

# **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)

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

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

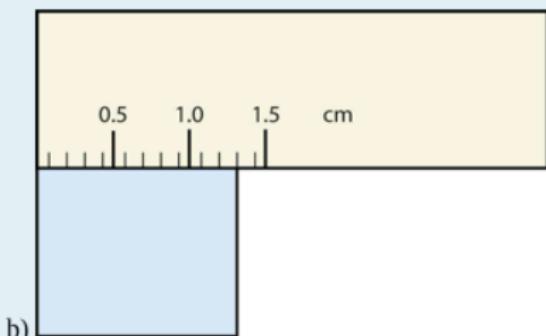
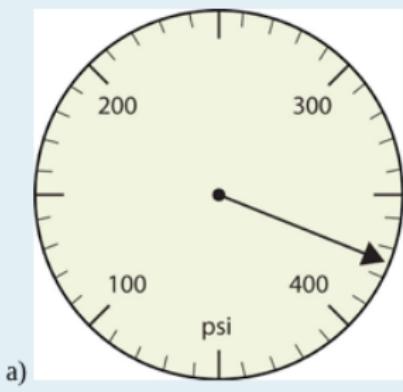
Basic Units      deci (d)      centi (c)      milli (m)      micro ( $\mu$ )      nano (n)

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

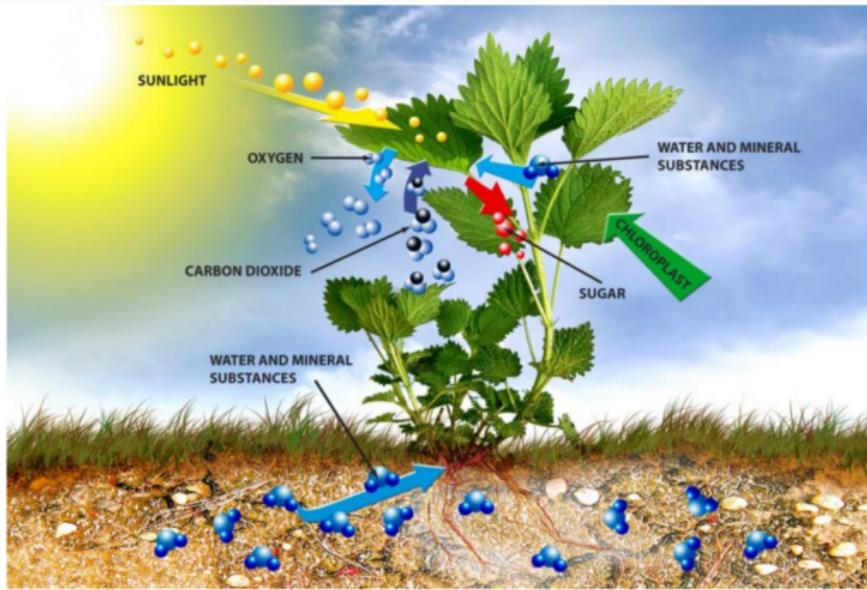
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# Chemistry is Everywhere!



## 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 search bar with the element symbol 'Ge' and its atomic number '32'. Below the search bar is a detailed card for Germanium (Ge) with its atomic number (32), symbol (Ge), name (Germanium), and weight (72.630). The main periodic table is displayed with a color-coded legend:

- Solid**: Elements 1 through 20.
- Liquid**: Elements 55 through 57.
- Gas**: Elements 58 through 71.
- Unknown**: Elements 89 through 103.
- Metals**: Elements 1 through 20, 55 through 57, and 71 through 88.
- Nonmetals**: Elements 21 through 32, 58 through 71, and 89 through 103.
- Noble gases**: Elements 33 through 36.
- Alkali metals**: Elements 1 through 3.
- Alkaline earth metals**: Elements 4 through 7.
- Actinoids**: Elements 58 through 71.
- Transition metals**: Elements 21 through 32.
- Post-transition metals**: Elements 55 through 57.

Below the table, there are sections for 'Temperature' (with a slider from 0°C to 273 K), 'Practogens', 'Chalcogens', and 'Halogens'. The table itself has rows for Series (1-18), Groups (1-18), and Periods (1-7). Each element cell contains its symbol, name, atomic number, and atomic weight. For example, Hydrogen (H) is shown with an atomic weight of 1.008. The table also includes sections for 'Write-up', 'State at 0 °C', 'Weight', 'Energy levels', 'Electronegativity', 'Melting point', 'Boiling point', 'Electron affinity', 'Ionization, 1st', 'Radius, calculated', 'Hardness, Brinell', 'Modulus, bulk', 'Density, STP', and 'Conductivity, Electrical'.

## 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

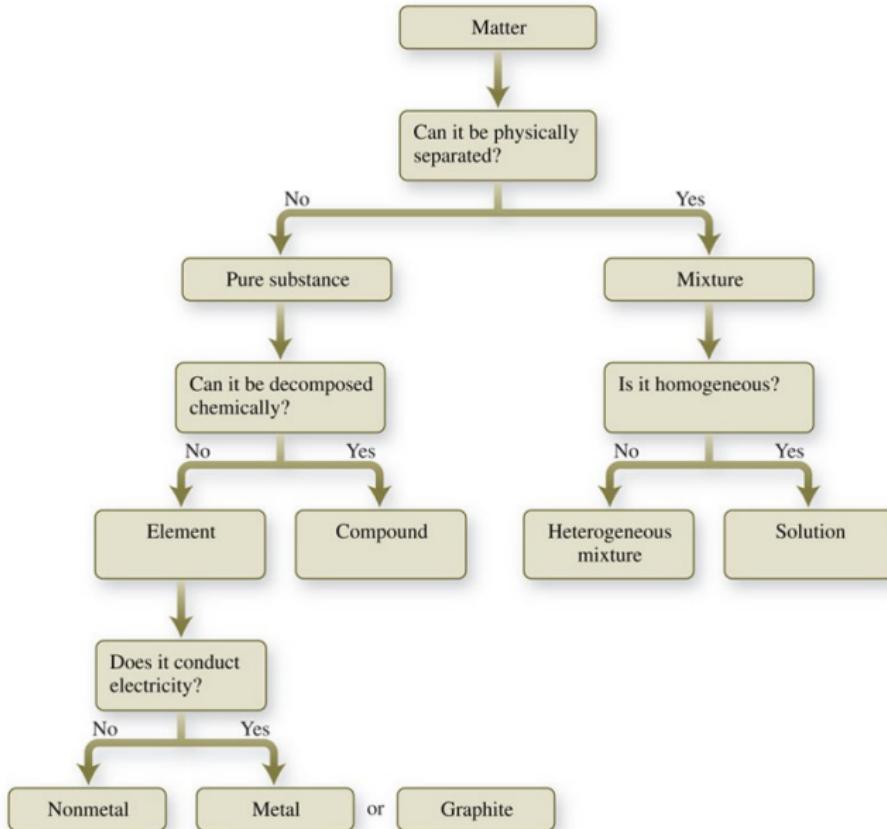


Rain

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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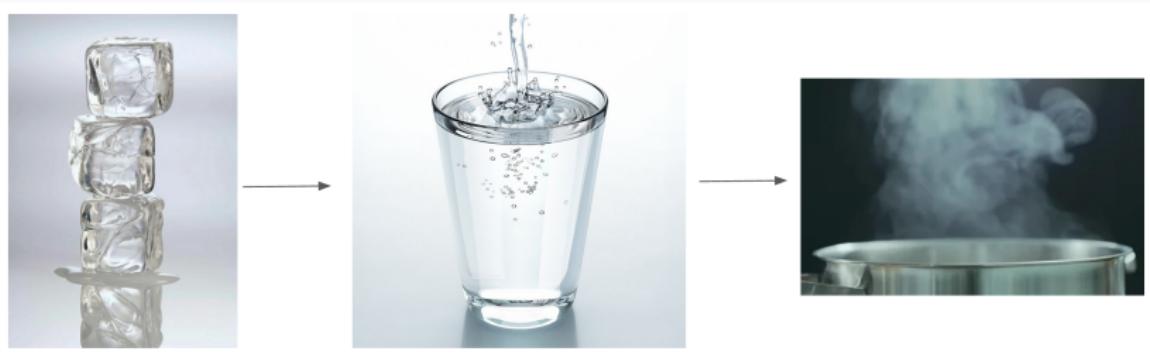
**Chemical and Physical Changes**

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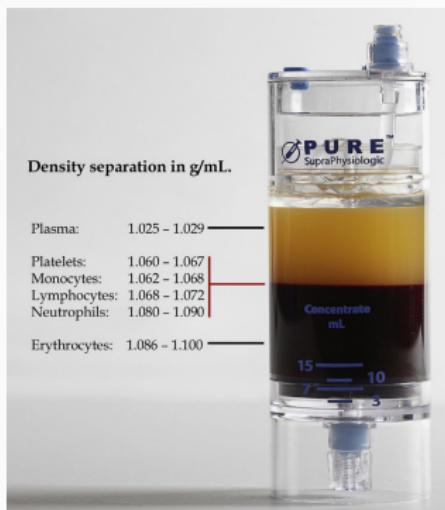
# Physical Properties

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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## Research Uses Scientific Method

1. Gather observations
2. Ask a question. Propose a hypothesis which is a supposed explanation of a given phenomenon
3. Design and perform your experiment
4. If results support the hypothesis, then propose a theory, which explains the observation. If not, then revise the hypothesis.