Chapter 1 - Matter and Change

1-1 Chemistry is a Physical Science

I. Physical science
   - A. Purpose
     1. Search for relationships in nature which can be used to predict the behavior of things
   - B. Branches of Chemistry
     1. Analytical chemistry
     2. Organic chemistry
     3. Inorganic chemistry
     4. Physical chemistry
     5. Biochemistry
     6. Physical chemistry
     7. Nuclear chemistry

II. Types of Research
   - A. Basic Research
     1. Carried out for the purpose of increasing knowledge
        a. Commercial applications can result from basic research, but they are not the goal of basic research
   - B. Applied Research
     1. Carried out to solve a problem
        a. Cures and vaccines for diseases
        b. Non-polluting fuels
   - C. Technological Development
     1. Application of discoveries to products that improve quality of life
        a. transistors and microchips
        b. optical fibers

1-2 Matter and Its Properties

I. Matter
   - A. Definition of Matter
     1. Anything that has mass and occupies space (has volume)
        a. mass is a measure of the amount of matter
        b. volume is a measure of the amount of 3-dimensional space an object occupies
   - B. Basic Building Blocks of Matter
     1. Atom
        a. The smallest unit of an element that maintains the properties of that element
     2. Element
        a. A pure substance made of only one kind of atom
     3. Compound
        a. A substance that is made from the atoms of two or more elements that are chemically bonded

4. Molecule
    a. The smallest unit of an element or compound that retains all of the properties of that element or compound

II. Properties and Changes in Matter

A. Extensive Properties
    1. Dependent upon the amount of matter present
        a. volume
        b. mass
        c. energy (heat content)

B. Intensive Properties
    1. Independent of the amount of matter present
        a. melting point
        b. boiling point
        c. density

C. Physical Properties
    1. A characteristic that can be observed or measured without changing the identity of the substance
        a. melting point, boiling point, density, hardness, color, odor

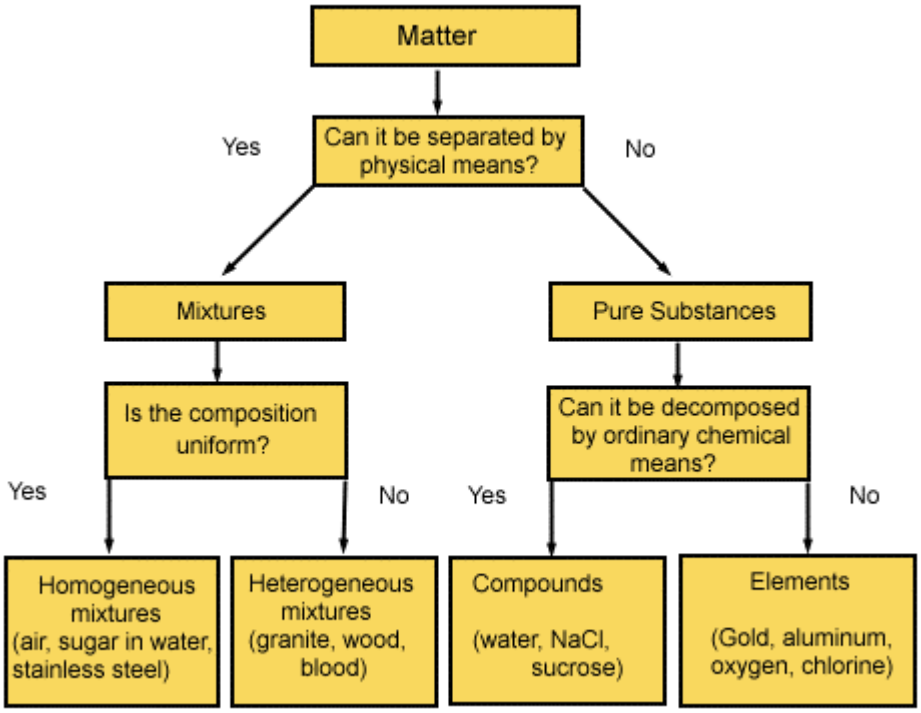
D. Physical Changes
    1. A change in a substance that does not involve a change in the identity of the substance
        a. Change of state (phase change)
            (1) Solid
                Retains size and shape
                Has a definite volume
                Cannot be compressed
            (2) Liquid
                Not rigid
                Takes the shape of its container - no definite shape
                Has a definite volume
            (3) Gas or vapor
                Easily compressed
                No definite shape or volume
                Takes the shape of its container

E. Chemical Properties
    1. Relates to a substances ability to undergo changes that transform it into different substances
        a. ability to: combust, oxidize, neutralize, etc

F. Chemical Changes
    1. A change in which one or more substances are converted into different substances
        a. combustion, oxidation, neutralization

G. Energy Changes in Matter
    1. The Law of Conservation of Energy
        a. Energy may be absorbed in a reaction (called "endothermic") or released in a reaction (called "exothermic"), but energy is not created or destroyed

III. <u>Classification of Matter</u>



A. Mixtures
    1. A blend of two or more kinds of matter, each of which retains its own identity and properties
    2. The components of mixtures can usually be separated through physical means
        a. filtration, distillation, chromatography, sedimentation, extraction
    3. Heterogeneous mixtures
        a. mixtures that are not uniform throughout
    4. Homogeneous mixtures (solutions)
        a. mixtures that are uniform throughout

B. Pure Substances
    1. Fixed composition
        a. Every sample of a pure substance has the same characteristic properties
        b. Every sample of a pure substance has exactly the same composition
    2. Compounds are pure substances
        a. A compound can be decomposed into two or more simpler compounds or elements by a chemical change
    3. Elements are pure substances

C. Laboratory Chemicals and Purity
    1. All laboratory chemicals include some impurities
    2. Lower impurities = higher cost
    3. Reagent grade is highest purity

1-3 Elements

I. Introduction to the Periodic Table

A. Symbols of Elements
    1. First letter is always capitalized
    2. Second letter, if there is one, is never capitalized
    3. Latin (*L*) and German (*G*) Origins of some symbols

Modern Name	**Symbol**	**Older name**
Antimony	Sb	Stibium - *G*
Copper	Cu	Cuprum - *L*
Gold	Au	Aurum - *L*
Iron	Fe	Ferrum - *L*
Lead	Pb	Plumbum - *L*
Mercury	Hg	Hydrargyrum - *L*
Potassium	K	Kalium - *L*
Silver	Ag	Argentum - *L*
Sodium	Na	Natrium - *L*
Tin	Sn	Stannum - *L*
Tungsten	W	Wolfram - *G*

B. Organization of the Table
    1. Groups or Families
        a. Vertical columns containing elements with similar chemical properties
    2. Periods (series)
        a. Horizontal rows of elements
    3. Metals and Nonmetals
        a. A line on the table usually separates the metals from the nonmetals
        b. Metalloids, which straddle the line, are considered nonmetals
    4. Lanthanide and Actinide Series
        a. Metals - there place at the bottom will become more apparent in chapter 4

II. Types of Elements

A. Metals
   1. Luster
   2. Good conductor of heat and electricity
   3. Malleability
   4. Ductility
   5. High tensile strength

B. Nonmetals
   1. Many nonmetals are gases at room temperature
   2. Solid nonmetals tend to be brittle
   3. Poor conductors of heat and electricity

C. Metalloids
   1. Some properties of metals and some properties of nonmetals
   2. Solids at room temperature
   3. Semiconductors of electricity

D. Noble Gases
   1. All are gaseous members of group 18
   2. Generally unreactive