Mixtures, Elements, and Compounds

Chapter 3
(plus K4 & K5) (Big 11 & 12)

Matter: Building Blocks of the Universe
Atoms and the Periodic Table
Section 3-1 Classes of Matter

- It is important to **classify**, or group, objects in a collection; using **characteristics** or **properties** makes it easier.

- Examples of classified objects can be found in the
  - library,
  - grocery store,
  - music store, and
  - department store.
Section 3-1 Classes of Matter (cont)

- Scientist classify matter, to make the study of matter easier.

**Phases** of matter are one way to classify matter.

- Solid
- Liquid
- Gas
- Plasma
Section 3-1 Classes of Matter (cont)

- Scientist classify matter, to make the study of matter easier.

Make-up of matter is another way to classify matter.

- Mixtures (mechanical)
- Solutions
- Elements
- Compounds
Section 3-2 MIXTURES

• Matter that consist of two or more substances mixed together but not chemically combined is called a mixture.

Mixtures are a combination of substances.
Section 3-2 MIXTURES (cont)

- Each substance has its own specific properties.
- It is not the same throughout.
- Examples of Mixtures:
  1. Granite
  2. Sand
  3. Soil
  4. Salad dressing
PROPERTIES OF MIXTURES

A. Each substance keeps its own property.

B. Chemical composition does not change; some physical properties may change.

1) Sugar water – still consist of sugar and water, no new chemical has been produced.
C. Substances can be present in any amount; the amounts are not fixed.

D. The substances can be separated out by simple physical properties

1) Most common methods of separation of substances are filtration and evaporation

https://www.studyladder.com/games/activity/separating-mixtures-29646
2) **Separation** is based on the physical properties of substances

a) powered iron and sulfur mixture
   – separate using a magnet

b) sugar and water and sand mixture – **separate** by evaporation / recollect the water
MOVE TYNDELL HERE

• BE SURE TO FIX THE STUDENT VERSIONS !!!!
Tyndall Effect

1.) A beam of light **passes through** a mixture and becomes **visible**. This is **due to** the larger **particle sizes**.

- a) Examples of the tyndall effect are
  - i) **fog**
  - ii) **movie projector**
  - iii) **dust particles in a sunny window**
  - iv) **a nighttime searchlight in the sky**.
Tyndall Effect

- b) Order of particle size from largest to smallest:
  - 1) Largest – suspensions
  - 2) Medium – colloids
  - 3) Smallest – solutions
MOVE SOLUBILITY HERE ??

• BE SURE TO FIX THE STUDENT VERSIONS !!!!
Solubility

1) A substance that **dissolves** or breaks apart in another substance is said to be **soluble**.

2) Substances that **do not dissolve** in other substances are said to be **insoluble**.

3) Solubility is the given amount of a solute that can be dissolved in a given solvent at a specific temperature.
Solubility

a) Liquid solubility increases with the increase in temperature
   • more sugar will dissolve in hot water than in cold water.

b) Gaseous solubility decreases with the increase in temperature.
   • less gas will dissolve in warmer temperatures, explaining why soda goes flat when it gets warm
Types Of Mixtures

• Mixtures are **classified** based on how “**well mixed**” they are. Granite, concrete and stainless steel are mixtures.

• Granite is a mixture of minerals: **quartz, feldspar, and mica**

• Concrete is a mixture of **rock, sand and cement**.

• Stainless steel, which does rust, is a mixture of chromium and iron.
Types Of Mixtures (cont)

A. **HETEROGENEOUS MIXTURES**
1) The **least mixed** of all mixtures
2) Does not appear to be the **same** throughout
3) Individual **particles** are large enough to be **seen** and to be **separated** from the mixture
Types Of Mixtures (cont)

a) Solid – Solid heterogeneous mixtures (ie. concrete, iron and sulfur, sand and salt)

b) Solid – Liquid heterogeneous mixtures (ie. sand and water, Pepto-Bismol, salt and water)

d) Particles often settle when the mixture is allowed to stand for a period of time.
Special Heterogeneous Mixtures - Colliods

a) appear to be homogenous but when observed closely, they are heterogeneous.
b) are often solid – liquid mixtures (not dissolved)
   i) Mayonnaise
   ii) Milk
   iii) Toothpaste
c) these special mixtures do not settle when allowed to stand for a period of time.
d) these mixtures scatter light, they show a Tyndall effect.
Special Heterogeneous Mixtures - Suspensions

a) Are heterogeneous mixtures that are often solid–liquid mixtures

b) These heterogeneous mixtures settle when allowed to stand for a period of time

c) These mixtures scatter light, they show a Tyndall effect.
Special Heterogeneous Mixtures - Emulsions

a) are a **special** type of **suspension**; they are **liquid – liquid** mixtures

b) these heterogeneous mixtures **settle** when allowed to stand for a period of time

c) these mixtures **scatter light**, they show a Tyndall effect.
B. HOMOGENEOUS MIXTURES

1) A well-mixed mixture

2) Appears to be the same throughout

3) Particles are very small and not easily recognized

4) Particles do not settle when allowed to stand for a period of time
Types Of Mixtures (cont)

B. HOMOGENEOUS MIXTURES

a) Solid – Solid homogeneous mixture (ie. stainless steel)
b) Solid – Liquid homogenous mixture (ie. air, instant coffee)
c) Liquid – Liquid homogenous mixture (ie. vinegar and water)
Special Homogeneous Mixtures - Solutions

• A type of **homogeneous** mixture formed when **one** substance **dissolves** in **another** is known as a solution.

  1. **Best mixed** of all mixtures.
  2. Contains a **substance** that is **dissolved** (solute) and a **substance** that **does** the dissolving (solvent).
Special Homogeneous Mixtures - Solutions

- Lemonade – solute: LEMON solvent: WATER
- tea – solute: TEA solvent: WATER
- koolaid– solute: POWDER solvent: WATER

3. Particles are very small, they cannot be seen.
4. Appear to be clear or transparent.
5. Do not scatter light, they do not show the Tyndall effect.
Solubility

4) Alloys are solids that dissolve in other solids
   a) Brass – copper and zinc solution
   b) Sterling silver – copper and silver solution
   c) Stainless silver – chromium and iron solution.
Steel must be mostly Iron with less than about 2% carbon. Other elements are added in small amounts, too (less than 10%).

The other elements are used to make it behave in special ways:
- Chromium to make it rust resistant, for instance. Common elements added are:
  - Silicon,
  - Manganese,
  - Chromium,
  - Vanadium,
  - Tungsten,
  - Molybdenum,
  - Nickle, and Cobalt.

Test results showed high concentrations of sulfur, oxygen, and phosphorous, and low concentrations of manganese, nitrogen and silicon. This was mainly a result of producing the steel using open-health furnaces.
MATTER

Element  Compound  Homogeneous  Heterogeneous

• FROM the Periodic Table  • Single substance
• FROM two or more substances found on the Periodic Table  • Chemically combined
• DOES NOT look the same  • Looks the same throughout
• LOOK Homogeneous (really heterogeneous)  • Can not see particles (small)
• DO NOT Settle out  • Does not settle (separate)
• SHOWS TYNDALL  • Well mixed
• Particles not dissolved (but trapped) in liquid  • NOT look the same throughout.
• SHOWS TYNDALL  • Large particles
• Settles (separate)  • Not well mixed
• Substances dissolved  • BEST mixed
• SHOWS TYNDALL  • Solutions
• Worst mixed  • Large particles
• Often Settles (separates)  • SHOWS TYNDALL
• MANY types of Suspensions
• Often Solid – Liquid  • SHOWS TYNDALL
• Settle out (separate)  • LOOK Homogeneous (really heterogeneous)
• DO NOT Settle out  • DO NOT Settle out
• Particles not dissolved (but trapped) in liquid  • SHOWS TYNDALL
• SHOWS TYNDALL
MATTER

Element

Compound

Homogeneous

Heterogeneous

• From the Periodic Table
• Single substance

• From two or more substances found on the Periodic Table
• Chemically combined

• Looks the same throughout
• Can not see particles (small)
• Does not settle (separate)
• Well mixed

• DOES NOT look the same throughout.
• Large particles
• Settles (separate)
• Not well mixed
• Substances dissolved
• NO TYNDALL
• Very small particles

S - S (Alloy)
S - L (Koolaid)
L - L (H2O + Vinegar)
L - G (soda)

Solutions

• Worst mixed
• Large particles
• Often Settles (separates)
• SHOWS TYNDALL

Colloids

• Often Solid – Liquid
• Settle out (separate)
• SHOWS TYNDALL
• LOOK Homogeneous
• DO NOT Settle out
• Particles not dissolved in liquid
• SHOWS TYNDALL

Particles

• L-G (soda)
A PURE SUBSTANCE is made of only one kind of material and has definite properties.

PURE SUBSTANCES are the same throughout.

All of the particles in a PURE SUBSTANCE are exactly the same.

Examples: salt, sugar, pure water, iron, oxygen, lead, and nickel.
Elements are the simplest of all pure substances.

They CANNOT be broken down or changed into any smaller parts.

The smallest part of an element is an atom; the basic building blocks of all matter.

Atoms are made of neutrons (neutral), proton (positive), and electrons (negative).
CHEMICAL SYMBOLS

• Short hand for the names of elements.

• Contains 1 or 2 letters.
  – When 2 letters are used;
    • the first = ALWAYS a capital letter
    • the second = ALWAYS a lowercase letter.

• The symbol (letters) for the elements are sometimes developed from the Latin names for the elements.
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Section 3-4 COMPOUNDS

• Remember, Elements are…
  – Smallest part of pure substances
  – Have definite properties
  – CAN NOT be broken down

• BUT… NOT ALL PURE SUBSTANCES ARE ELEMENTS.
Compounds

- Made of **2 or more chemically combined elements**
- Are **pure substances** ... but can be separated

- **Water** is a pure substance
  - but broke down into ... ... $H + O$

- **Table salt** is a pure substance
  - but can be broken into... $Na + Cl$
Section 3-4 COMPOUNDS

• Carbon dioxide, baking soda, TNT, and Ammonia are other examples.

• Can be separated by:
  • Heat to high energy
    – Copper sulfide heated to high temperature can be separated into copper and sulfur
  • Electrical current energy
    – Use when high temperature is not sufficient; an electric current sent through water will separate it into Hydrogen and Oxygen
• Properties of Compounds
  – A compound is different from the individual elements
  • NaCl = table salt
    – NA = sodium, a silvery metal, explosive in water
    – Cl = chlorine, a poisonous yellow gas
Section 3-4 COMPOUNDS

Compounds and Molecules

• Most compounds are made of molecules

• Molecule

  • 2 or more atoms chemically bonded together
  • The smallest part of a compound, which maintains all the properties of that compound
    – EXAMPLE
    – Water = 2 atoms of Hydrogen and 1 atom of Oxygen
      » If broken down further, it would not be water.

• All molecules of a specific compound are alike
  – Example: all molecules of water are alike
  – All molecules of NaCl are alike
Section 3-4 COMPOUNDS
Chemical Formulas

- Chemical symbols combined to make a chemical formula
  - A chemical word
  - A chemical shorthand
  - Provide information about the compound
  - Some represent compounds
    - NH$_3$ (Ammonia), AgNO$_3$ (Silver Nitrate)
  - Some represent elements
    - O$_2$ (Oxygen), H$_2$ (Hydrogen)
Section 3-4 COMPOUNDS
Chemical Formulas

• Subscripts
  – The number of atoms of a specific element in that compound (written on the lower right)
    • AgNO₃
      1 atom of Ag 1 atom of N 3 atoms of O

• Coefficients
  – The number of molecules of a specific element or compound necessary to balance a chemical equation. (written on the left)
    • Water = 2H₂ + O₂ → 2H₂O
Section 3-4 COMPOUNDS

Chemical Equations

• Chemical sentences that describe a chemical process or a chemical reaction
  – Chemical reactions produce new products as the atoms become rearranged
    • Burning charcoal → carbon dioxide gas
    • in WORDS:
      One carbon atom + one oxygen molecule produces carbon dioxide molecules

• And as a CHEMICAL EQUATION
Section 3-4 COMPOUNDS
Chemical Equations

• YOU TRY THIS ONE:

– IN WORDS:
Two molecules of Hydrogen plus a molecule of oxygen produces two water molecules.

– AS A CHEMICAL EQUATION
\[ 2H_2 + O_2 \rightarrow 2H_2O \]