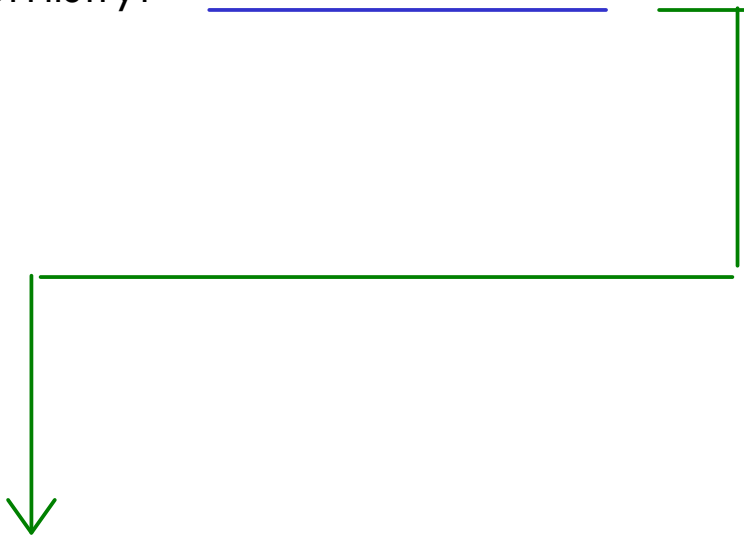
Some basic definitions:

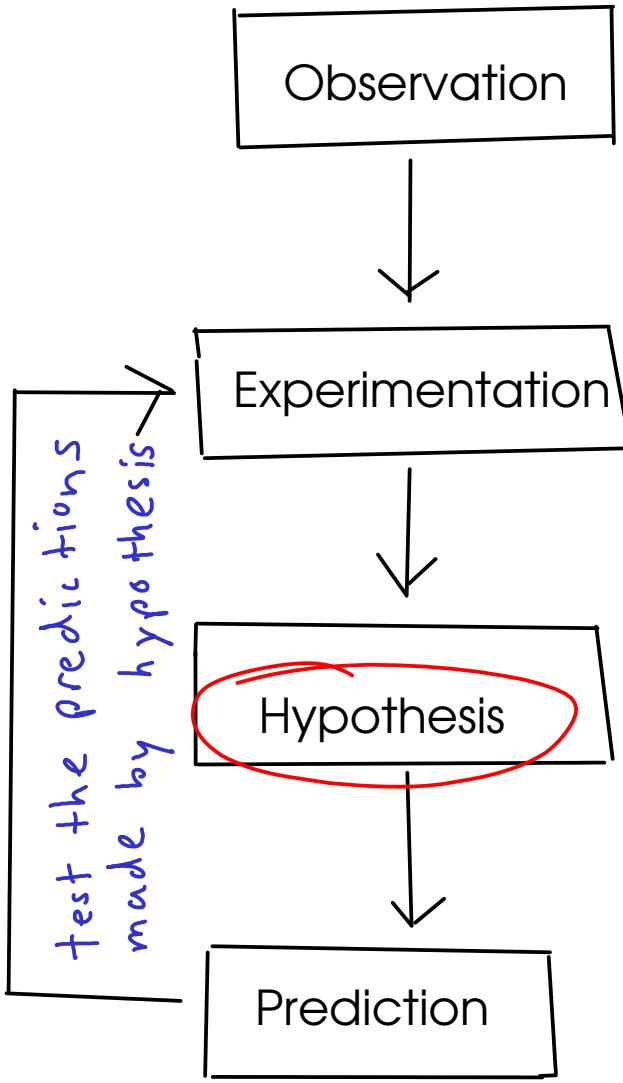
Chemistry: SYSTEMATIC STUDY OF MATTER AND THE CHANGES IT UNDERGOES



Matter: ANYTHING THAT TAKES UP SPACE AND CAN BE PERCEIVED (DETECTED)

... so what about "SYSTEMATIC STUDY"?

Systematic study? The scientific method



controlled conditions

vary one condition while keeping others the same

initial explanation of observations "WHY?"

Scientific laws

- SUMMARY of observation often in equation form.
- DOES NOT EXPLAIN OBSERVATIONS

Scientific theories

- an EXPLANATION of observations confirmed by repeated experiments
- accepted by most scientists

You flip the light switch in your den, but nothing happens. What is wrong?

observation/experiment: Flip light switch, no light!

hypothesis: ~~Explanation: Bulb is burned out.~~
Explanation: No power to bulb - check the breaker box.

prediction: ~~Changing the bulb should bring back the light.~~
Resetting the breaker would allow the light to come on.

experiment Result of changing the bulb: Still no light.
Result of resetting the breaker: Lights are on.

Measurements

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

English / US units:

1 foot = 12 inches 1 yard = 3 Feet 1 mile = 1760 yards

5280 ft = 1 mile

So what's the problem? English units are not consistent. This makes the English system hard to learn and use. The relationships between units in the English system must all be memorized separately.

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 _____ m = _____ m

1 km = 10^{3} m (1000 m) 10 x 10 x 10

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

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?

$K = 10^3$, $Km = 10^3 m$ (1000 m)

107 Km

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

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

8.0 cm

Derived Units

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

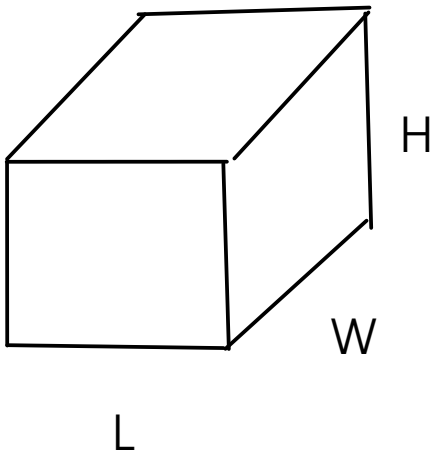
Example: speed $\frac{\text{miles}}{\text{hr}}$, $\frac{\text{Km}}{\text{hr}}$ $\left(\frac{\text{length}}{\text{time}}\right)$ $\frac{\text{m}}{\text{s}}$

Two derived units are particularly important in introductory chemistry:

1) VOLUME

2) DENSITY

VOLUME



VOLUME = L × W × H

What are the units of volume in the metric system?

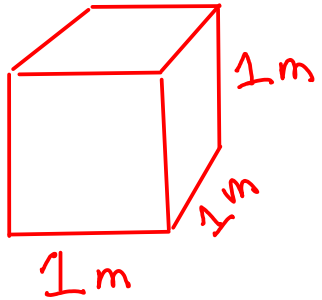
L = LENGTH. Metric base unit of length is the meter (m)

W = WIDTH; also in meters

H = HEIGHT; also in meters

VOLUME = (m)$_L$ × (m)$_W$ × (m)$_H$ = m^3 "CUBIC METERS"

... but the cubic meter is a large unit. Too large for typical lab and medical work! (Picture a cube that is a meter - a little longer than a yard - on each side.)



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! dm^3

(decimeter = 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)

"cc"
cubic centimeter
=
milliliter

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

-or-

$1000\ mL = 1\ L$