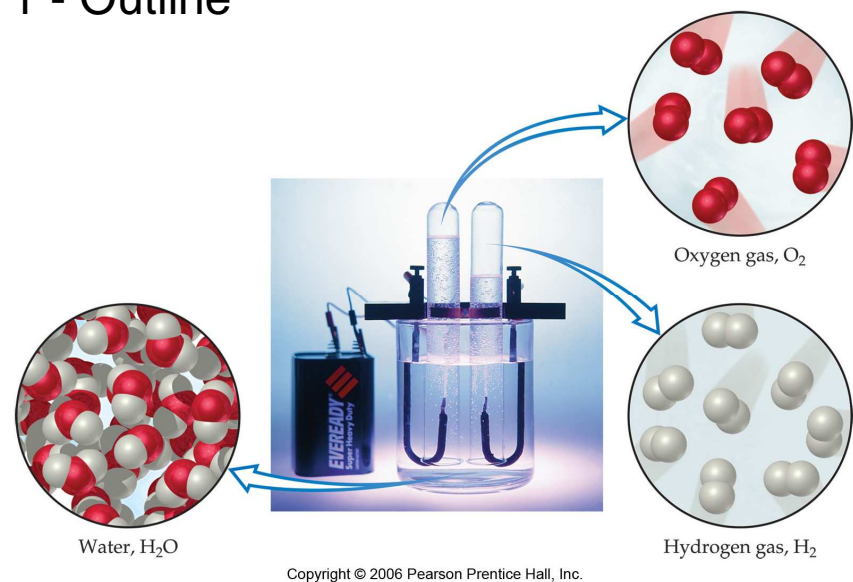


# Lecture 1 - Outline

Syllabus + Course Intro.

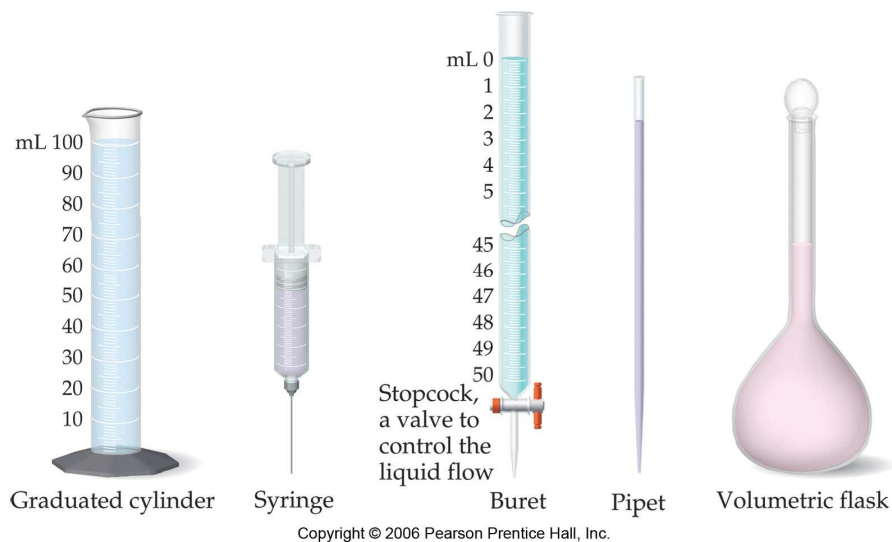
1.1 What is Chemistry?

1.2 & 1.3 Chemical Terminology



1.4 & 1.5 Things you need to know about Measurements

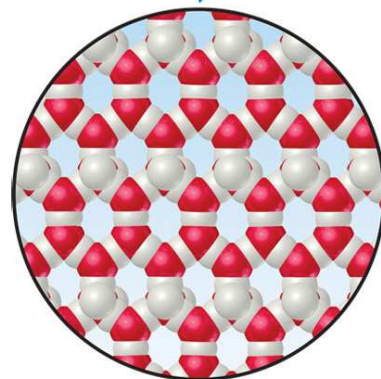
1.6 Unit Conversion



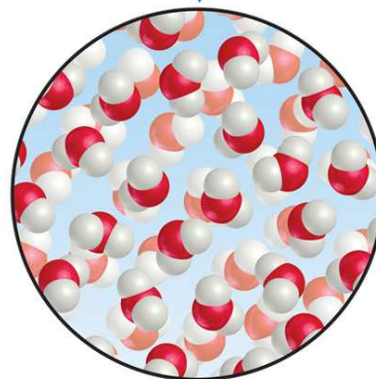
What is chemistry? Why are we studying it?



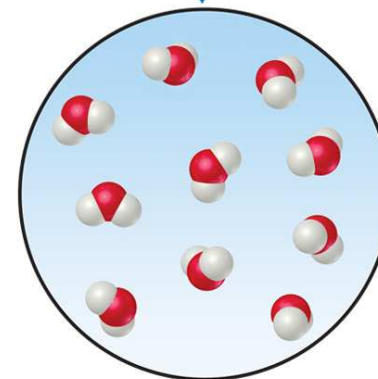
Molecular View



Solid



Liquid



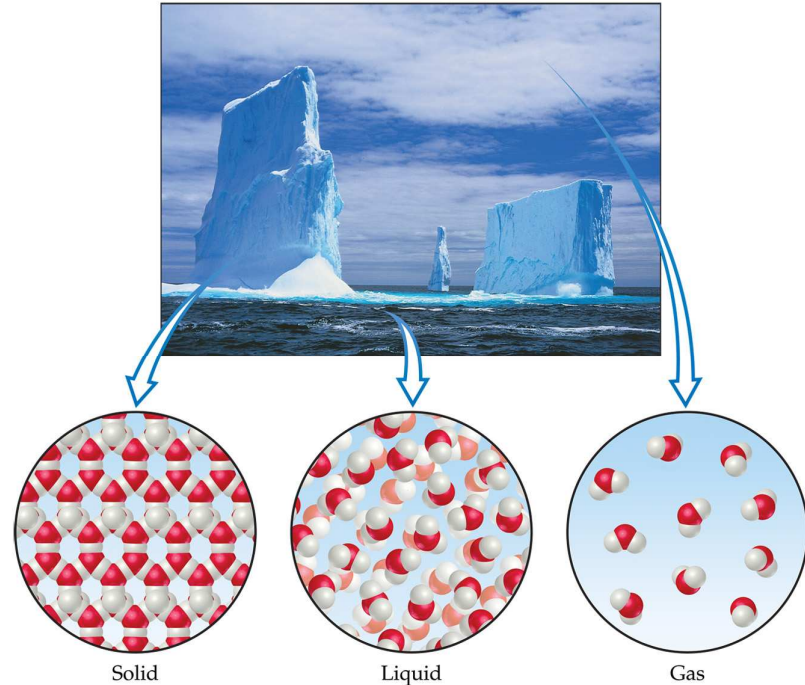
Gas

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Chemistry is the study of **matter** and the **changes** it undergoes.

# Classification of Matter by State or Composition

State: solid, liquid, gas



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Macroscopic –

solid – rigid, shape independent of container

liquid – shape dependent on container, incompressible

gas – no fixed volume or shape, compressible

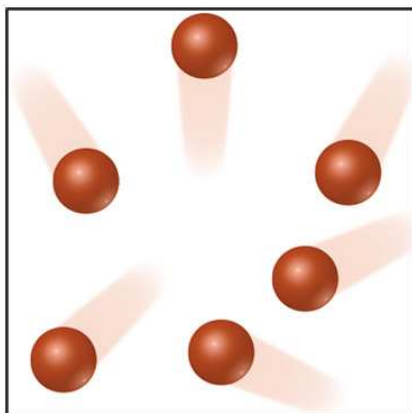
Microscopic –

solid – molecules are closely packed

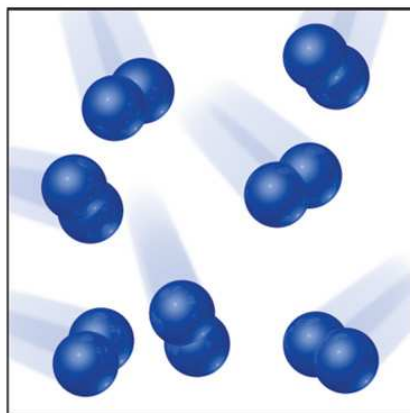
liquid – molecules close and slide over one another

gas – molecules are far apart and move at high speeds

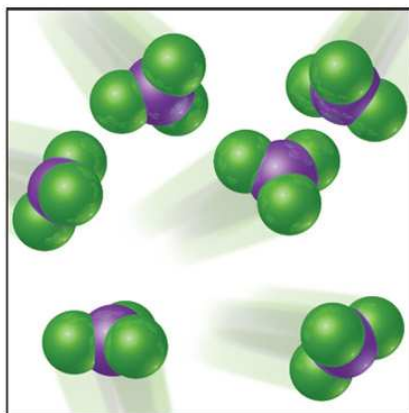
## Terminology: Atoms, Elements, Molecules, and Compound



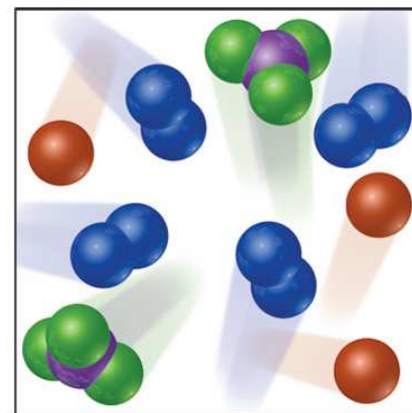
(a) Atoms of an element



(b) Molecules of an element



(c) Molecules of a compound

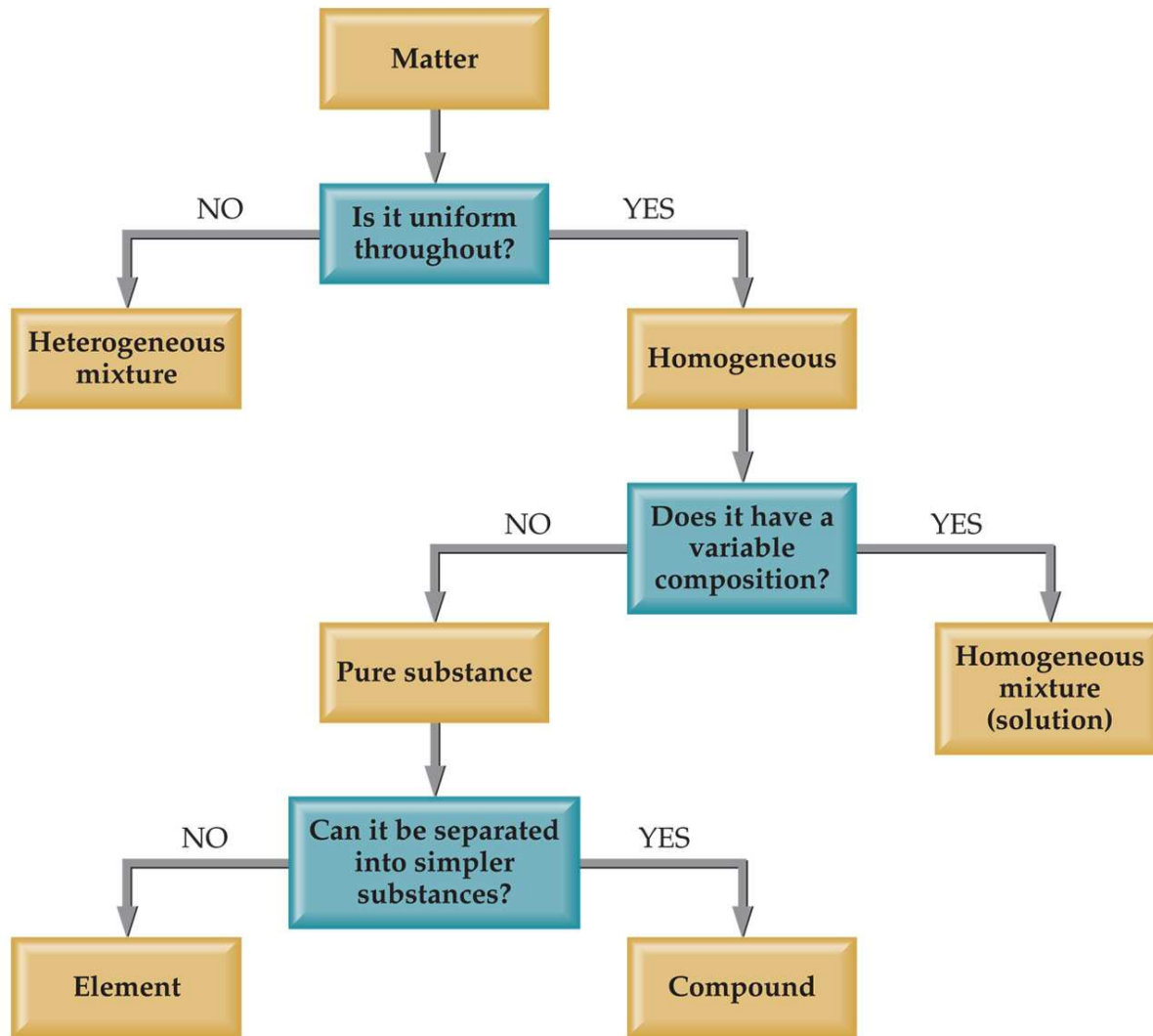


(d) Mixture of elements and a compound

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- Atoms are the building blocks of matter.
- Each element is made of the same kind of atom.
- Molecules are the smallest unit of a substance
- A compound is made of two or more different kinds of elements

# Classification of Matter



## Physical and Chemical Properties

Physical Properties can be measured without changing the substance  
mass, volume, temperature, etc.

Chemical Properties can only be measured by changing the substance  
flammability, corrosiveness, etc.

## Physical and Chemical Changes

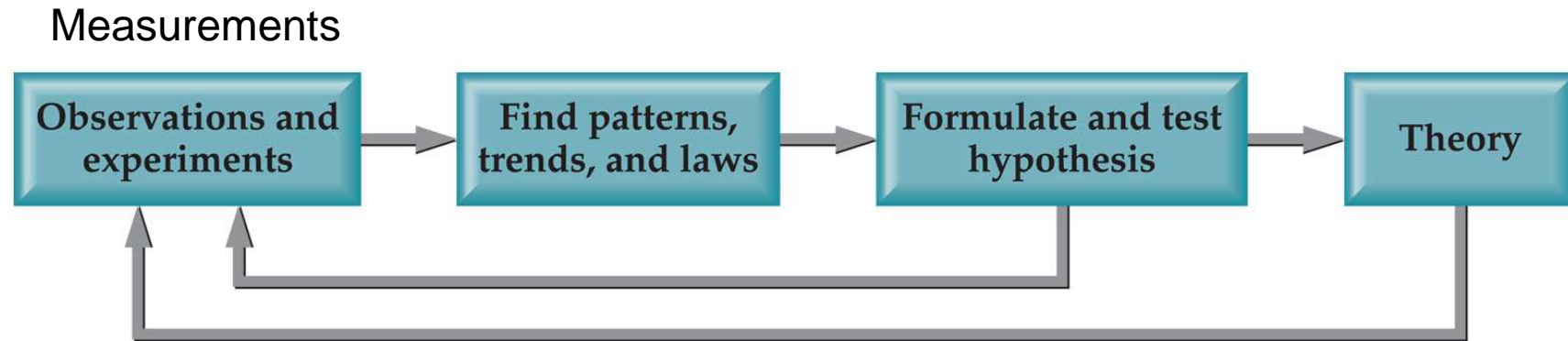
Physical change does NOT change the composition just physical characteristics.  
Chemical change does change the composition from one substance to another.

## Intrinsic and Extrinsic Properties

Intrinsic Properties – do not depend on quantity  
Density, boiling point, etc.

Extrinsic Properties – depend on quantity  
Mass, volume, etc.

# Scientific Method



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Hypothesis – tentative explanation

Law – concise statement or equation that summarizes the hypothesis

Theory – explains general principles

## SI Units

Physical Quantity	Name of Unit	Abbreviation
Mass	Kilogram	kg
Length	Meter	m
Time	Second	s <sup>a</sup>
Temperature	Kelvin	K
Amount of substance	Mole	mol
Electric current	Ampere	A
Luminous intensity	Candela	cd

<sup>a</sup>The abbreviation sec is frequently used.

Prefix	Abbreviation	Meaning	Example
Giga	G	$10^9$	1 gigameter (Gm) = $1 \times 10^9$ m
Mega	M	$10^6$	1 megameter (Mm) = $1 \times 10^6$ m
Kilo	k	$10^3$	1 kilometer (km) = $1 \times 10^3$ m
Deci	d	$10^{-1}$	1 decimeter (dm) = 0.1 m
Centi	c	$10^{-2}$	1 centimeter (cm) = 0.01 m
Milli	m	$10^{-3}$	1 millimeter (mm) = 0.001 m
Micro	$\mu^a$	$10^{-6}$	1 micrometer ( $\mu\text{m}$ ) = $1 \times 10^{-6}$ m
Nano	n	$10^{-9}$	1 nanometer (nm) = $1 \times 10^{-9}$ m
Pico	p	$10^{-12}$	1 picometer (pm) = $1 \times 10^{-12}$ m
Femto	f	$10^{-15}$	1 femtometer (fm) = $1 \times 10^{-15}$ m

<sup>a</sup>This is the Greek letter mu (pronounced "mew").

# Volume

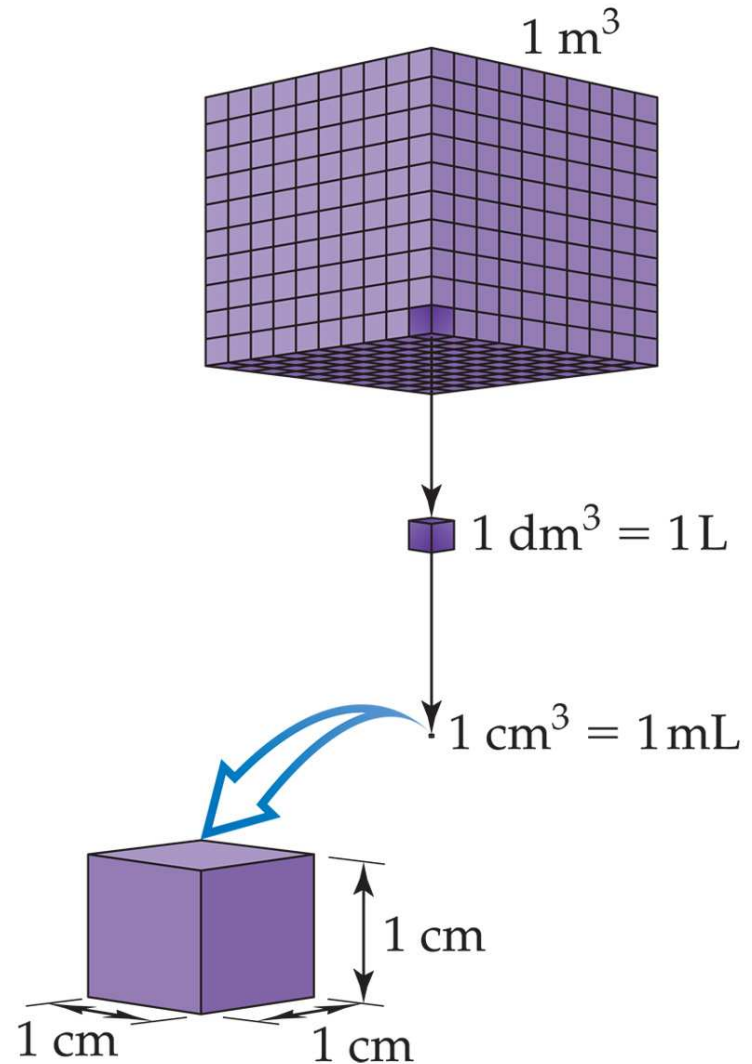
The most commonly used metric units for volume are the liter (L) and the milliliter (mL).

A liter is a cube 1 dm long on each side.

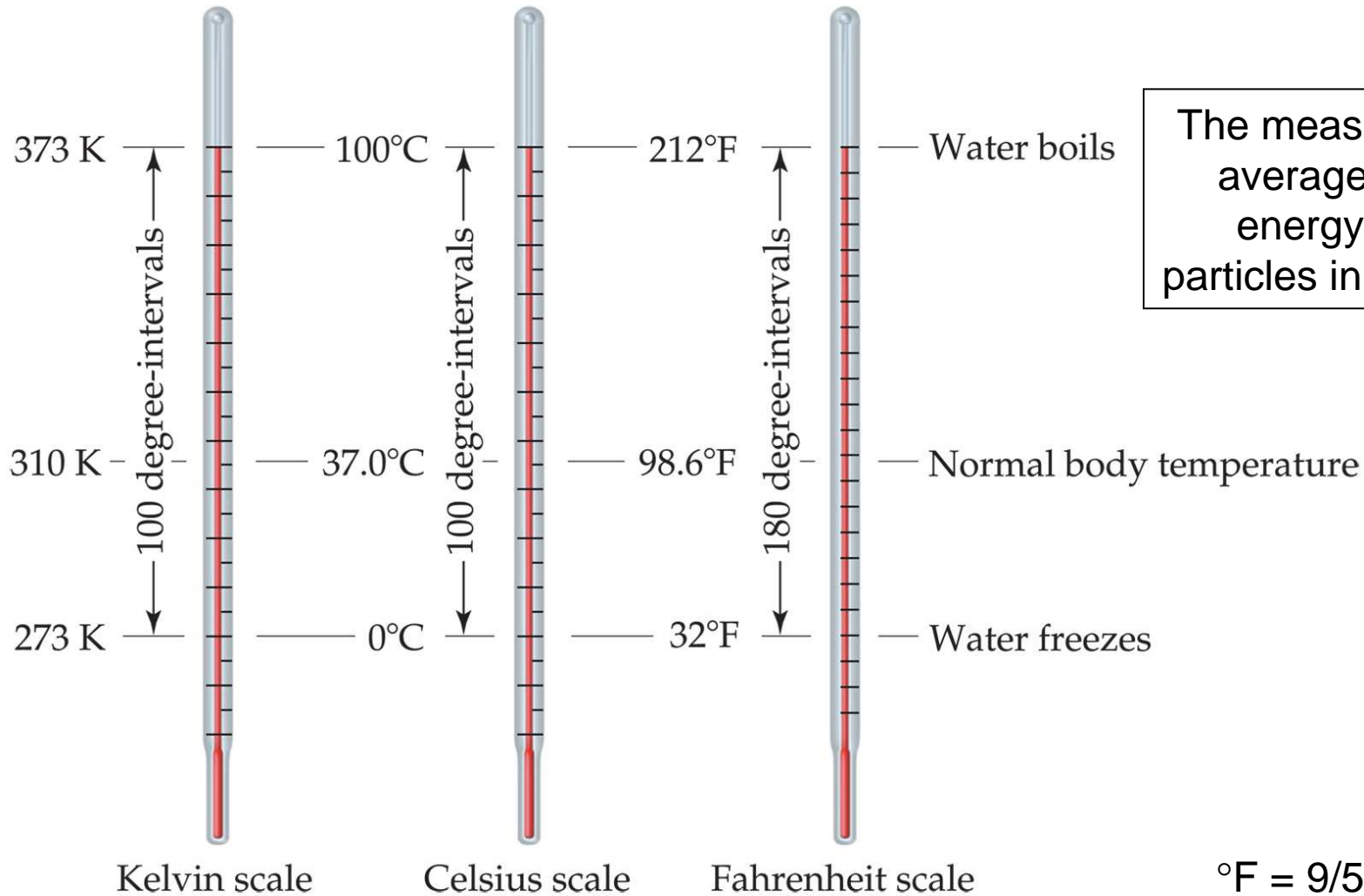
A milliliter is a cube 1 cm long on each side.

Density (g/mL)

Density = mass / volume



# Temperature



The measure of the average kinetic energy of the particles in a sample.

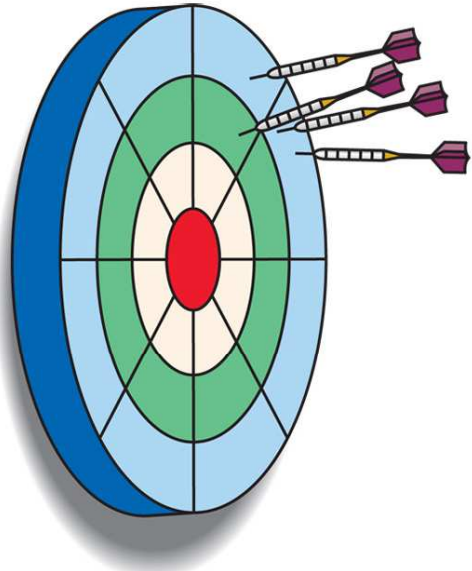
$$\begin{aligned} ^\circ\text{F} &= \frac{9}{5}(^\circ\text{C}) + 32 \\ ^\circ\text{C} &= \frac{5}{9}(^\circ\text{F} - 32) \end{aligned}$$

# Significant Figures

Significant Figures – refers the numbers actually measured

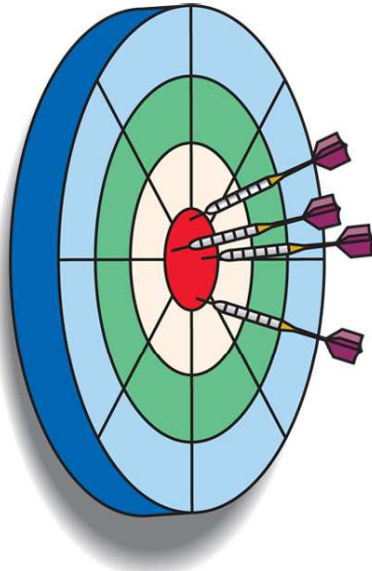
- All nonzero digits are significant. 0.242
- Zeroes between two significant figures are themselves significant. 1.01
- Zeroes at the beginning of a number are never significant. 0.0023
- Zeroes at the end of a number are significant if a decimal point is written in the number. 1500  
1500.0

# Accuracy vs. Precision



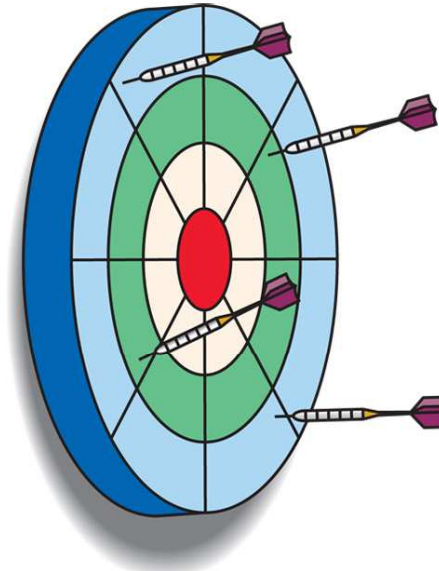
(i)

High precision  
Low Accuracy



(ii)

High precision  
High Accuracy



(iii)

Low Precision  
High Accuracy

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# Significant Figures in Calculations

Addition/Subtraction – answers are rounded to least significant decimal.

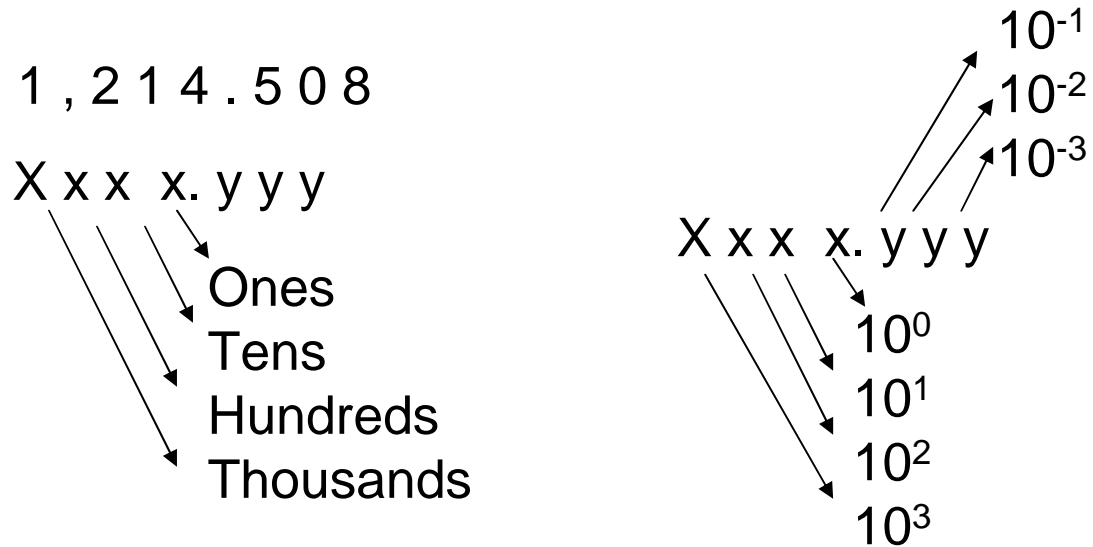
Multiplication/Division – answers are rounded to the number of digits that corresponds to the *least* number of significant figures in any of the numbers used in the calculation

$$\begin{array}{r} 1.03 \\ +0.2 \leftarrow \text{Least sig. decimal} \\ \hline 1.2 \end{array}$$

$$\begin{array}{r} 1.00 \leftarrow 3 \text{ sig. figs.} \\ \times 5.1 \leftarrow 2 \text{ sig. figs.} \\ \hline 5.1 \leftarrow 2 \text{ sig. figs.} \end{array}$$

# Scientific Notation

$$N \times 10^n$$



$$1,200,000 = 1.2 \times 1,000,000 = 1.2 \times 10^6$$

$$0.00634 = 6.34 \times 0.001 = 6.34 \times 10^{-3}$$

See Appendix A1 for more details

How many significant figures are there in the following summation:

A. 2

B. 3

C. 4

D. 5

$$\begin{array}{r} 6.220 \\ 1.0 \\ + \underline{125} \end{array}$$

**How many significant figures are there in the result of the following multiplication:**

$$(2.54) \times (6.2) \times (12.000)$$

- A. 2**
- B. 3**
- C. 4**
- D. 5**

# Dimensional Analysis - Unit Conversion

How many eggs in a half dozen?

A. 12

B. 6

C. 6.5

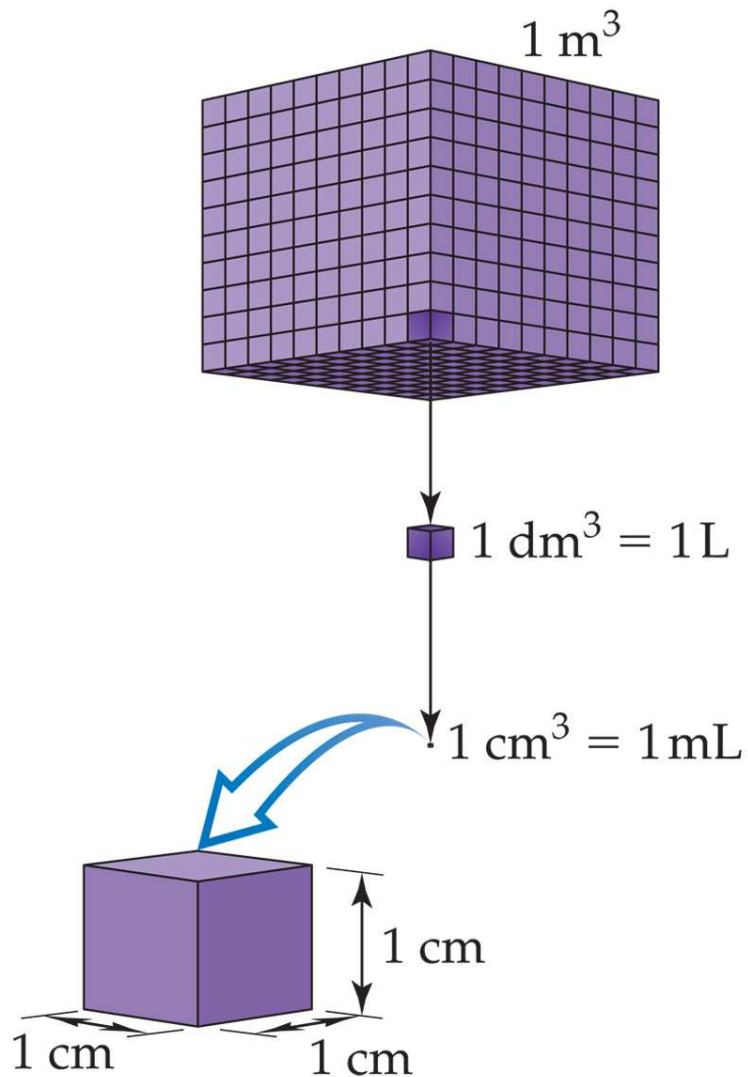
D. 3

0.5 dozen eggs

1 dozen eggs = 12 eggs ← Conversion Factor

$$0.5 \text{ dozen eggs} \times \frac{12 \text{ eggs}}{1 \text{ dozen eggs}} = 6 \text{ eggs}$$

# Dimensional Analysis - Unit Conversion



Convert 2 m<sup>3</sup> into cm<sup>3</sup>:

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

$$2 \text{ m}^3 \times \left( \frac{100 \text{ cm}}{1 \text{ m}} \right)^3 = 2,000,000 \text{ cm}^3$$

**YOU MUST CUBE THE  
CONVERSION FACTOR!**