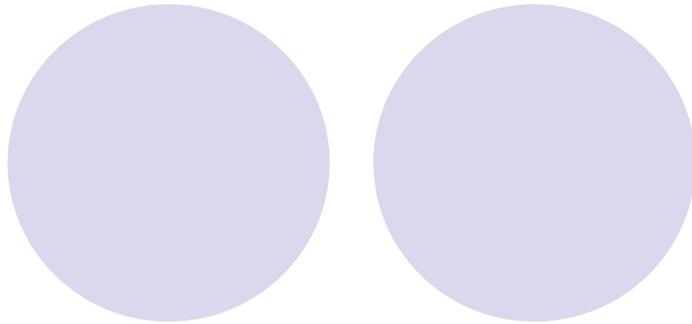
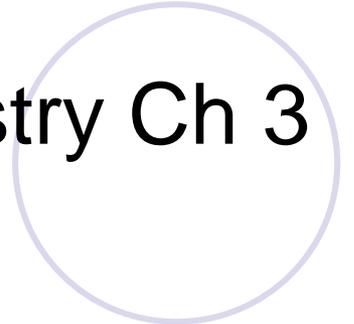
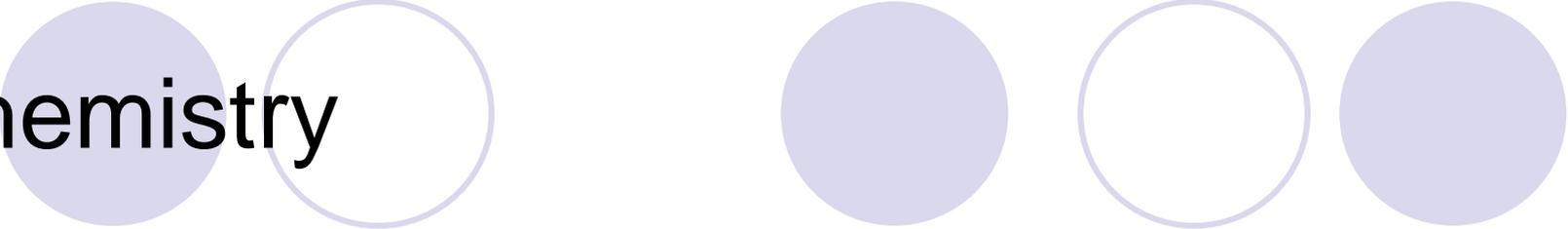


Matter - Properties and Changes



Chemistry Ch 3





Chemistry

- **Chemistry** is the study of the composition of substances and the changes that they undergo.
- **Organic chemistry** is the study of most substances that contain carbon.
- **Inorganic chemistry** focuses on substances lacking carbon.
- **Analytical chemistry** concerns the composition of substances.
- **Physical chemistry** explains the behaviors of chemical substances.
- **Biochemistry** concerns living organisms

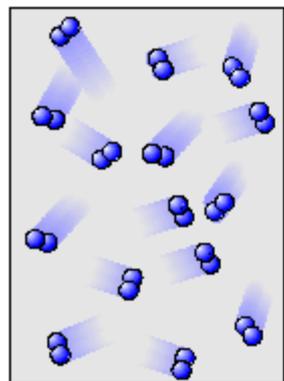
Matter

Matter – any that takes up space

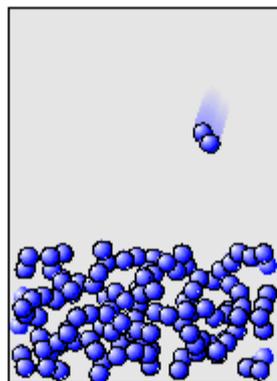
- **Mass**- how much matter an object or substance contains
- What is NOT matter?
 - Energy

3 states of matter

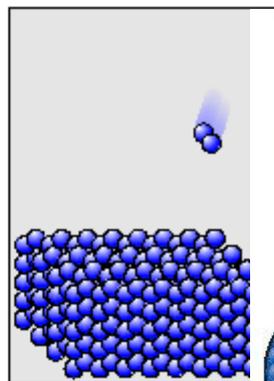
- **Solid** – definite shape and volume
- **Liquid** – definite volume and takes shape of container
- **Gas** – takes the volume and shape of its container



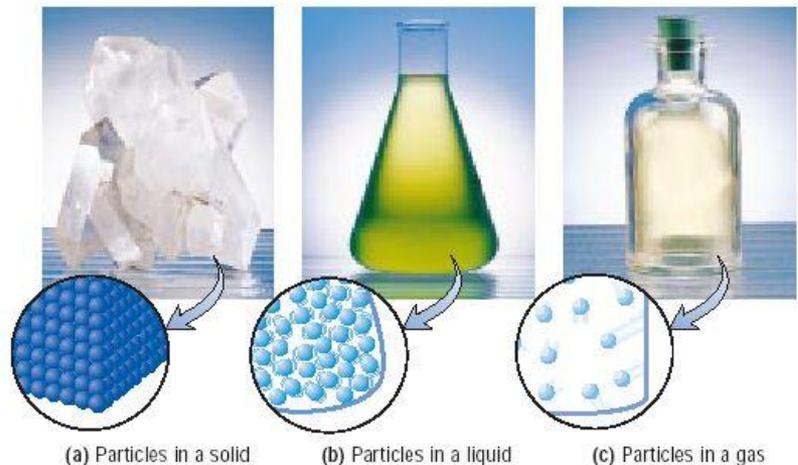
gas



liquid



solid

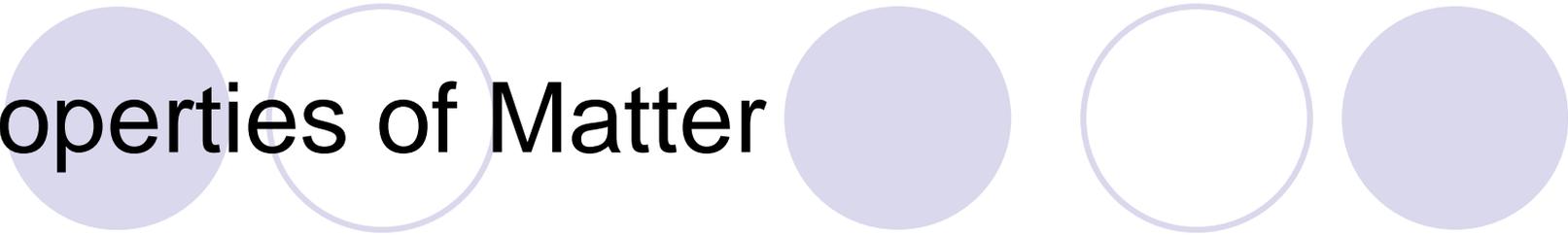


(a) Particles in a solid

(b) Particles in a liquid

(c) Particles in a gas

Properties of Matter



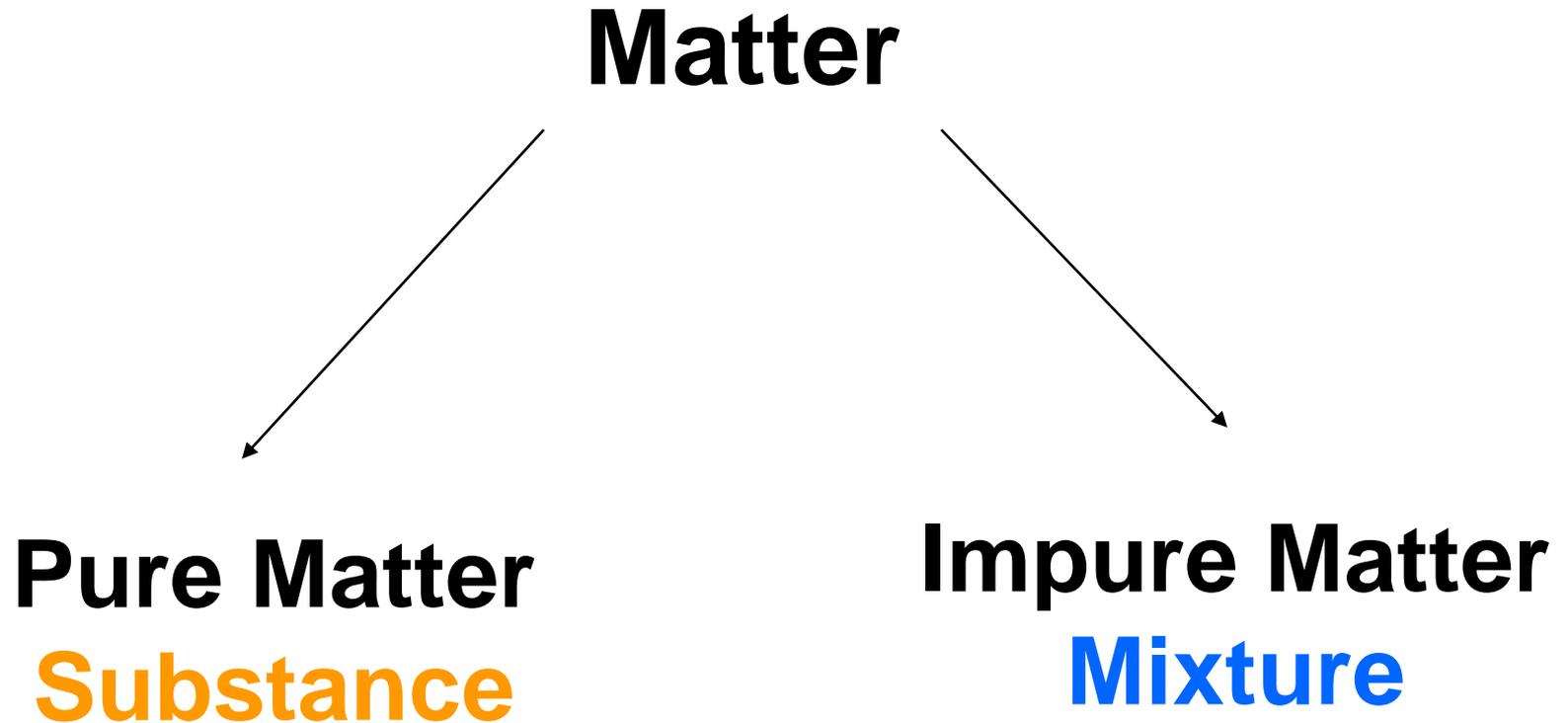
- **Extensive properties**

- Depend on the amount of matter that is present
 - Volume
 - Mass
 - Energy Content (think calories)

- **Intensive properties**

- Do not depend on the amount of matter present
 - Melting point
 - Boiling point
 - Density

What is the composition of matter?



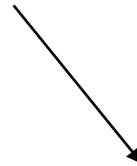
What is a pure substance?

- A **pure substance** has a definite & uniform composition
 - Can **NOT** be separated by physical means
 - Can be separated into constituent elements by chemical means
- **Types of Substances**

Pure Substance



Compounds

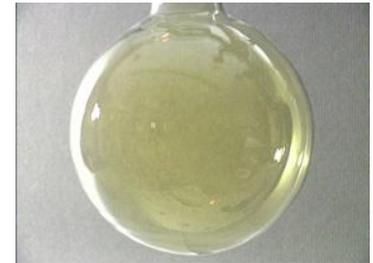
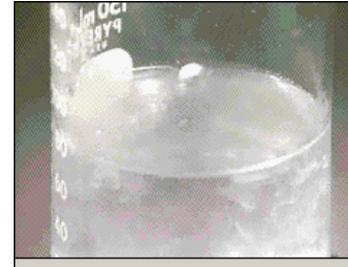


Elements

Types of Pure Substance

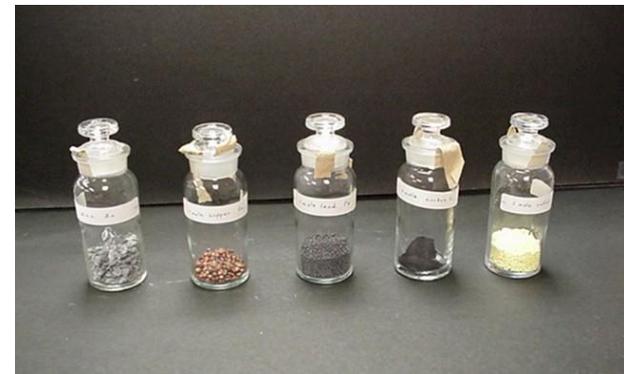
● Elements

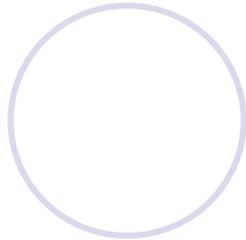
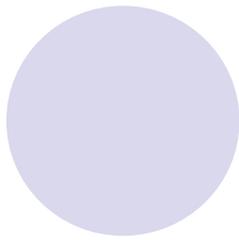
- Matter in which all the atoms are alike
- 92 elements occur naturally on Earth
- Each element is represented by a **chemical symbol**
- Examples: **H**=hydrogen, **C**=carbon, **Na**=sodium, **Hg**=mercury
 - One or two letters may be used.
 - The first letter is upper case while the second is lower case.



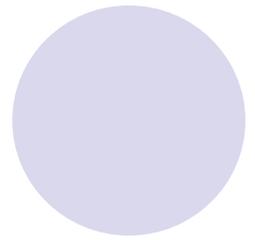
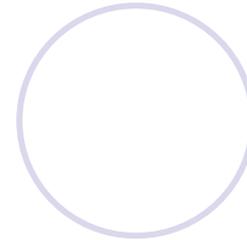
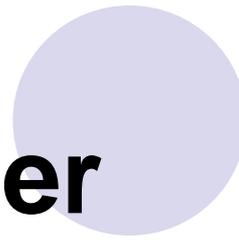
● Compounds

- Combination of atoms of two or more elements
 - Always have the same amounts or ratios
 - H_2O , CO_2 , HCl
- No longer has the properties of its constituent elements.





Matter



Pure Substance

Mixture

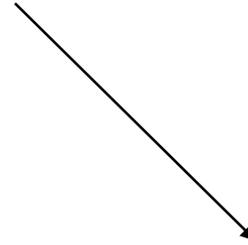
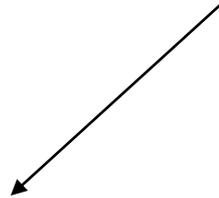
Impure Matter

Compounds

Elements

**Homogeneous
Mixture**

**Heterogeneous
Mixture**

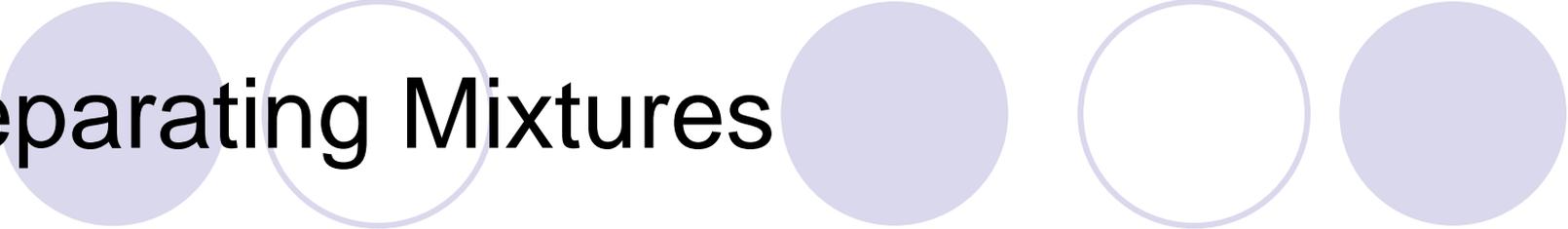


Mixtures

- **Mixture** is a blend of two or more substances, each of which retains its own identity and properties
 - maybe separated by physical means
 - Air, salt water, milk, brass metals
- **Heterogeneous mixture** different materials are spread out unevenly
 - Gravel
 - Vegetable Soup
- **Homogeneous mixture**
 - They have the same proportion of components throughout.
 - Homogeneous mixtures are called *solutions*.
 - Salt water
 - gasoline



Separating Mixtures



- **Filtration** is a technique that uses a porous barrier to separate a solid from a liquid in a heterogeneous mixture
- **Distillation** is a separation technique for homogeneous mixtures that is based on the differences in boiling points of substances.
- **Crystallization** is a separation technique for homogeneous mixtures that results in the formation of pure solid particles from a solution containing the dissolved substance.
- **Sublimation** is the process of a solid changing directly to a gas, which can be used to separate mixtures of solids when one sublimates and the other does not.
- **Chromatography** is a technique that separates the components of a mixture on the basis of tendency of each to travel across the surface of another material.

Matter Properties



Physical Properties

- Any characteristic of a material that you can observe
 - State
 - Size
 - Color
 - Odor
 - Mass
 - Melting point, boiling pt
 - Magnetic
 - Density
 - Electrical conductivity

Chemical Properties

- Characteristic that indicates a chemical change could occur
 - Flammable
 - Corrosive
 - Burns in air
 - Tarnishes
 - Toxic
 - Decomposes when heated
 - Reacts with water
 - Reacts with certain acids

Chemical Change versus Physical Change

- **Chemical change** involves changes in the composition of matter which is the result of a chemical reaction
 - Reacting hydrogen gas and oxygen gas to form water
 - Reacting iron and oxygen to form iron oxide (rust)
- **Physical change** involves only changes in the physical state, phase or form of matter without change in composition
 - Identity remains the same but a change occurs in matter's size, shape, or phase
 - Melting ice to form liquid water (no chemical change)
 - Mixing two or more pure substances to form a mixture
 - Mixing sand and salt

Chemical Change versus Physical Change

Chemical Change

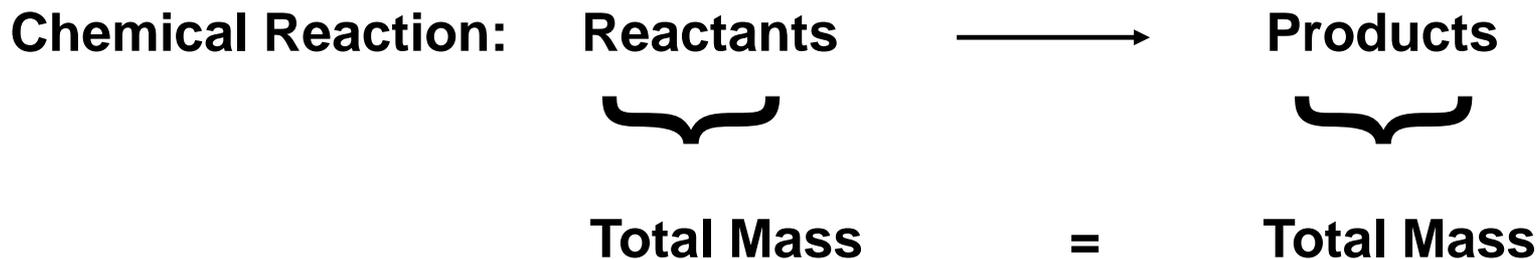
- New smell
- Rapid production of energy, light, or sound
- New substance
- Rusting
- Foaming
- Precipitate forms when 2 clear liquids are mixed

Physical Change

- Different size
- Different shape
- Color
- Different state

Chemical Reactions

- **Chemical reactions** change at least one substance into a new substance
- The **law of conservation of mass**: During a chemical process or change, the total mass remains unchanged



Law of Definite proportions

- The law of definite proportions states that a compound is always composed of the same elements in the same proportion by mass, no matter how large or small the sample.
- The relative amounts are expressed as percent by mass, the ratio of the mass of each element to the total mass of the compound expressed as a percentage.

$$\text{percent by mass (\%)} = \frac{\text{mass of element}}{\text{mass of compound}} \times 100$$

Law of Multiple Proportions

- The law of multiple proportions states that when different compounds are formed by a combination of the same elements, different masses of one element combine with the same relative mass of the other element in whole number ratios.
 - H_2O_2 and H_2O
 - Copper(I) chloride and copper(II) chloride

Key Concepts - Review



- The three common states of matter are solid, liquid, and gas
- Physical properties can be observed without altering a substance's composition.
- Chemical properties describe a substance's ability to combine with or change into one or more new substances.
- External conditions can affect both physical and chemical properties
- A physical change alters the physical properties of a substance without changing its composition.
- A chemical change, also known as a chemical reaction, involves a change in a substance's composition..

Key Concepts - Review

- In a chemical reaction, reactants form products.
- The law of conservation of mass states that mass is neither created nor destroyed during a chemical reaction; it is conserved

$$\text{mass}_{\text{reactants}} = \text{mass}_{\text{products}}$$

- A mixture is a physical blend of two or more pure substances in any proportion
- Solutions are homogeneous mixtures.
- Mixtures can be separated by physical means. Common separation techniques include filtration, distillation, crystallization, sublimation, and chromatography
- Elements cannot be broken down into simpler substances.
- Elements are organized in the periodic table of the elements.
- Compounds are chemical combinations of two or more elements and their properties differ from the properties of their component elements

Key Concepts - Review

- The law of definite proportions states that a compound is always composed of the same elements in the same proportions.
- The law of multiple proportions states that if elements form more than one compound, those compounds will have compositions that are whole-number multiples of each other

$$\text{percent by mass (\%)} = \frac{\text{mass of element}}{\text{mass of compound}} \times 100$$

Extra

Classification of Matter

