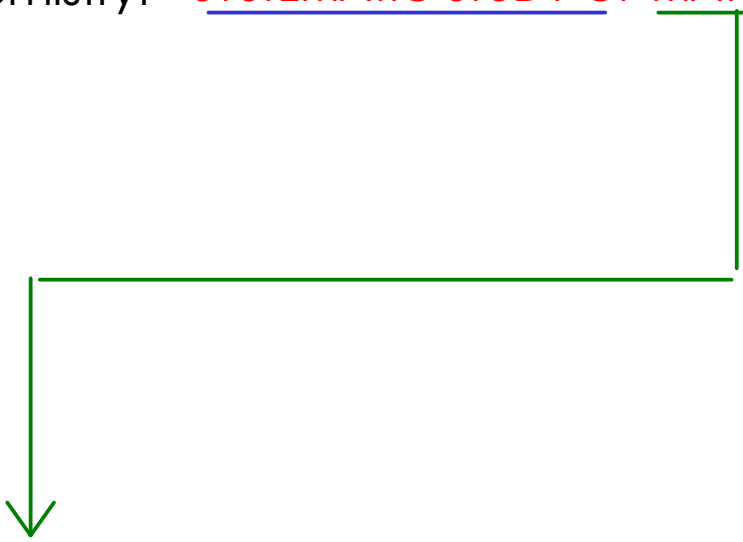
Some basic definitions:

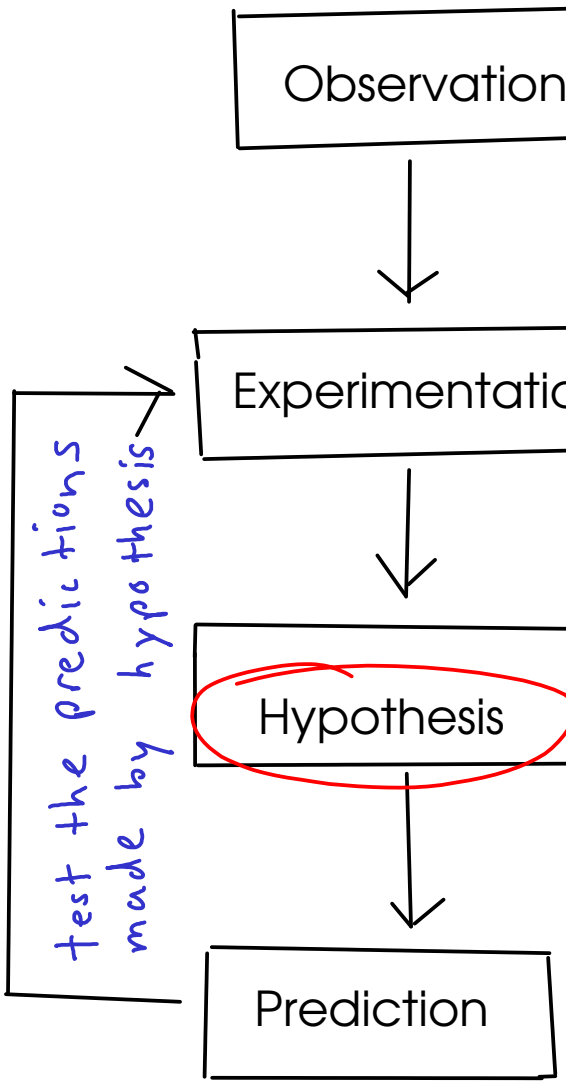
Chemistry: SYSTEMATIC STUDY OF MATTER AND THE CHANGES IT UNDERGOES



Matter: Anything that takes up space and can be perceived (or DETECTED)

... so what about SYSTEMATIC STUDY?

Systematic study? The scientific method



Preferably, under controlled conditions

Vary one (or a limited number of) parameter(s) while keeping others the same

An INITIAL EXPLANATION of observations and experiments

WHY?

Scientific laws

- are SUMMARIES of observations, often in equation form

Scientific laws DO NOT EXPLAIN the observations they are describing. In other words, they tell WHAT, not WHY.

Scientific theories

- are EXPLANATIONS of observations that have been supported by many experiments

- similar to HYPOTHESES, but with a lot more supporting data

Explanations are called theories when there's enough data for most scientists to accept the explanation as valid.

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

observation/experiment: Flip switch, but no light.

hypothesis: ~~Explanation: Bulb is burned out.~~
Explanation: The circuit breaker has tripped.

prediction: ~~Changing the bulb will restore the light.~~
Resetting the circuit breaker will restore the light.

experiment: ~~Change the bulb, but the light does not come on.~~
Reset the breaker. Result is that the light comes on.

Measurements

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

A properly-reported measurement has TWO PARTS:
(1) a measured NUMBER
(2) a UNIT

English/US Units:

1 foot = 12 inches

1 yard = 3 feet

1 mile = 1760 yards

5280 feet = 1 mile

So what's the problem? English units are not consistent. They don't relate to one another in meaningful ways.

The English system in practice is hard to learn and use. Relationships between units have to be memorized separately for each unit type, leading to confusion and errors in conversion.

English units are nonstandard and difficult to use. Solution?

THE METRIC SYSTEM

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

Metric Base Units:

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

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

Comparing to the English system:

- 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)

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

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

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?

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

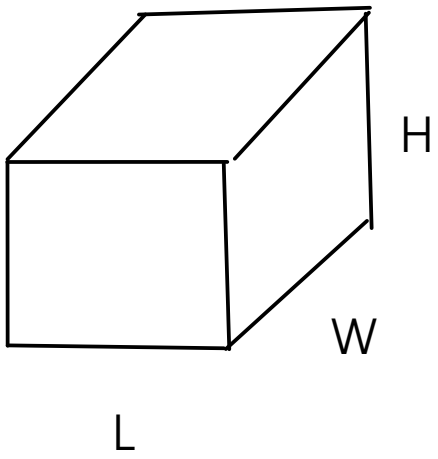
Example: speed $\frac{\text{miles}}{\text{hr}}$, $\frac{\text{km}}{\text{hr}}$ $\left(\frac{\text{length}}{\text{time}}\right)$, $\frac{\text{m}}{\text{s}}$

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?

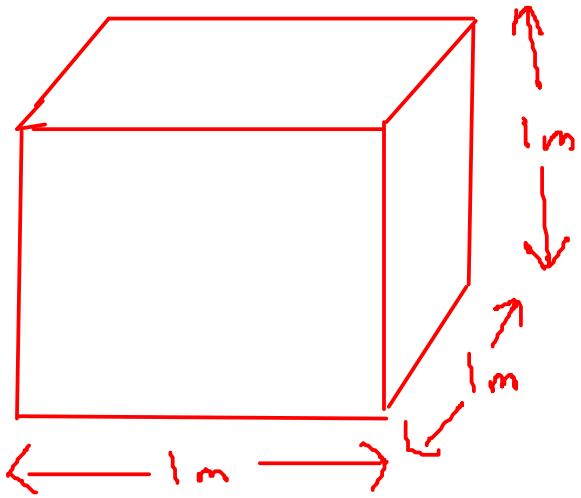
L = LENGTH. meter (m)

W = WIDTH. meter (m)

H = HEIGHT. meters (m)

VOLUME UNIT = (m) × (m) × (m)

= m^3 ("cubic meters")



... but the cubic meter is TOO LARGE for lab/medical work, so we scale this unit down.

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-

$1000\ mL = 1\ L$