

Chem 101

Matter

Lecture 2

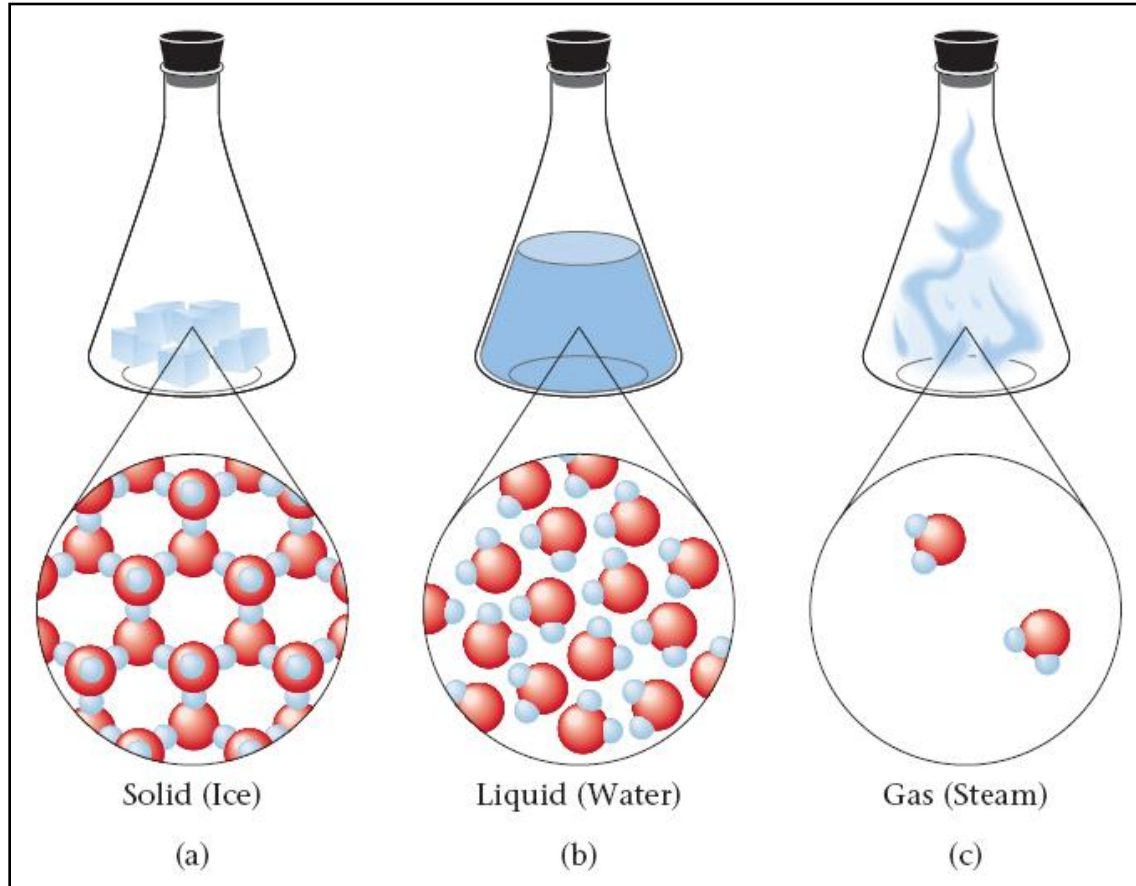
Chapter 3.1 – 3.5

States of Matter

Table 3.1 The Three States of Matter

State	Definition	Examples
solid	rigid; has a fixed shape and volume	ice cube, diamond, iron bar
liquid	has a definite volume but takes the shape of its container	gasoline, water, alcohol, blood
gas	has no fixed volume or shape; takes the shape and volume of its container	air, helium, oxygen

States of Matter



Universe Classified

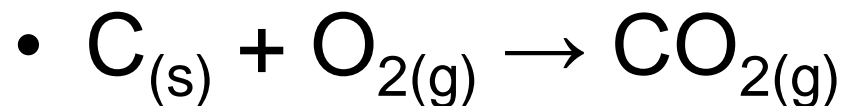
- **Matter:** the part of the universe that has mass and volume
- **Chemistry is the study of matter**
 - The properties of different types of matter
 - The way matter changes and behaves when influenced by other matter and/or energy

Properties of Matter

- **Physical Properties:** the characteristics of matter that can be changed without changing its composition
 - Characteristics that are directly observable
- **Chemical Properties:** the characteristics that determine how the composition of matter changes as a result of contact with other matter or the influence of energy
 - Characteristics that describe the behavior of matter

Chemical Properties

- One commonly cited chemical property is flammability, the ease with which a substance burns in a flame. Burning is a chemical reaction.



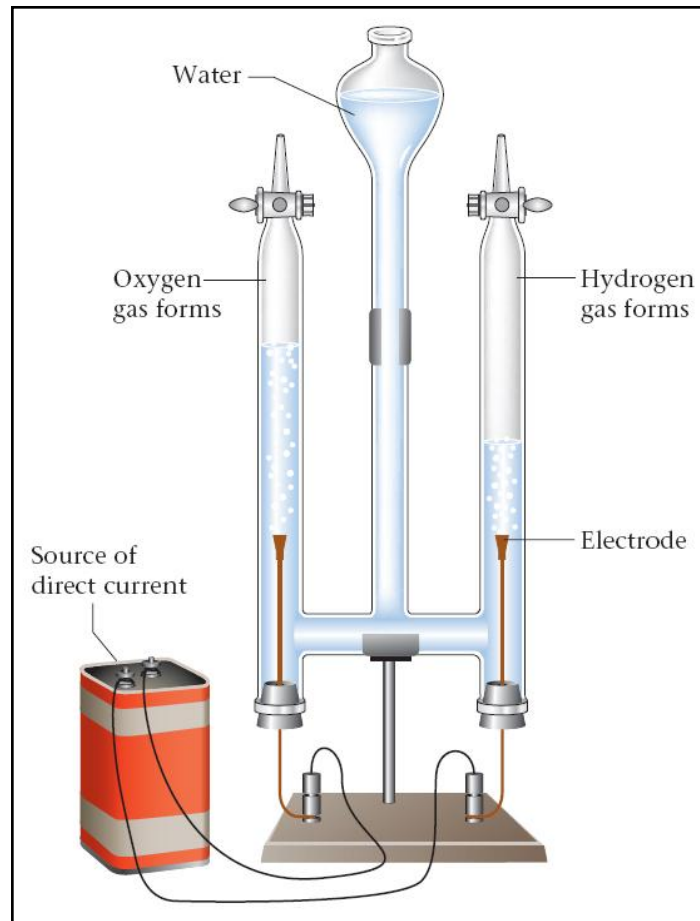
Classify as a Physical or Chemical Property

- Ethyl alcohol boiling at 78°C.
- Hardness of a diamond.
- Sugar fermenting to form ethyl alcohol.

Changes in Matter

- **Physical changes:** changes to matter that do not result in a change to the fundamental components that make up the substance
 - State changes: boiling, melting, condensing
- **Chemical changes:** changes that involve a change in the fundamental components of the substance
 - Produce new substances
 - Chemical reactions occur
 - Reactants → Products

Chemical Change



Chemical Change

- Chemical change involves a chemical reaction. At least one new substance is formed.

Classify as a Physical or Chemical Change

- Iron metal melting.
- Iron combining with oxygen to form rust.
- Leaves turning colors in fall.
- Egg cooking
- Wood burning
- Chopping wood

Elements and Compounds

- **Elements:** substances that cannot be broken down into simpler substances by chemical reactions – Fe, He, Hg
- Most substances are chemical combinations of elements. These combinations are called **compounds** – Fe_2O_3 , CO_2 , H_2O
 - Compounds are made of elements
 - Compounds can be broken down into elements
 - Properties of the compound not related to the properties of the elements that compose it
 - Same chemical composition at all times

Classification of Matter

- **Homogeneous:**
 - uniform throughout, appears to be one thing
 - Pure substances
 - Water, aluminum metal, brass alloy
 - Solutions (homogeneous mixtures)
 - Salt water
- **Heterogeneous:**
 - non-uniform, contains regions with different properties than other regions
 - Concrete, chunky peanut butter

Pure Substances

- **Pure substances**
 - All samples have the same physical and chemical properties
 - Constant composition: all samples have the same composition
 - Homogeneous
 - Separate into components based on **chemical properties**

Mixtures

- **Mixtures**
 - Different samples may show different properties
 - Variable composition
 - Homogeneous or heterogeneous
 - Separate into components based on physical properties
- **All mixtures are made of pure substances**

Solutions

- A solution is a ***homogeneous mixture***.
- Phases can be gaseous, liquid, or solid.
 - Air is a mixture of many gases
 - A cup of tea may be a mixture of water, sugar, milk, and tea
 - Brass is a mixture of copper and zinc
 - Mayonnaise is a colloid of oil, vinegar, salt and egg. The particles of each component are so small that they don't separate.

Identify each of the following as a Pure Substance, Homogeneous Mixture, or Heterogeneous Mixture.

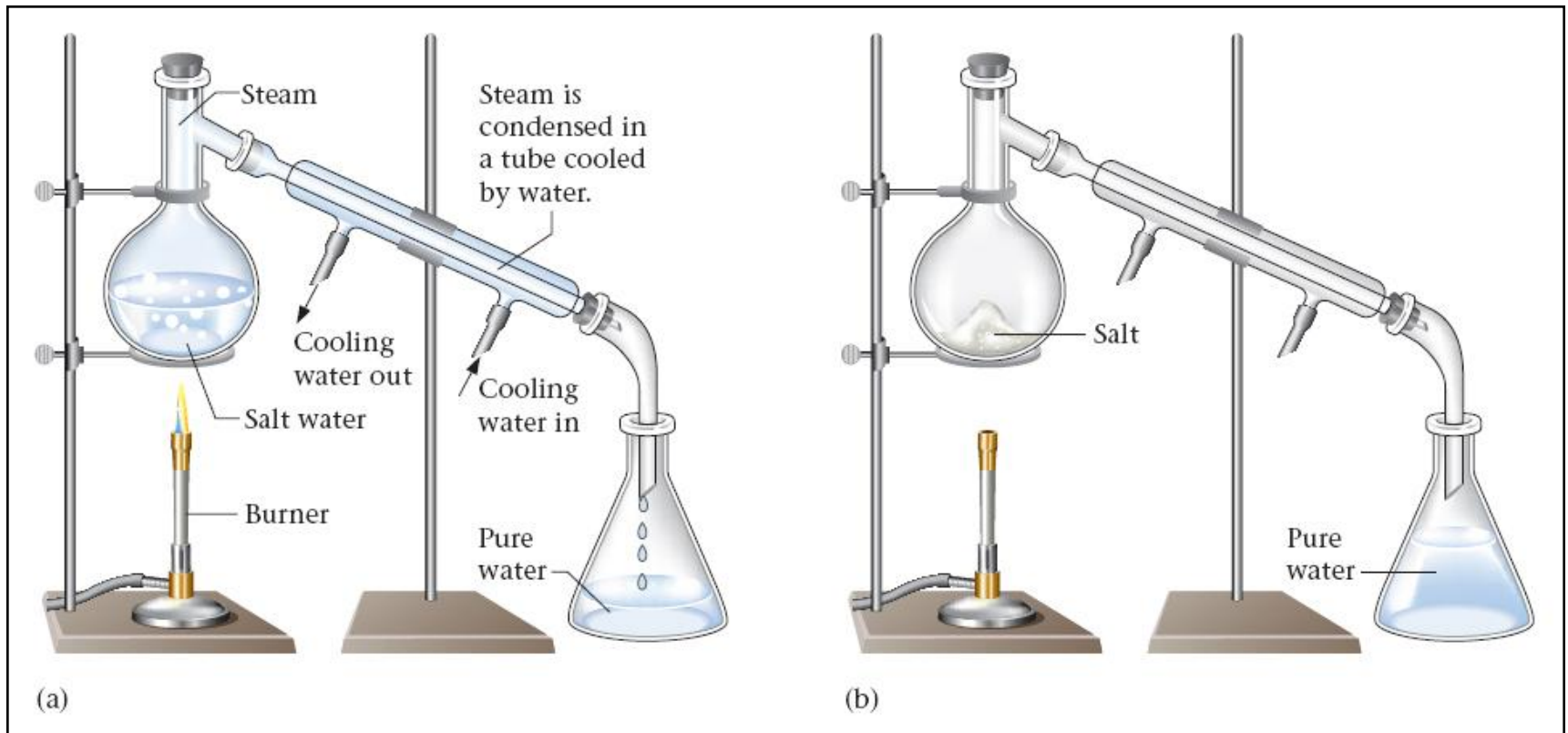
- Gasoline
- A stream with gravel on the bottom
- Copper metal

Separation of Mixtures

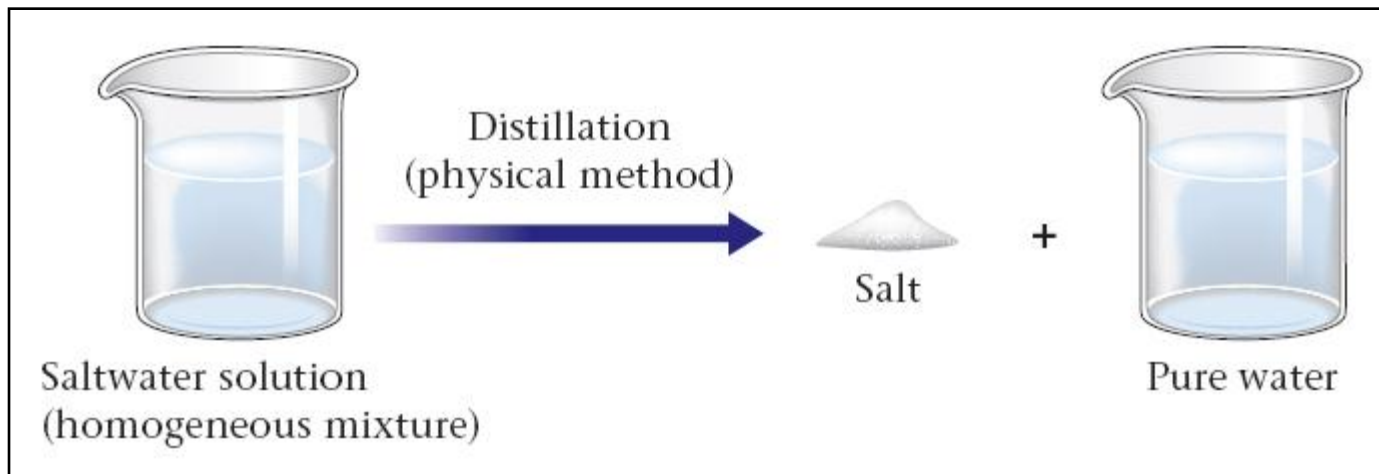
- Mixtures can be separated based on different physical properties of the components
 - Physical change

Different Physical Property	Technique
Boiling point	Distillation
State of matter (solid/liquid/gas)	Filtration
Adherence to a surface	Chromatography
Volatility	Evaporation

Separation of Mixture (cont.)



Separation of a Mixture (cont.)



Separation

- Get into a group of 2-3-4 or 5
- Set up one page for the group:
 - 1-13-10, Names of all in group, put Separation as the heading
- Write a step by step procedure describing how you would totally separate a bucket of the following mixture:
 - Sand, blue gills, salt, water, motor oil, gravel, duckweed, tadpoles, mud, feathers, oak leaves