

# **Chapter 1: Matter and Energy**

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August 24, 2022

Chemistry Department, Cypress College

# Class Announcements

- chromebook checkout
- Extended due date for the prerequisite scan - provide ID card, transcript for algebra class, and the blue worksheet (give 1 EC)

## Canvas

- when2meet office hours survey will be sent out after class
- Lecture slides will be posted after class
- First quiz will be posted Thurs at 11am and you have until Mon, Aug 29th at 11:59pm
- First homework assignment posted Fri, Aug 26th at 3pm

# Outline

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Review: Scientific Notation and Unit Conversion

Matter and Its Classification

Chemical and Physical Changes

Potential and Kinetic Energy

Scientific Method

## Recap: Building the Mathematical Toolbox

- Scientific notation simplifies large numbers to a manageable one
- Significant figures imply accuracy
  - Leading, sandwiched, and trailing zeroes
  - Addition and subtraction round to the fewest digits after the decimal
  - Multiplication and division round to the least significant digit
- Unit conversion - *familiarize* the metric system e.g. Gm, Mm, km, m, dm, cm, ...

# Prefixes of Metric System

Giga (G)      Mega (M)      kilo (k)      hecto (h)      deca (da)

$$\left( \frac{1 \text{ Gm}}{1 \times 10^9 \text{ m}} \right) \quad \left( \frac{1 \text{ Mm}}{1 \times 10^6 \text{ m}} \right) \quad \left( \frac{1 \text{ km}}{1000 \text{ m}} \right) \quad \left( \frac{1 \text{ hm}}{100 \text{ m}} \right) \quad \left( \frac{1 \text{ dam}}{10 \text{ m}} \right)$$

$$\left( \frac{1 \times 10^9 \text{ m}}{1 \text{ Gm}} \right) \quad \left( \frac{1 \times 10^6 \text{ m}}{1 \text{ Mm}} \right) \quad \left( \frac{1000 \text{ m}}{1 \text{ km}} \right) \quad \left( \frac{100 \text{ m}}{1 \text{ hm}} \right) \quad \left( \frac{10 \text{ m}}{1 \text{ dam}} \right)$$

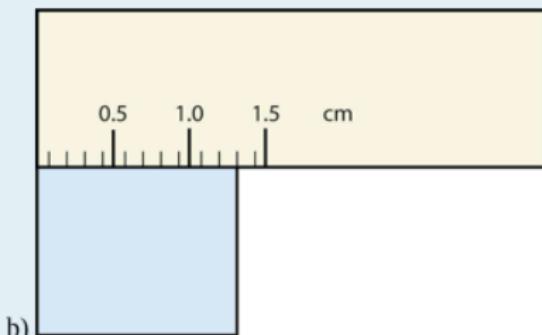
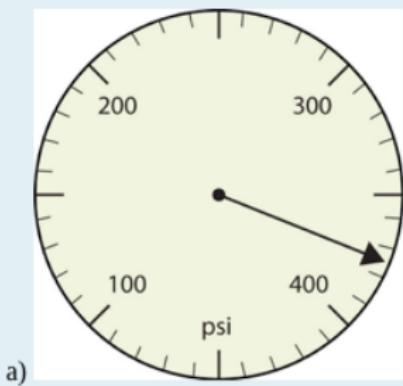
Basic Units      deci (d)      centi (c)      milli (m)      micro ( $\mu$ )      nano (n)

meter (m)  
gram (g)  
Liter (L)  
second (s)  
mole (mol)  
calorie (cal)  
Joule (J)

$$\left( \frac{10 \text{ dm}}{1 \text{ m}} \right) \quad \left( \frac{100 \text{ cm}}{1 \text{ m}} \right) \quad \left( \frac{1000 \text{ mm}}{1 \text{ m}} \right) \quad \left( \frac{1 \times 10^6 \text{ } \mu\text{m}}{1 \text{ m}} \right) \quad \left( \frac{1 \times 10^9 \text{ nm}}{1 \text{ m}} \right)$$

$$\left( \frac{1 \text{ m}}{10 \text{ dm}} \right) \quad \left( \frac{1 \text{ m}}{100 \text{ cm}} \right) \quad \left( \frac{1 \text{ m}}{1000 \text{ mm}} \right) \quad \left( \frac{1 \text{ m}}{1 \times 10^6 \text{ } \mu\text{m}} \right) \quad \left( \frac{1 \text{ m}}{1 \times 10^9 \text{ nm}} \right)$$

# Quick Practice: Significant Figures



## Strategy for Dimensional Analysis

1. Identify the information given and the information needed to answer.
2. Find the relationship(s) between the known information and unknown answer, and plan a series of steps, including conversion factors, for getting from one to the other.
3. Solve the problem by canceling units.
4. Check the answer to make sure it makes sense, both in magnitude and units.

# Whiteboard: Sig Figs and Dimensional Analysis

# **Outline**

Review: Scientific Notation and Unit Conversion

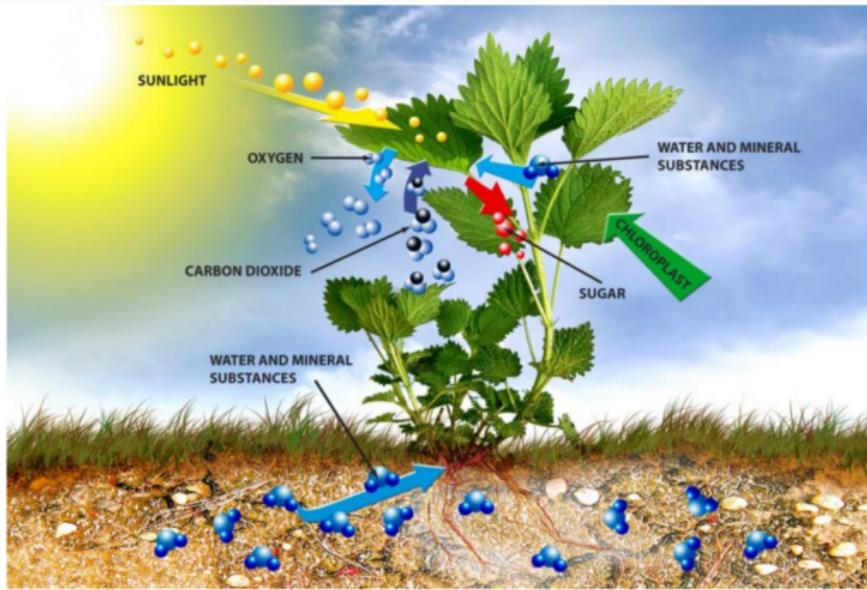
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# Chemistry is Everywhere!



## Conservation of Mass

Any system closed to all transfers of matter and energy, the mass of the system must remain constant over time

## Classification: Composition of Matter

**Pure substance** - cannot be separated into components

**Mixture** - consists at least 2 pure substances mixed together

# Classification: Composition of Matter

Pure substance - cannot be separated into components

Checkout the preiodic table (ptable)

The image shows the Ptable app interface. At the top, there's a navigation bar with a search bar containing 'Temperature' and buttons for units (0°C, 32°F, 273 K). Below the table, there are dropdown menus for 'Series' (Metalloids), 'Write-up' (Germanium, Wikipedia), 'State at' (Solid), 'Weight' (72.63), 'Energy levels' (2, 8, 18, 4), 'Electronegativity' (2.01), 'Melting point' (938.25 °C), 'Boiling point' (2,820 °C), 'Electron affinity' (119 kJ/mol), and 'Ionization, 1st' (762 kJ/mol). There are also dropdowns for 'Radius, calculated' (125 pm), 'Hardness, Brinell' (N/A MPa), 'Modulus, bulk' (N/A GPa), and 'Density, STP' (5,323 kg/m³). The table itself has a green header row with element numbers 1 through 18. The first column (Hydrogen) is highlighted in green. The table is color-coded: Metals (blue), Nonmetals (orange), and Noble gases (light blue). Germanium (Ge) is highlighted with a green box. The table continues below the first 18 elements with rows for groups 19-36 and 57-71.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	H	Atomic Symbol	C	Metals	Metals	Metals	Lanthanoids	Metals	Post-transition metals	Metals	Nonmetals	Nonmetals	Noble gases	S	C	N	B	He
2	Li	Hydrogen Name	Be	Alkaline earth metals	Actinoids	Transition metals	Actinoids	Transition metals	Post-transition metals	Metals	Reactive nonmetals	Nonmetals	Reactive noble gases	Boron	Carbon	Nitrogen	Oxygen	Helium
3	Na	Weight	Mg	Alkaline earth metals	Actinoids	Transition metals	Transition metals	Transition metals	Post-transition metals	Metals	Reactive nonmetals	Nonmetals	Reactive noble gases	Boron	Carbon	Nitrogen	Oxygen	Neon
4	K	Hydrogen Name	Ca	Scandium	Ti	V	Cr	Mn	Fe	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Weight	Caesium	Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Nickel	Copper	Zinc	Gallium	Germanium	Arsenic	Selenium	Bromine	Xenon
6	Cs	Hydrogen Name	Fr	Yttrium	Yttrium	Zirconium	Nb	Ta	Ru	Pd	Pt	Os	Re	In	Sn	Sb	Te	Xe
7	Fr	Weight	Rutherfordium	Yttrium	Zirconium	Nb	Tungsten	Rhenium	Ruthenium	Palladium	Platinum	Ir	Rhodium	Indium	Antimony	Tellurium	Polonium	Radon
8-10																		
11-12																		
13-14																		
15-16																		
17-18																		
19-36																		
57-71																		
89-103																		

## Examples of Pure Substances



# Is water a pure substance?



# Types of Mixtures

## Heterogeneous Mixture



particles distributed non-uniformly



Cereal in milk



Ice in soda



Soil



Blood

VS

## Homogeneous Mixture



particles distributed uniformly



Vodka



Steel



Air

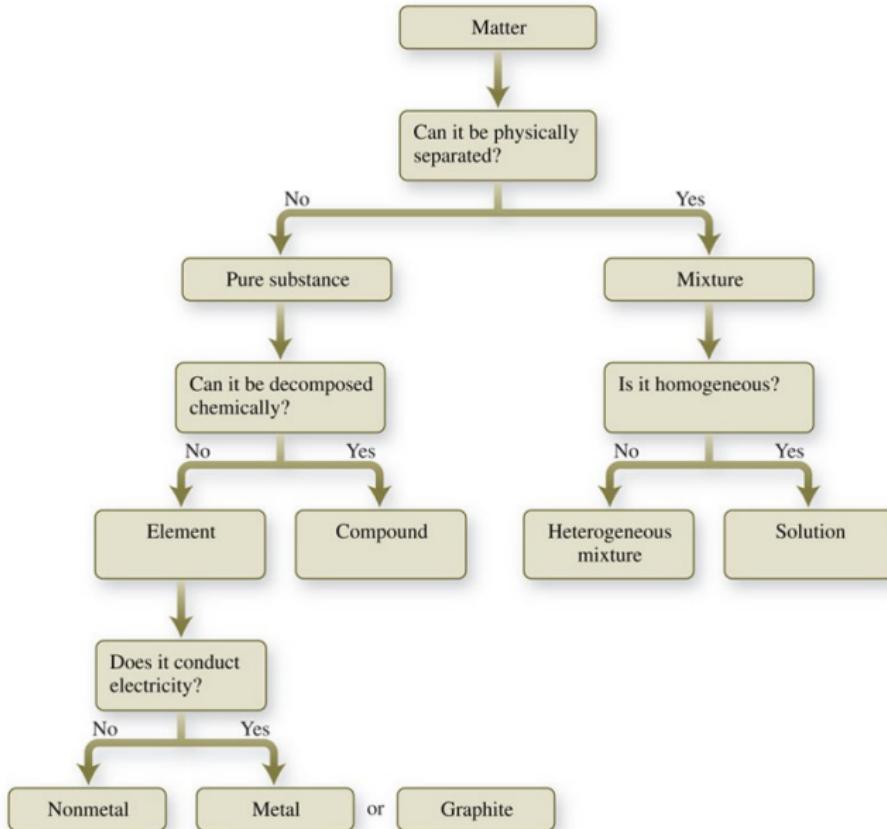


Rain

ThoughtCo.

# Mixture Flowchart

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# States of Matter: Water



- Solid has the smallest volume whereas gas occupies the largest space
- Water molecules have the most energy in which state?
- Notation for states -  $\text{H}_2\text{O}(s)$ ,  $\text{H}_2\text{O}(l)$ ,  $\text{H}_2\text{O}(g)$
- **Aqueous state** - substance dissolved in water e.g.  $\text{NaCl(aq)}$

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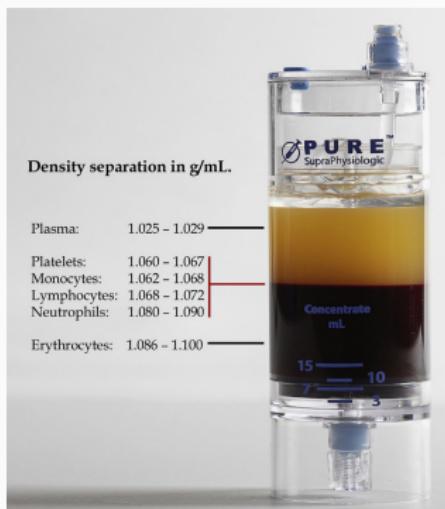
# Physical Properties

A characteristic that can be observed or measured without changing the composition of a substance



# Quantifying Physical Properties

- Mass - quantifies matter; measuring in grams
- Volume - amount of space occupied; measuring in L
- Density - ratio of mass and volume



- Temperature - quantifies the intensity of heat in a substance or object

# Chemical Properties

A characteristic of a particular substance that can be observed in a chemical reaction e.g. combustion



## Practice: Classify the following as chemical or physical changes

1. Melting solid gold into liquid gold
2. Combining copper and tin to form bronze (an alloy)
3. Electrolysis of water ( $H_2O$ ) into hydrogen ( $H_2$ ) gas and oxygen ( $O_2$ ) gas
4. Filtering algae from water

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# Whiteboard: Potential and Kinetic Energy

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