

Chapter 1 and Sections 3.1-3.3

Major Goals of Chapter 1:

1. Define the term chemistry.
2. Identify substances (matter) as chemicals.
3. Describe some physical and chemical properties of matter.
4. Describe the activities that are part of the scientific method.
5. Describe how you tell call whether you have a pure element or a compound.

Major Goals of Sections 3.1 - 3.3

1. The organization of matter concept map.
2. Classify matter as pure substances or mixtures.
3. Homogeneous versus heterogeneous substances.

Before viewing this powerpoint, go to end of Chapter 1 and read the Chapter Review:

1.1 Chemistry and Chemicals

1.2 Some Fundamental Ideas of Chemistry

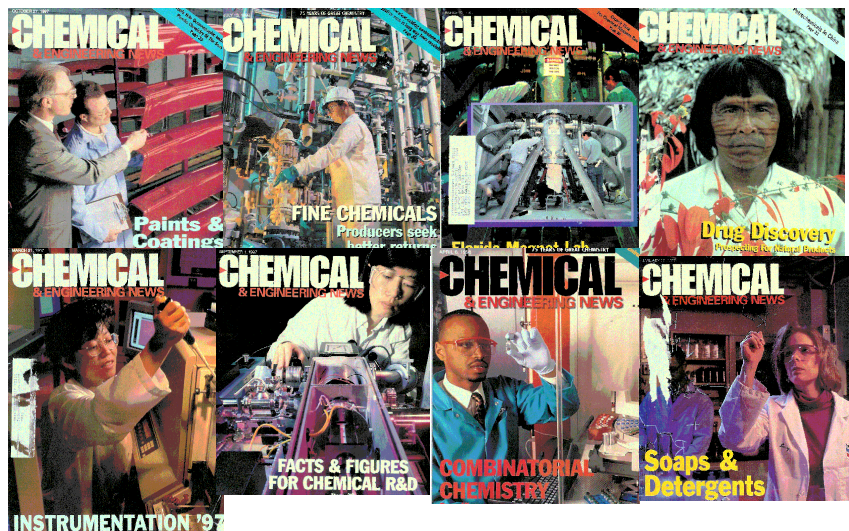
1.3 Scientific Method: Think like a Scientist

1.4 A Study Plan for Learning Chemistry

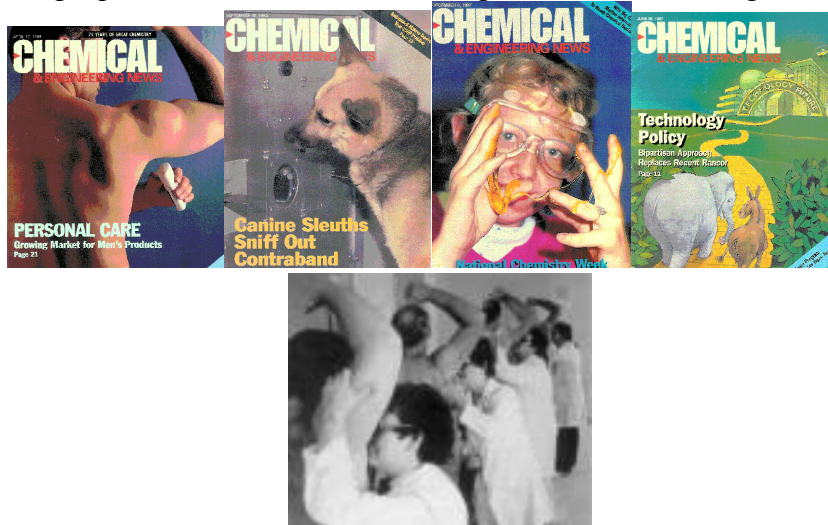
Also read,

Sections 3.1, 3.2 & 3.3 Classification of Matter

What do these individuals and hundreds of thousands of other chemistry professionals have in common?



And these individuals?
They all work to characterize or analyze the composition, structure and properties of matter and the changes that matter undergoes.



Section 1.1 - Chemistry & Chemicals

supplemental HO 5

Creative Chemistry

Dr. Gergens - SD Mesa College

I. What is Chemistry?

composition

Matter/change/time/energy/substances/compounds/elements

Chemistry is the study of the composition of matter (substances) and the way in which they interact physically and chemically over time. Energy is involved in every change/transformation of matter.

Chemists work to characterize or analyze the composition, structure and properties of matter and the changes that matter undergoes.

Chemistry is the study of the properties of matter. These are:

- physical and chemical properties, including,
 - physical separations and physical changes
 - chemical separations and chemical changes

- Chemists work to characterize or analyze the composition, structure and properties of matter and the changes that matter undergoes.
- Chemists can use their expert knowledge in designing and performing chemical reactions in the laboratory.

Creative Chemistry

Matter + Time + Energy + Expert Knowledge

- Equals New and Useful Substances, Products, and Materials

- Chemists will even “stir, mix and fish” with the hope of recovering new materials

Evolutionary Chemistry

Matter + Time + Energy

Section 1.2 - Some Fundamentals of Chemistry supplemental HO 5

composition

Matter/change/time/energy/substances/compounds/elements

What is matter?

A. Matter has mass and occupies volume.

- a. mass is a physical measurement of the amount or quantity of a substance.

Note: the weight of an object depends on the strength of the gravitational force exerted on an object. (**weightlessness**).

- b. volume is an area of space for a physical amount of a substance.
- c. the ratio of a mass amount per a volume is called density; density = mass/volume

Matter/change/time/energy/substances/compounds/elements

B. Change, Δ

- physical change in state. For example.
boiling liquid water into water as steam
- chemical change is a substance's ability to change form into new some new substance. For example.
hydrogen and oxygen react to make water
- a symbol for change is the Greek letter, Δ , delta.

Matter/change/time/energy/substances/compounds/elements

C. Time

- the change in time equals the final time minus initial time

This statement would be mathematically written as:

$$\Delta t = t_{\text{final}} - t_{\text{initial}}$$

composition

Matter/change/time/energy/substances/compounds/elements

D. Energy

allows us to do things; the capacity to do **work**.

a. temperature measures the average kinetic energy of molecules.

1. The change in temperature mathematically would be written as:

$$\Delta T = T_{\text{final}} - T_{\text{initial}}$$

Add these definitions to your “Key Terms” at the end of Chapter 1

b. heat energy

1. adding heat, or heat absorbed, is an endothermic process, a change in heat, Δheat
2. removing heat, or heat released, is an exothermic process, a change in heat, Δheat
3. The symbol Δ also represents heat or the process of heating

E. Composition

ALL PURE SUBSTANCES are HOMOGENEOUS

pure substance - overall composition consists of only one substance. Examples are:

- a. elements - the fundamental unit of all matter which combines to form compounds.
- b. compounds - two or more elements combined in a fixed ratio or proportion.

MIXTURES (impure substances)

mixtures are two or more different substances mixed together

Mixture Composition

Substances as mixtures.

There are two types of mixtures:

1. homogeneous

- For example, a homogeneous solution is a mixture of dissolved solute in a solvent
- A salt water solution; NaCl (solute) dissolved in H₂O (solvent)

2. heterogeneous

- Your eye can see two or more separated phases in the mixture
- Classic example: vinegar and oil as salad dressing
- Epsom salt in apricot oil

F. Pure Composition homogeneous

- a. elements - the fundamental unit of all matter which combines to form compounds.
- b. compounds - two or more different elements combined in fixed a ratio or proportion; having a chemical formula, for example H_2O

there are two hydrogen atoms for every one oxygen atom in the chemical formula for water

A compound has a chemical formula

Add this to your notes

The concept of elements combined in a fixed a ratio

a chemical formula (molar subscript ratio of atoms)

- H_2O (water) 2H:1O
2 hydrogens for every 1 oxygen
 - H_2O_2 (dihydrogen peroxide) 2H:2O
2 hydrogens for every 2 oxygens
- Or 1 hydrogen for every 1 oxygen
1H:1O

Matter/change/time/energy/substances/compounds/elements

G. Separation of composition

1. Most substances in the universe and on our planet exist as mixtures.
2. Goals of a chemist are to analyze mixture composition and to develop new techniques for the separation of mixture components into *pure substances*.

Section 3.1- Classification of Matter

- Matter is everything that has density, mass and occupies a volume.
- Density is the ratio of mass per volume where mass is an amount given in grams and volume is given in milliliters.
- Matter can be organized into two broad classes; pure or impure.
- Pure matter, which are elements and compounds, is always homogeneous and has a fixed composition.
- Impure matter exists as a mixture of substances which can appear either homogeneous or heterogeneous and can have variable composition.
- Homogeneous means substance composition is the same throughout. For example, a saline IV solution (salt water) used for IV intravenous therapy to replace electrolytes in a hospital setting.
- Heterogeneous composition means two or more physically separated phases. For example, oil layered over water.
- Mixtures can be physically separated into its individual components.

Section 3.1- Classification of Matter

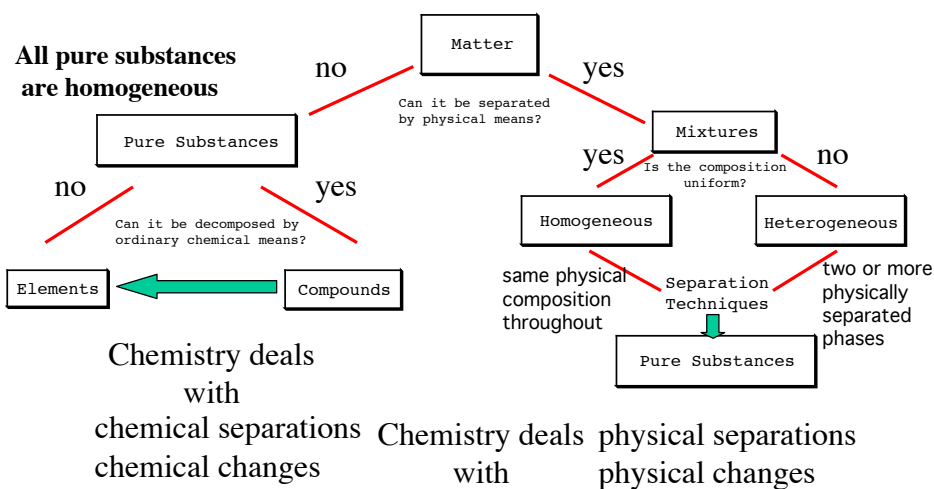
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- How do chemists classify whether a sample of matter is either pure or impure by using physical and chemical properties?
- **Pure matter** is homogeneous as will be either elemental substance or compound. **Impure matter** will be a homogenous mixture or a heterogeneous mixture.
- **MOST substances exist as mixtures**
- **Mixtures** can be **physically** separated into individual components.
- **Pure matter** exists as **only one component** thus its composition cannot be physically separated into individual components.
- All **pure matter** is **homogeneous**, as either a pure **element** or **compound**.
- If pure matter can be **chemically** broken down into its **elemental components**, then the substance is recognized as a **compound**.
- **Elements** cannot be broken down chemically in new elements.

Section 3.1- Classification of Matter

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II. The Organization of Matter

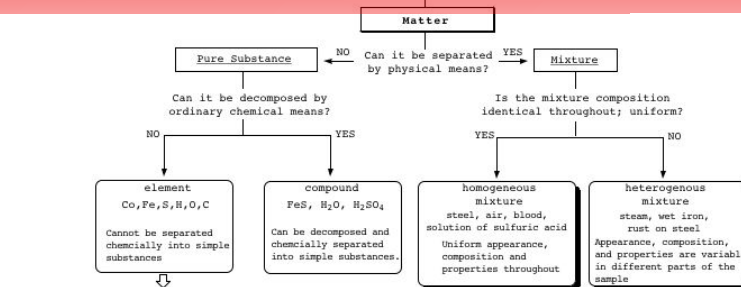


Section 3.1- Classification of Matter [Handout \(click here\)](#) Memorize this organizational chart

Organization of Matter - Flowchart

Study the physical properties in these box for each physical state.
NOTE: Plasma (gaseous hot ions) is our fourth physical state.

solids - generally more dense than liquids	liquids - more dense than gases	gases - least dense state - exert a pressure easily	plasma - atmosphere of stars - a comet's tail
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Isotopes

Is a mass number attached to the element?

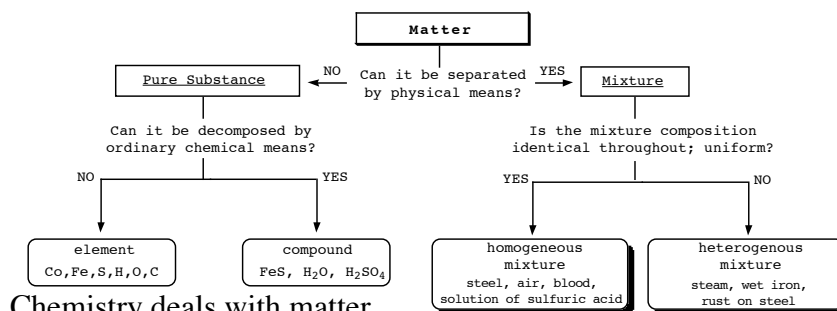
NO: All atoms of the same element are **not** exactly alike. The element is as a mixture of its isotopes and has an average mass as determined by a mass spectrometer.

YES: mass number equals the sum of protons + neutrons in the nucleus. $^{57}_{26}\text{Fe}$ also can be written as iron-57

The concept of isotopes will be discussed at the end of Chapter 3, Section 3.6

Section 3.1- Classification of Matter [Memorize this organizational chart](#) Classifying all matter into four basic categories

How do chemists classify whether a sample of matter is pure as a compound or as elemental substance or impure as a homogenous mixture, or a heterogeneous mixture, or using the matter organizational chart?



Chemistry deals with matter,

- physical separations
- physical changes
- chemical separations
- chemical changes

III. Separation techniques

A. Physical Methods

- Example, the use of a separatory funnel
- Paper Chromatography

B. Chemical Methods

- Use of chemical reagents
- Use of energy to cause a chemical change

IV. Physical and Chemical States of Matter

A. Physical State (s, l, g) & Change, Δ

(s) = solid

(l) = liquid

(g) = gas

Know these symbolisms

B. a solution = solute + solvent

(aq) = solute dissolved in H₂O solvent

for example: salt water

supplemental HO 8

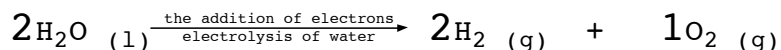
IV. Physical and chemical properties of matter.

A. Each substance has a set of properties that is characteristic to that substance and gives it its unique identity.

B. Physical properties are the inherent characteristics of a substance that can be determined without altering its composition. Common physical properties are:

melting point temperature	boiling point temperature
freezing point temperature	condensing point temperature
color	density
odor	

C. Chemical properties describe the ability of a substance to form new substances, either by reaction with other substance or by decomposition.

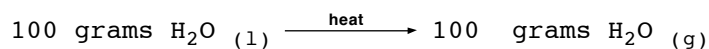


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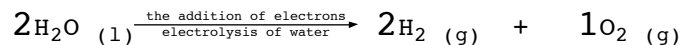
Physical and chemical changes.

A. Physical changes are changes in matter in which no new chemical have been formed.

Instead, we have changed a substance from one physical state to another, mixed two substances, or changed the size and shape of a substance. A physical change alters the physical and shape of a substance. A physical change alters the physical properties of a substance without altering its chemical composition



B. Chemical changes are changes in which the starting chemicals are converted into one or more chemicals. That is, changes that alter the chemical composition of the substance.

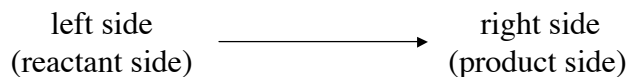


C. The Law of Conservation of Matter.

When a physical change of state or chemical reaction takes place, matter is neither created nor destroyed.

Describe how the law of conservation of matter is being observed in the above physical and chemical changes for the substance water, H₂O, above.

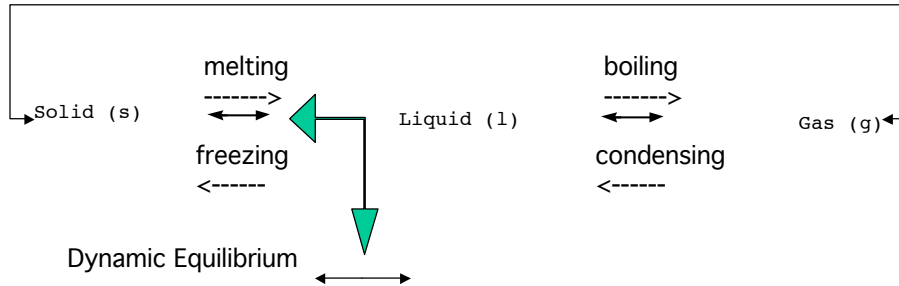
Count the total number of atoms on both sides of the arrow.



Changes in Physical State

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Sublimation (going directly from the solid state to the gas state)



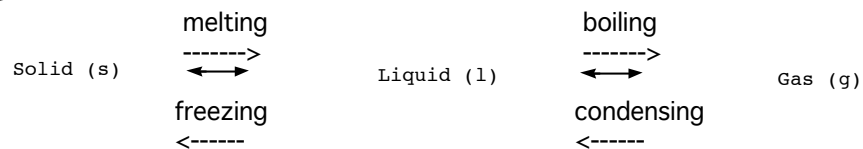
melting and at the same time its freezing

boiling at the same time it is condensing

Commit these terms to memory

supplemental HO 9; add processes to your notes

Energy Processes



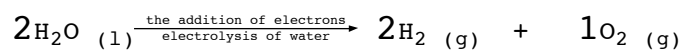
The melting process is endothermic; heat absorbed

The boiling process is endothermic; heat absorbed

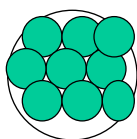
The freezing process is exothermic; heat released

The condensing process is exothermic; heat released

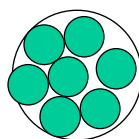
Chemical Change alters the chemical composition of the substance



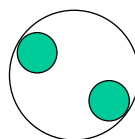
B. What is characteristic about each state?



solid



liquid



gas

SOLIDS

Particles are stacked together, (compact arrangement)

Highly ordered arrangement
Very low compressibility.

In general more dense than liquids.

Particles can only vibrate about fixed positions

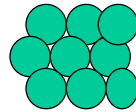
A solid has a definite shape and volume. The shape of a solid is independent of its container.

Do not flow or diffuse.

Very low compressibility.

Strongest attractive forces between particles.

Expand slightly when heated.



solid

LIQUIDS

Particles are far away

Moderate disorder.

Moderately low compressibility

more dense than gases

Particles are relatively free to move.

A liquid has a definite volume, but not a definite shape. It takes the shape of its container.

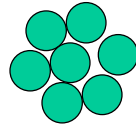
Flow and diffuse, but not easily as gases.

Moderately low compressibility

Weaker attractive forces.

Expand slightly when heated.

- Evaporation
- Vapor Pressure
- Boiling Point
- Freezing Point
- Surface Tension
- Viscosity



liquid

GASES

Particles are very far away.
Extreme disorder

High compressibility.

low density

Particles have almost complete freedom of motion.

Indefinite volume and no fixed shape.

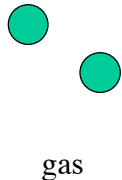
Flow and diffuse.
High compressibility.

The attractive forces are so weak that the particles of the gas are practically independent of one another.

Expand greatly when heated

EXERT A PRESSURE

$$P = \frac{\text{FORCE}}{\text{AREA}}$$



States of Matter
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List the four states of matter:

1.	2.	3.	4.
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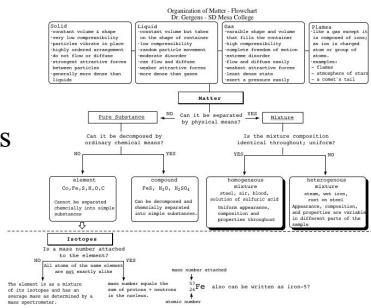
In your own words, summarize the characteristics of:

Solid

Liquid

Gas

Look over the organizational chart for matter and summarize in your own words the characteristics of a solid, liquid and gas.
Note: the fourth state of matter is plasma.



Answer these questions then check your work. supplemental HO 11

Decide whether each of the following is a physical (P) or a chemical change (C).

- | | | | |
|-----------------------------|--------------|------------------------------------------|--------------|
| 1. Bending a piece of wire | <u> P </u> | 5. Burning of gasoline in a car's engine | <u> C </u> |
| 2. Rusting of iron | <u> C </u> | 6. Table salt dissolves in water | <u> P </u> |
| 3. Snow melts on a warm day | <u> P </u> | 7. Freezing water to make ice cubes | <u> P </u> |
| 4. Souring of milk | <u> C </u> | | |

Classify the following properties of the element silicon, Si, as chemical (C) or physical properties (P)

- | | | | |
|-----------------------|--------------|------------------------------------|--------------|
| 1. shiny | <u> P </u> | 4. brittle | <u> P </u> |
| 2. blue-gray color | <u> P </u> | 5. melts at 1410 °C | <u> P </u> |
| 3. insoluble in water | <u> P </u> | 6. reacts vigorously with fluorine | <u> C </u> |

Identify each of the following as an element (E), a compound (C), or a mixture (M):

- | | | | | | |
|------|--------------|-----------------|--------------|----------|--------------|
| ice | <u> C </u> | oxygen gas | <u> E </u> | blood | <u> M </u> |
| wine | <u> M </u> | pure table salt | <u> C </u> | gasoline | <u> M </u> |

Indicate whether each of the following is homogeneous or heterogeneous:

- | | | | |
|--------------------|----------------------|--------------------------------------------|--------------------|
| a pepperoni pizza | heterogeneous | the compound, sodium chloride (table salt) | homogeneous |
| the element copper | homogeneous | a solution of sugar dissolved in water | homogeneous |

In an essay of required length, describe how you would experimentally determine whether a cup of an unknown liquid is:

- 1) pure water or
- 2) a sodium chloride water solution or
- 3) pure ethanol

Now watch the powerpoint

- The Scientific Method