

Elements & Compounds

Holt Chapter 4, Sections 1 & 2

It's all elemental!

- An element is about as simple as it gets.
- It cannot be broken down into anything else.
- We know a substance is an element if we keep making it smaller and smaller, but each piece is still made up of **one** type of atom.
- An element is a **pure** substance, or a substance that has only one type of particle or atom.

Gold = Element

- For example, gold (Au), is a pure substance, an element.
- If you take a nugget of gold and keep breaking it down, each particle (atom) looks exactly the same.
- It is made up of **ONLY** gold atoms.



Names of Elements

- Each element has a special name and some are very ancient.
- The element copper is derived from Cyprus, where it was once mined.
- Vanadium, which forms beautiful compounds, is named after the Scandinavian goddess Vanadis.
- The International Union of Pure and Applied Chemistry (IUPAC) decides on the element names.

Element Symbols

- An element also has a **chemical symbol**, made up of either one or two letters.
- If the symbol has two letters, the first is capitalized and the second is **lower** case
- Many of the symbols are the first letter or two of the element: hydrogen (H), oxygen (O), nickel (Ni), helium (He)
- Other symbols are of the first letter and the 3rd letter: chlorine (Cl).
- Others are derived from the Latin, Greek or German name: iron (Fe).

Guessing Game: Can you guess the right symbol for each element?

- | | |
|--------------|----------------|
| 1. Lithium | 6. Chromium |
| ■ Li | ■ Cr |
| 2. Beryllium | 7. Uranium |
| ■ Be | ■ U |
| 3. Boron | 8. Californium |
| ■ B | ■ Cf |
| 4. Nitrogen | 9. Plutonium |
| ■ N | ■ Pu |
| 5. Sodium | 10. Mercury |
| ■ Na | ■ Hg |

Element Properties

- Every element is unique, with its own special properties that make it different from every other element.
- We call these **characteristic** properties.
- Of course, some elements are pretty similar to one another, but there's always something that makes it different from the rest.
- These small differences, both physical & chemical, separate the elements into 3 main categories.

Element Categories

There are only 3 categories for elements:

1. **Metals**
2. **Nonmetals**
3. **Metalloids**

Each element falls into one of these categories and shares common properties, though keep in mind - there are always exceptions.

Metals



- **Good** conductors of electricity and heat
- **Shiny** (metallic luster)
- **Malleable** (hammered into sheets)
- **Ductile** (drawn into thin wires)

Example: Aluminum (Al)

Think of aluminum foil, it is a classic metal. Why?

- (1) it's shiny
- (2) It's malleable - flattened into very thin sheets
- (3) it conducts electricity



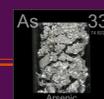
Nonmetals



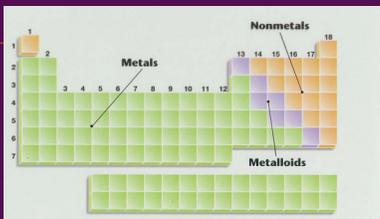
- **Poor** conductors of electricity and heat
- **Dull** (not shiny)
- **Brittle** - not malleable
- **Not** ductile
- Examples: gases (Hydrogen, Helium, Oxygen, etc.) & odd non-gases (Sulfur, Carbon, Phosphorous).

Metalloids or semiconductors

- Possess properties of both metals and nonmetals - some metalloids are ductile but not shiny, etc.
- Usually, they look like a **metal**, but behave *chemically* like a **nonmetal**.
- The **7** metalloids are: Boron, Silicon, Germanium, Arsenic, Antimony, Tellurium, Polonium.



Periodic Table of Elements



- In our next unit we'll learn about how elements are organized in the Periodic Table.
- Is it coincidence that metals are on the left side of the table and nonmetals on the right, with metalloids running diagonally between them?

Compounds

- While some elements are found in their pure form in nature, most are bonded to other elements.
- A compound is a **pure** substance made up of two or more elements that are **chemically combined**.
- In order to combine two elements to make a compound, the elements have to *chemically react* with one another.
- The elements in a compound are not simply mixed together, they are actually joined or **bonded** to one another in a specific way.
- Complicated? Basically, **a compound is one or more elements stuck together!**

Definite Ratios

- What's more, a compound is made up of a **DEFINITE ratio** of these elements.
- Salt (sodium chloride) is made up of 1 sodium atom and 1 chloride atom.
- The ratio is always 1:1 (1 to 1, or 1/1). It doesn't matter if you were looking at salt in California, Siberia, or Mars - it's always the same.
- Similarly, in water, there are always 2 hydrogen atoms to 1 oxygen atom.
- In fact, we call this the **law of constant composition**.

Classified Compounds

We really have only two types of compounds:

1. **Organic compounds** are compounds that contain carbon and usually hydrogen. They are called organic because it was ONCE believed that they could only be formed by living organisms.
2. **Inorganic compounds** are all other compounds.

Compound Properties

- Just like elements, each compound has unique properties that help identify and distinguish the compound.
- Usually, a compound's properties are **VERY different** from its constituent elements.
- For example, look at salt, sodium chloride.
 - Sodium: reacts violently with water
 - Chlorine: a poisonous deadly gas
 - However, when we put the two together - we get salt, which is definitely safe to eat and dissolves in water.

Interesting Tidbit

In ancient times, salt was a precious commodity. It was even traded for an equal weight of gold. Soldiers in ancient Rome, as part of their pay, often received a *salarium*, a special ration of salt (Salt in latin is *sal*). This term eventually evolved into the English word salary, a payment for work.

Breakin' it down

- Since compounds are made up of several elements, it makes sense that we can separate the elements.
- In other words, a compound can be broken down into similar elements through chemical change (heat, reactions).
- For example, carbonic acid is a gas that gives soda its carbonation or fizz. This compound can be broken down into simpler carbon dioxide and water.
- What happens when you open up a soda and leave it out? The released pressure lets the carbonic acid separate into its simpler elements - and goes flat.

IT'S NOT PHYSICAL

- The only way to break down a compound is through CHEMICAL change, not physical change.
- Think about it - compounds are made up of elements that are BONDED to one another. The only way to rip apart the bonds is by providing some serious energy to the whole thing.
- Heating** is one way to separate compounds.
- Electrolysis** is another method, where an electric current is used to break down the compounds.



Review

1. What are the 3 categories of major elements?

Metals, nonmetals, metalloids

2. Describe the differences between metals, nonmetals, & metalloids:

Metals: good conductors, shiny, malleable, ductile

Nonmetals: opposites of metals

Metalloids: act like both of them

Review

3. How are elements and compounds alike? And different?

Both are pure substances, but elements cannot be broken down into anything simpler while compounds can be broken down into elements

4. What are 2 ways to break down a compound?

Heating and electrolysis