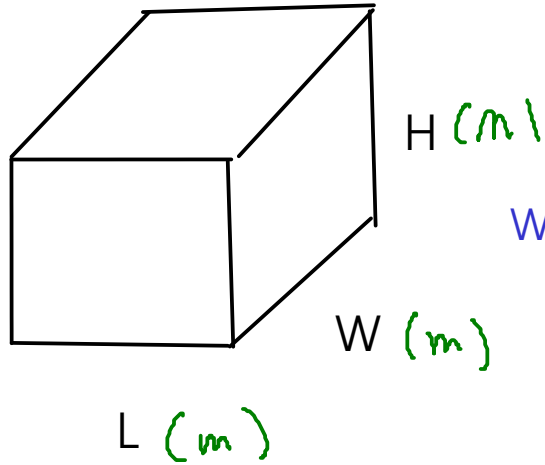
- are units that are made up of combinations of metric base units with each other and/or with prefixes

velocity:  $\frac{\text{miles}}{\text{hr}}$      $\frac{\text{km}}{\text{hr}}$      $\left(\frac{\text{m}}{\text{s}}\right)$      $\frac{\text{length}}{\text{time}}$

Two derived units are particularly important in general chemistry:

1) VOLUME

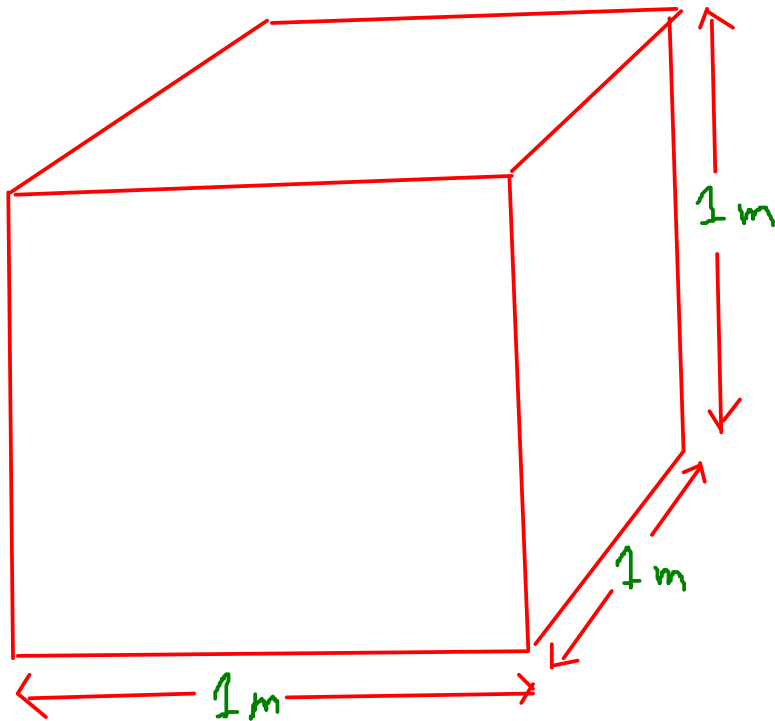
2) DENSITY

VOLUME

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

What are the units of volume in the metric system?

$$\begin{aligned} \text{VOLUME} &= m \times m \times m \\ &= m^3 \text{ "cubic meter"} \end{aligned}$$



Problem - the cubic meter is TOO LARGE for laboratory (and medical) work.

In lab, we need a smaller unit, so we'll have to scale the cubic meter down to something more manageable.