Unit 3- Lesson 2

Chemistry 0

March 2022, L. Tracey Gao

Measurement

- Demonstrate the difference between accuracy and precision
- Identify common physical properties
- Explain the difference between mass and weight
- Work with metric prefixes
- Perform simple conversions between metric units
- Write large and small numbers in scientific notation

Certainty in measurement

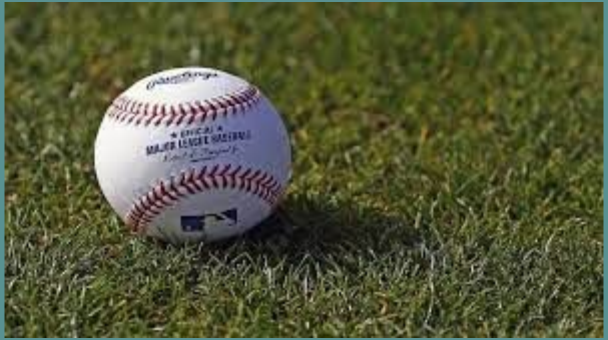
- Scientists can use **accuracy** and **precision** to describe the quality of their measurements.

- **Accuracy**: refers to how close a measured value is to the true measurement (true value) of something.

- **Precision**: refers to the ability to take the same measurement and get the same result over and over.

Certainty in measurement

Example:



Precision is easier to determine. You can see how close one measurement is to another.
Accuracy is more difficult because scientists might want to measure things that are not already known.

Units of Measurement

Measurements represent quantities.
A quantity is something that has magnitude, size, or amount.

measurement ≠ quantity
the teaspoon is a unit of measurement
volume is a quantity

The choice of unit depends on the quantity being measured.

Metric System and Prefixes

The metric system is a base ten system, so it is convenient to convert between prefixes by simply moving the decimal point accordingly. The base units that we most commonly use are liters (L), meters (m) and grams (g). Later in the year we will add moles to describe quantities of materials.

The metric line can help you to visualize moving the decimal point, when making conversions.

Value	1000000	100000	10000	1000	100	10	1	0.1	0.01	0.001	0.0001	0.00001	0.000001
Exponent	10^6	10^5	10^4	10^3	10^2	10^1	10^0	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}
Prefix	mega			kilo	hecto	deka	base	deci	centi	milli			micro
Abbr.	**M**			**k**	**h**	**da**		**d**	**c**	**m**			**μ**

Common Prefixes

Prefix	Abbreviation	Meaning		Scientific notation
exa	E	1,000,000,000,000,000,000		10^{18}
peta	P	1,000,000,000,000,000		10^{15}
tera	T	1,000,000,000,000		10^{12}
giga	G	1,000,000,000		10^{9}
mega	M	1,000,000		10^{6}
kilo	k	1,000		10^{3}
hecto	h	100		10^{2}
deka	da	10		10^{1}
(BASE)	(NONE)	1		10^{0}
deci	d		0.1	10^{-1}
centi	c		0.01	10^{-2}
milli	m		0.001	10^{-3}
micro	µ		0.000 001	10^{-6}
nano	n		0.000 000 001	10^{-9}
pico	p		0.000 000 000 001	10^{-12}
femto	f		0.000 000 000 000 001	10^{-15}
atto	a		0.000 000 000 000 000 001	10^{-18}

SI Measurement

- Scientists all over the world have agreed on a single measurement system called Le Système International d'Unités, abbreviated SI.
- SI has seven base units.
- Most other units are derived from these seven.

SI Base Units

Quantity	Quantity symbol	Unit name	Unit abbreviation	Defined standard
Length	l	meter	m	the length of the path traveled by light in a vacuum during a time interval of 1/299 792 458 of a second
Mass	m	kilogram	kg	the unit of mass equal to the mass of the international prototype of the kilogram
Time	t	second	s	the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom
Temperature	T	kelvin	K	the fraction 1/273.16 of the thermodynamic temperature of the triple point of water
Amount of substance	n	mole	mol	the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon-12
Electric current	I	ampere	A	the constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per meter of length
Luminous intensity	I_v	candela	cd	the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian

Scientific Notation

- **Scientific notation** is the method scientists use to quickly write very large or very small number.

- It can be as easy as counting. First, move the decimal in the appropriate direction. Move the decimal to the right for small numbers and to the left for large numbers. THen count the number of places the decimal moved to figure out the correct exponent.

Scientific Notation

- In **scientific notation,** numbers are written in the form $M \times 10^n$, where the factor M is a number greater than or equal to 1 but less than 10 and n is a whole number.

    - example: 0.000 12 mm = 1.2×10^{-4} mm