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

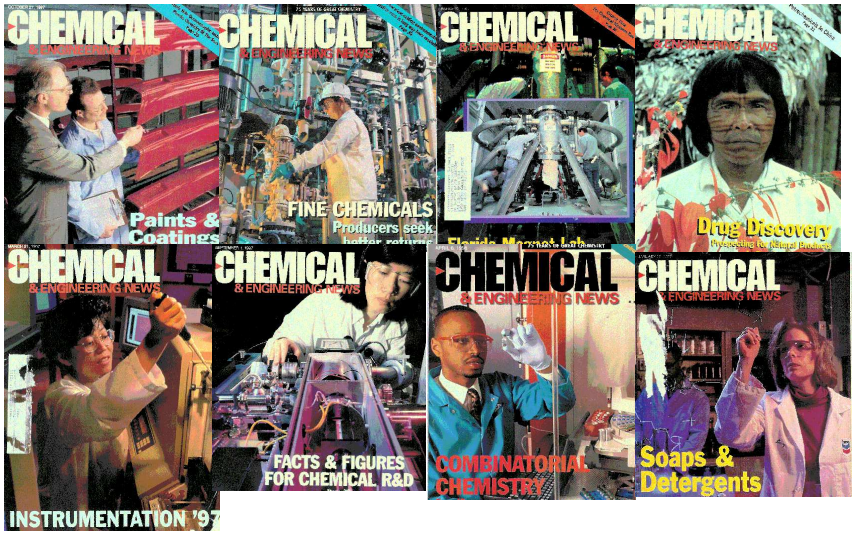
1.3 Scientific Method: Think like a Scientist

1.4 A Study Plan for Learning Chemistry

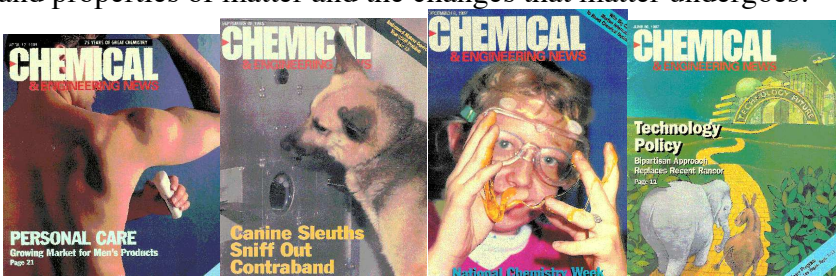
Also read,

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

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composition

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

B. Change, Δ

a. physical change in state. For example.

boiling liquid water into water as steam

b. chemical change is a substance's ability to change form into new some new substance. For example.

hydrogen and oxygen react to make water

c. a symbol for change is the Greek letter, Δ, delta.

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composition

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

C. Time

a. the change in time equals the final time minus initial time

This statement would be mathematically written as:

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

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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:

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

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

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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

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composition

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

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

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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 H_2O (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

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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

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composition

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 supplemental HO 6

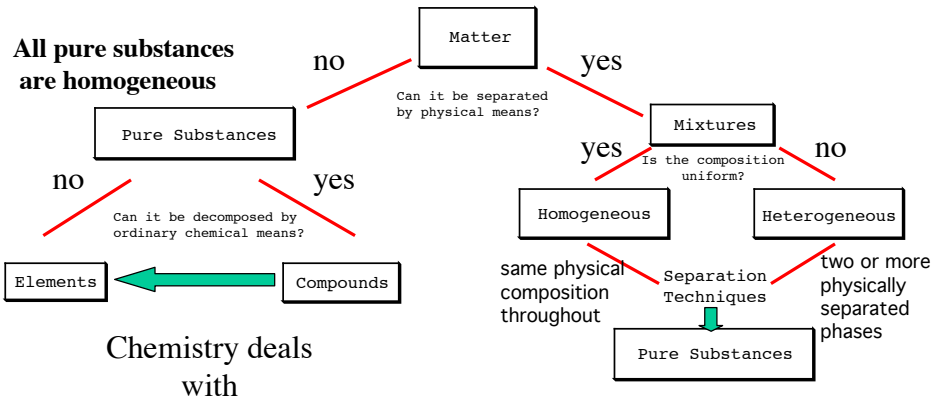
- Matter is everything that has density, mass and occupies a volume.
- Density is the ratio of mass per volume where mass is an amount given in grams and volume is given in milliliters.
- Matter can be organized into two broad classes; **pure** or **impure**.
- Pure matter, which are elements and compounds, 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 compostion.
- Homogeneous means substance composition is the same throughout. For example, a saline IV solution (salt water) used for IV intraveno 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 supplemental HO 6

- 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 supplemental HO 6

II. The Organization of Matter



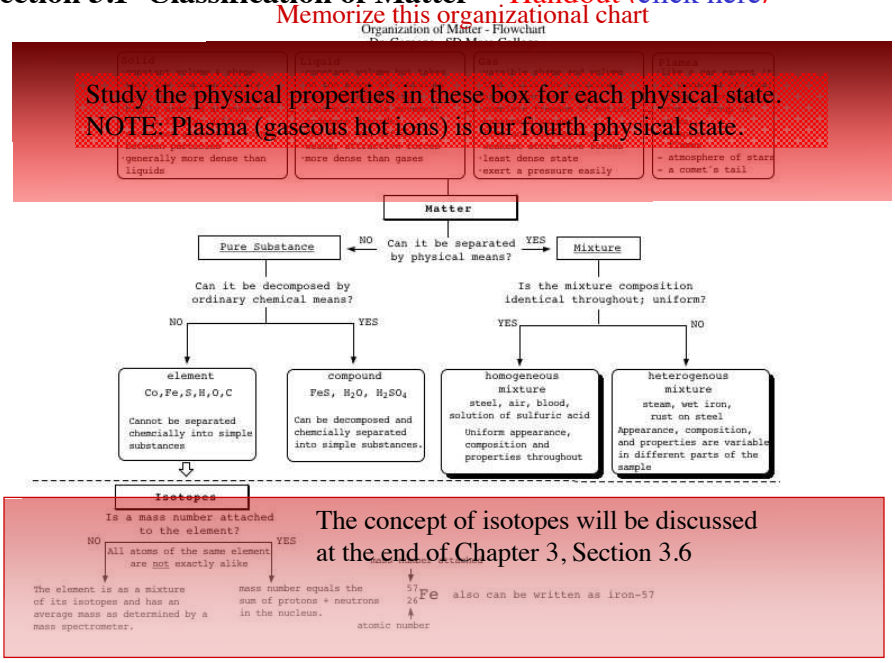
Chemistry deals with chemical separations chemical changes

Chemistry deals with physical separations physical changes

Section 3.1- Classification of Matter

Handout (click here)

Memorize this organizational chart

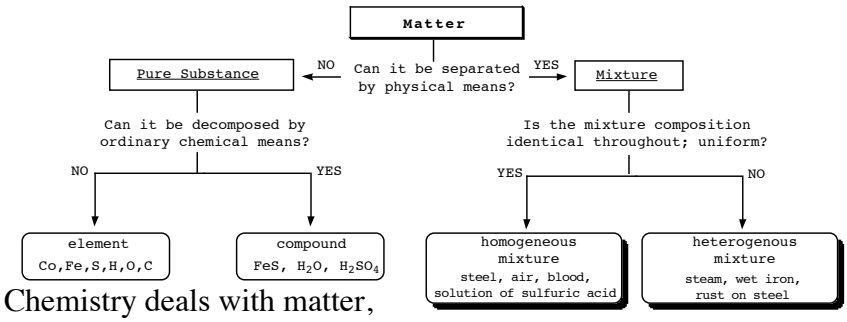


Section 3.1- Classification of Matter

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,

a. physical separations
b. physical changes
c. chemical separations
d. chemical changes

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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

supplemental HO 8; add symbolisms to your notes

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 H_2O 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 — odor — density

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

$$2H_2O_{(l)} \xrightarrow[\text{electrolysis of water}]{\text{the addition of electrons}} 2H_{2\,(g)} + 1O_{2\,(g)}$$

supplemental HO 8

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

$$100 \text{ grams } H_2O_{(l)} \xrightarrow{\text{heat}} 100 \text{ grams } H_2O_{(g)}$$

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.

$$2H_2O_{(l)} \xrightarrow[\text{electrolysis of water}]{\text{the addition of electrons}} 2H_{2\,(g)} + 1O_{2\,(g)}$$

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, H_2O, above.

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

left side (reactant side) → right side (product side)

Changes in Physical State

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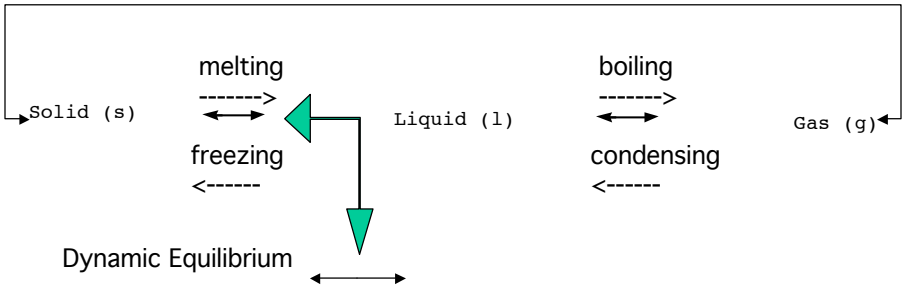
Sublimation (going directly from the solid state to the gas state)



Dynamic Equilibrium

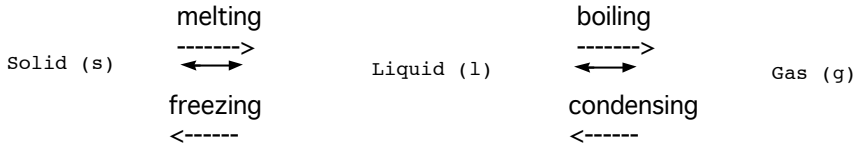
melting and at the same time its freezing

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

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Chemical Change alters the chemical composition of the substance

$$2H_2O_{(l)} \xrightarrow[\text{electrolysis of water}]{\text{the addition of electrons}} 2H_{2(g)} + 1O_{2(g)}$$

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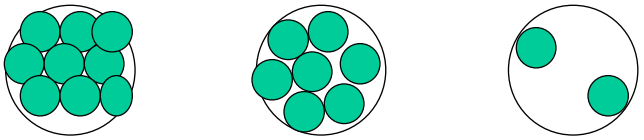
B. What is characteristic about each state?



solid liquid gas

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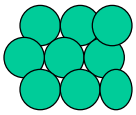
SOLIDS

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 of a solid can be independent of its container.
Do not flow or diffuse.
Very low compressibility.
Strongest attractive forces between particles.
Expand slightly when heated.



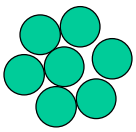
solid

supplemental HO 10

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 makes 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

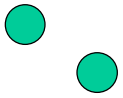


liquid

supplemental HO 10

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 = FORCE / AREA



gas

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States of Matter
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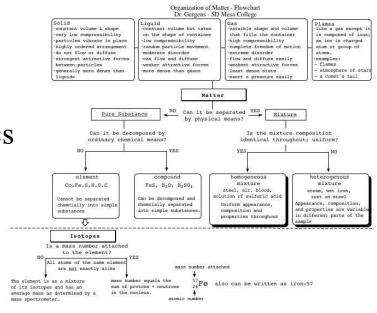
List the four states of matter:			
1.	2.	3.	4.

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 theses 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 P
2. Rusting of iron C
3. Snow melts of a warm day P
4. Souring of milk C
5. Burning of gasoline in a car's engine C
6. Table salt dissolves in water P
7. Freezing water to make ice cubes P

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

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

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

ice C | oxygen gas E | blood M
wine M | pure table salt C | gasoline M

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