Chapter 1: Matter and Energy

August 24, 2022

Chemistry Department, Cypress College

Class Announcements

- chromebook checkout

  Canvas

- when2meet office hours survey will be sent out after class
- Lecture slides will be posted after class
- First homework assignment posted Fri, Aug 26th at 3pm

Outline

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

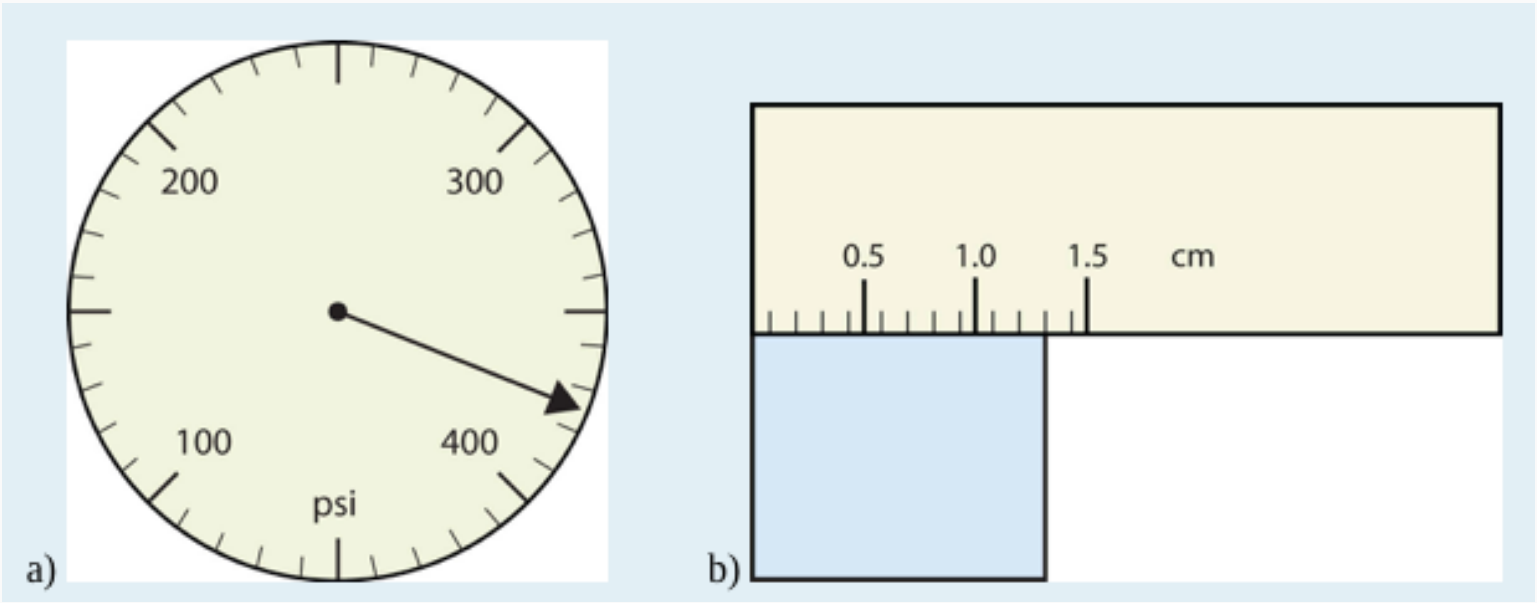
Giga (G)	Mega (M)	kilo (k)	hecto (h)	deca (da)
$\left(\frac{1\ \text{Gm}}{1 \times 10^9\ \text{m}}\right)$	$\left(\frac{1\ \text{Mm}}{1 \times 10^6\ \text{m}}\right)$	$\left(\frac{1\ \text{km}}{1000\ \text{m}}\right)$	$\left(\frac{1\ \text{hm}}{100\ \text{m}}\right)$	$\left(\frac{1\ \text{dam}}{10\ \text{m}}\right)$
$\left(\frac{1 \times 10^9\ \text{m}}{1\ \text{Gm}}\right)$	$\left(\frac{1 \times 10^6\ \text{m}}{1\ \text{Mm}}\right)$	$\left(\frac{1000\ \text{m}}{1\ \text{km}}\right)$	$\left(\frac{100\ \text{m}}{1\ \text{hm}}\right)$	$\left(\frac{10\ \text{m}}{1\ \text{dam}}\right)$

Basic Units

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

deci (d)	centi (c)	milli (m)	micro (μ)	nano (n)
$\left(\frac{10\ \text{dm}}{1\ \text{m}}\right)$	$\left(\frac{100\ \text{cm}}{1\ \text{m}}\right)$	$\left(\frac{1000\ \text{mm}}{1\ \text{m}}\right)$	$\left(\frac{1 \times 10^6\ \mu\text{m}}{1\ \text{m}}\right)$	$\left(\frac{1 \times 10^9\ \text{nm}}{1\ \text{m}}\right)$
$\left(\frac{1\ \text{m}}{10\ \text{dm}}\right)$	$\left(\frac{1\ \text{m}}{100\ \text{cm}}\right)$	$\left(\frac{1\ \text{m}}{1000\ \text{mm}}\right)$	$\left(\frac{1\ \text{m}}{1 \times 10^6\ \mu\text{m}}\right)$	$\left(\frac{1\ \text{m}}{1 \times 10^9\ \text{nm}}\right)$

Quick Practice: Significant Figures



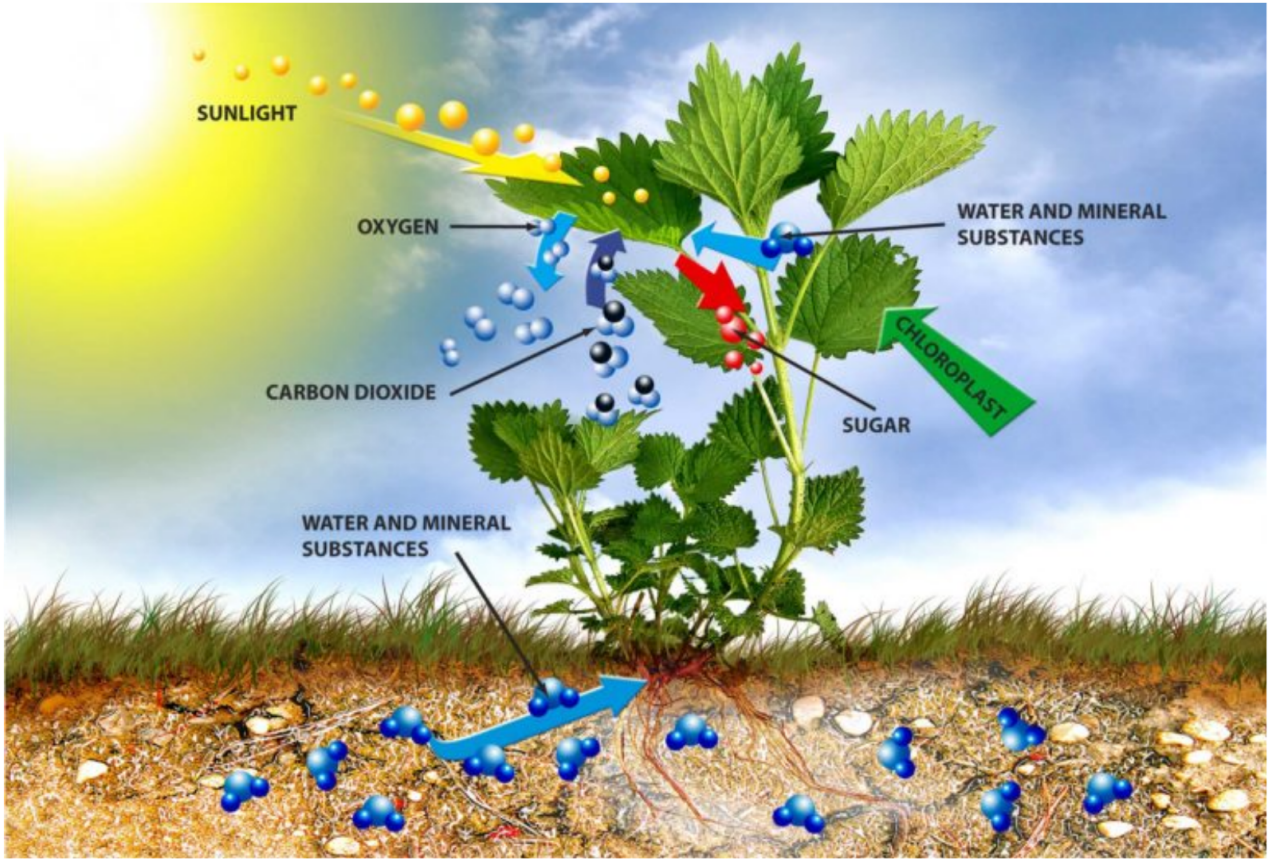
Strategy for Dimensional Analysis

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

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

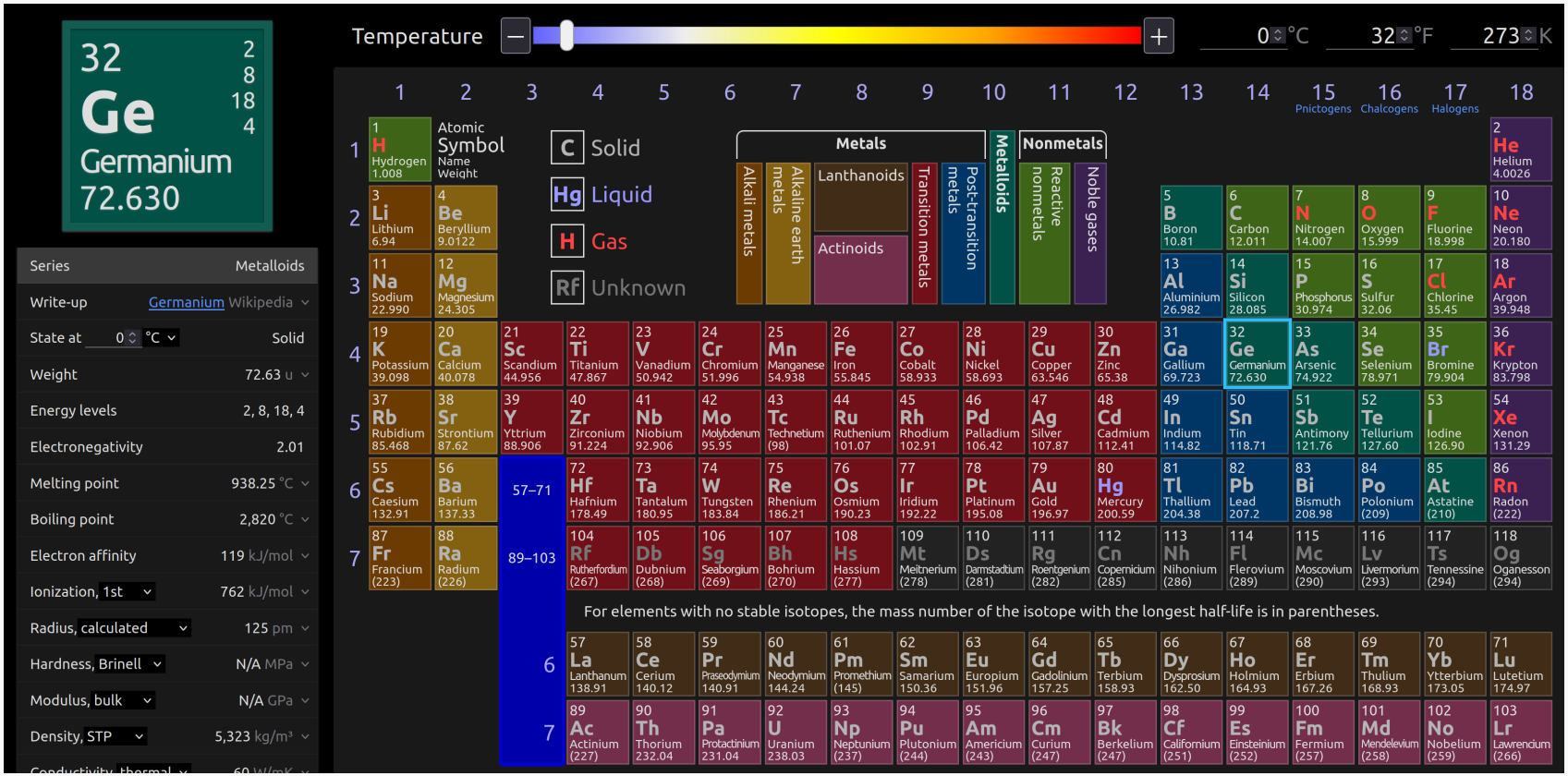
Pure substance - cannot be separated into components

Mixture - consists at least 2 pure substances mixed together

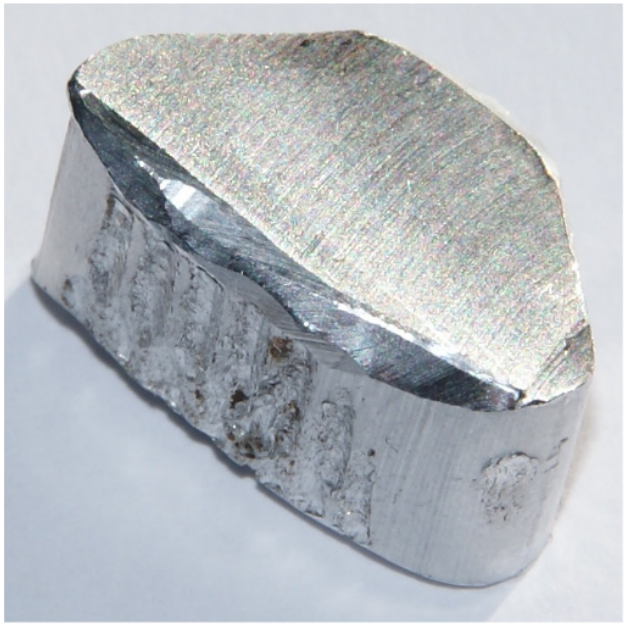
Classification: Composition of Matter

Pure substance - cannot be separated into components

Checkout the preiodic table (ptable)

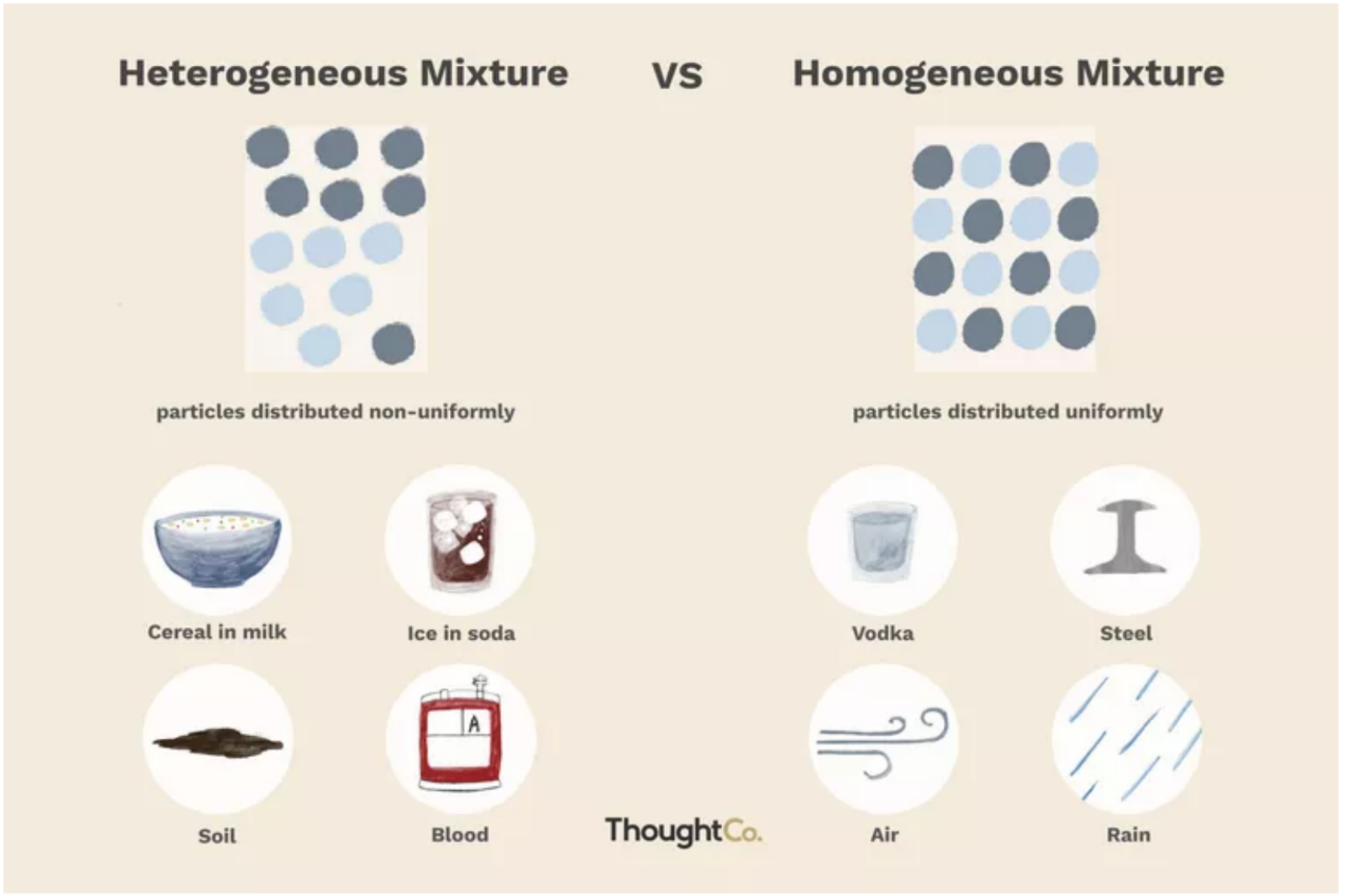


Examples of Pure Substances

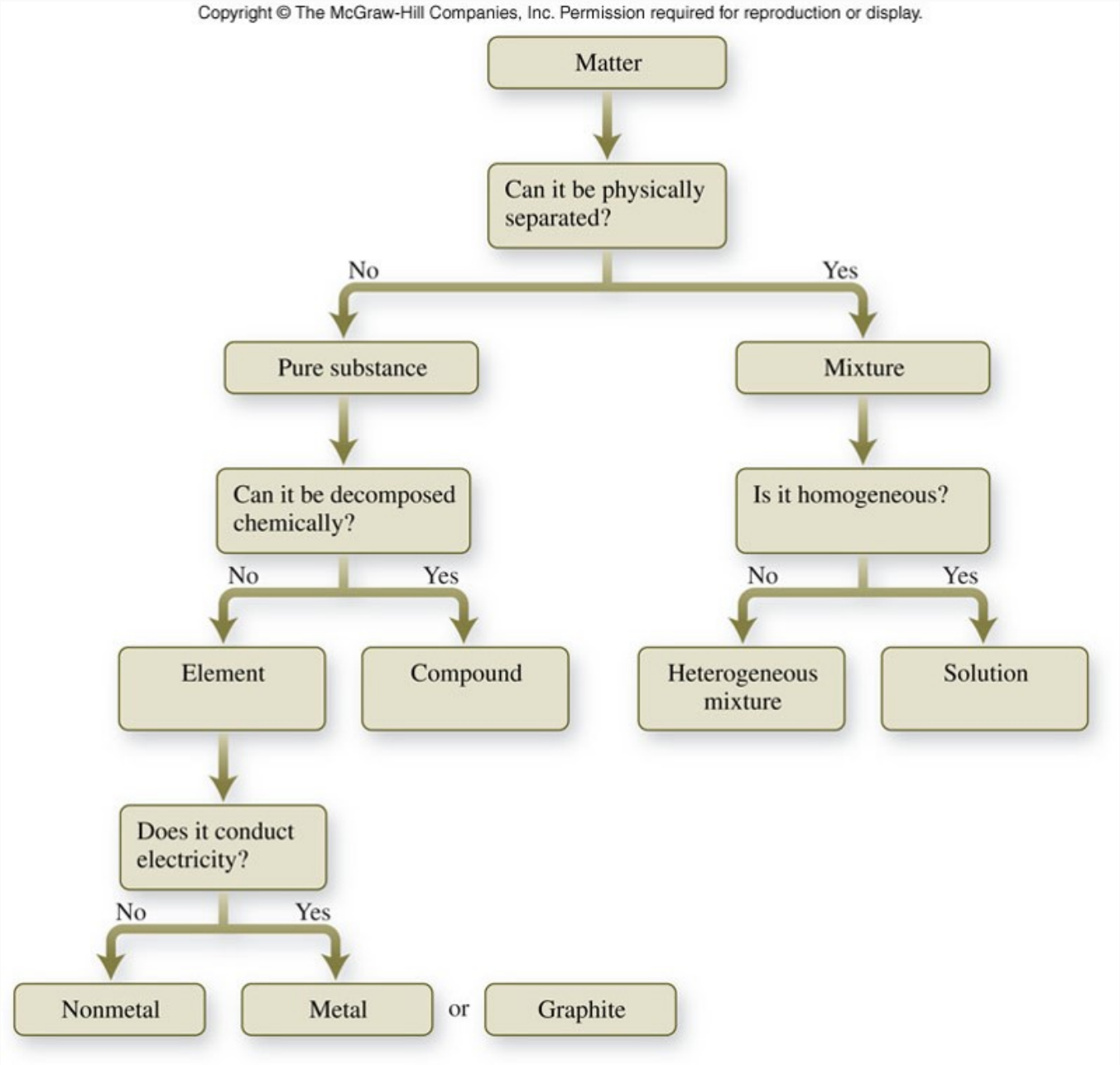


Is water a pure substance?

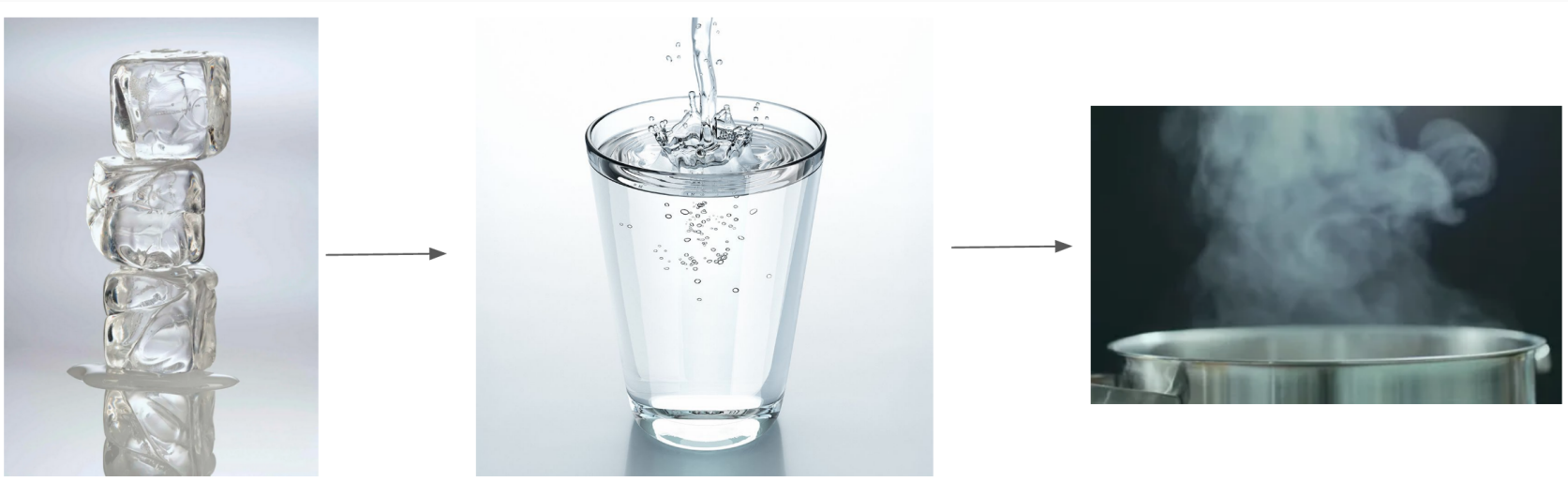
Types of Mixtures



Mixture Flowchart



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 - $H_2O(s)$, $H_2O(l)$, $H_2O(g)$
- **Aqueous state** - substance dissolved in water e.g. NaCl(aq)

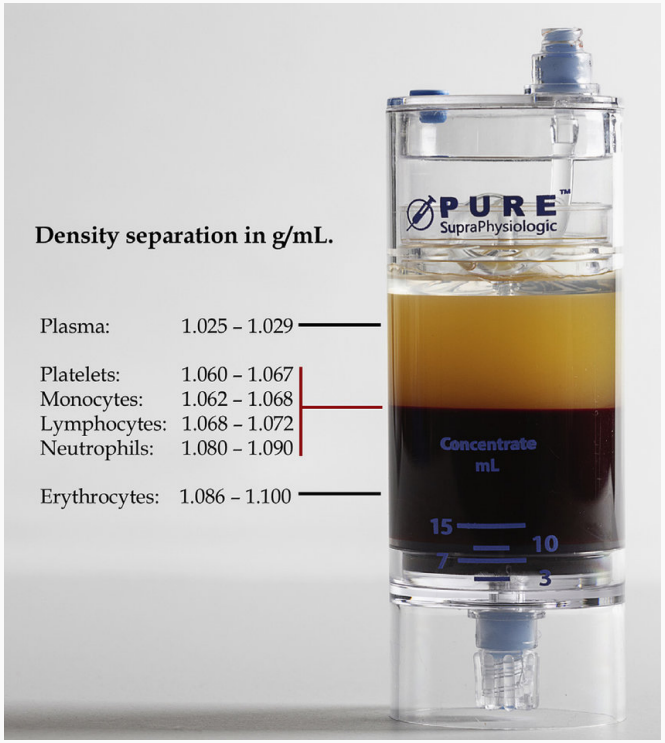
Outline

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 subtance 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

Outline

Whiteboard: Potential and Kinetic Energy

Outline

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.