

**Lesson Question**

How are compounds different from elements?

Lesson Goals

Differentiate between **elements** and compounds.

Describe **compounds**.

Use **models** to represent compounds.

Demonstrate how chemical **formulas** can be used to describe a compound.

W
2k**Words to Know**

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

- | | |
|-------------------------------|---|
| <u> C </u> coefficient | A. to contrast or to show how two or more things are different from each other |
| <u> A </u> differentiate | B. a letter, number, or symbol that is smaller and just below normal line of type |
| <u> B </u> subscript | C. a number that indicates how many times to multiply a variable |
| <u> E </u> compound | D. a unit of two or more atoms |
| <u> F </u> chemical formula | E. a pure substance that is made up of atoms or ions of two or more different elements |
| <u> D </u> molecule | F. a representation of a compound; gives the number of atoms and types of atoms in a compound |

How are compounds different from elements?

Elements:

- are made of atoms with the same atomic **number** .
- contain atoms with the same number of **protons** .
- are made of only one type of **atom** .
- are **pure** substances.
- cannot be broken down through **physical** means.
- cannot be broken down through ordinary **chemical** means.
- can be represented by chemical **symbols** .

Instruction | Compounds

Slide

2

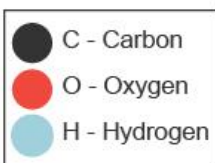
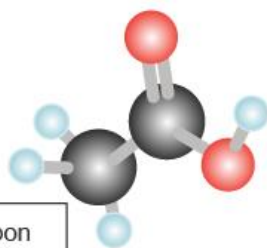
Compounds and Atoms

Elements can be very different from the compounds that they form.

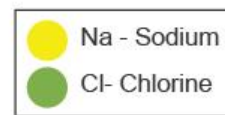
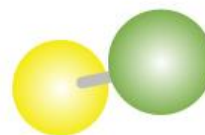
Atom	Elemental Form	Compound
Hydrogen	Highly flammable, colorless, and odorless gas	Water, a colorless, tasteless, odorless liquid
Oxygen	Reactive, colorless, and odorless gas	

Compounds: Structures

Acetic acid ($C_2H_4O_2$)



Sodium chloride (NaCl)



Compounds are made up of atoms or ions of **two** or more different elements.

- Acetic acid is made up of three different kinds of atoms: carbon, **oxygen**, and hydrogen.
- Sodium chloride is made up of two different kinds of atoms: sodium and **chlorine**.

Instruction | Compounds

Slide

4

Compounds: Properties

Compounds:

- are **pure** substances.
- can be **broken down** into simpler pure substances by chemical means.
- have properties that are different from their component **elements**.
- may be represented by chemical **formulas**.

A **chemical formula**:

- is a representation of a compound
- gives the number of atoms and types of atoms in the compound

Different Properties of Elements and Compounds

- When elements combine, compounds that have properties **different** from those of the uncombined elements are formed.
 - Sodium (a metal that reacts explosively with water) combines with chlorine (a poisonous gas) to form a white, crystalline **salt** that is used to flavor food.

Slide

6

Molecules

- **Molecules** are units of two or more atoms.
- Molecules can be made up of **atoms** of the same element or of different elements.
 - When two atoms of the same element combine, they form a **diatomic** molecule.
 - When atoms of different elements combine, they form a **compound**.
- Atoms **combine** to form molecules that can be made of two to thousands of atoms.

Slide

9

Chemical Formulas: Symbols and Subscripts

The chemical formula of a compound gives two types of information:

- the **type** of atoms
- the **number** of each type of atom

Example: Sugar— $C_6H_{12}O_6$

Step 1: Find the type of atoms by looking at the chemical **symbols**.

- C = carbon
- H = **hydrogen**
- O = oxygen

Step 2: Find the number of each type of **atom** using the subscripts.

- 6 carbon atoms
- **12** hydrogen atoms
- 6 oxygen atoms

Instruction | Compounds

Slide

9

Chemical Formulas: Parentheses and Coefficients

Some chemical formulas include parentheses and coefficients. A **coefficient** is a number in front of the chemical formula.

Example 1: Aluminum nitrate— $\text{Al}(\text{NO}_3)_3$

Step 1: Find the **type** of atoms by looking at the chemical symbols.

- Al = aluminum
- N = **nitrogen**
- O = oxygen

Step 2: Find the **number** of each type of atom. The subscripts outside the parentheses refers to all the elements inside the parentheses.

- 1 aluminum atom
- 3 x 1 nitrogen = **3** nitrogen atoms
- 3 x 3 oxygen = **9** oxygen atoms

Example 2: Potassium sulfate— $4\text{K}_2\text{SO}_4$

Step 1: Find the type of atoms by looking at the chemical **symbols**.

- K = potassium
- S = **sulfur**
- O = oxygen

Step 2: Find the **number** of each type of atom. The 4 in front of the chemical formula means that there are 4 molecules of K_2SO_4 .

- 4 x 2 potassium = 8 potassium atoms
- 4 x 1 sulfur = **4** sulfur atoms
- 4 x 4 oxygen = **16** oxygen atoms

Instruction | Compounds

Slide

12

Models: Ball and Stick

The model shows the way the atoms in a compound are connected. In a ball and stick model:

- the types of atoms are represented by **balls**.
- the connections between atoms are represented by **sticks**.

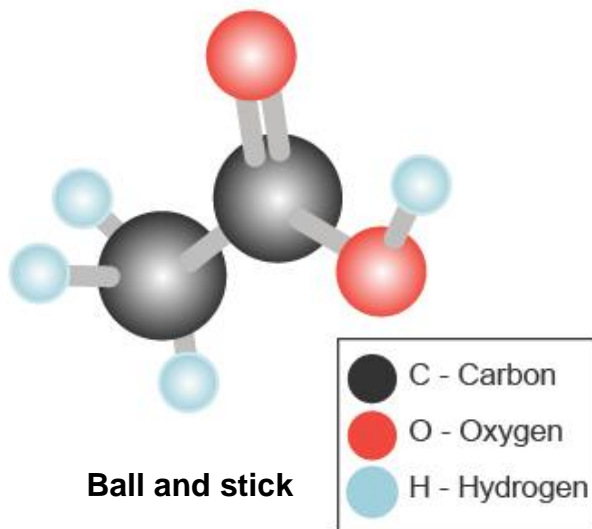
Types of atoms:

- **Carbon** (black)
- Hydrogen **blue**
- **Oxygen** (red)

Number of atoms:

- Carbon: **2**
- **Hydrogen** : 4
- Oxygen: **2**

Acetic acid ($C_2H_4O_2$)



Slide

12

Other Models: Space Filling and Structural Formula

These are some other types of models used to represent the chemical

structure of a compound.

- **Space** filling
- **Structural** formula

No matter what representation is used, all models of a particular compound show the same types and **number** of each type of atom in the compound.

Summary

Compounds

Lesson
Question

How are compounds different from elements?



Answer

(Sample answer) Even though elements and compounds are both pure substances, elements are made of one type of atom, and compounds are made of atoms or ions of two or more different elements. Elements cannot be separated into simpler substances through ordinary physical or chemical means, while compounds can be chemically broken down. Elements may be represented by chemical symbols, while compounds may be represented by chemical formulas and models.

Slide

2

Review: Key Concepts

Elements	Compounds
<ul style="list-style-type: none"> are pure substances. are made of one type of atom. cannot be separated into simpler substances by physical or chemical means. are represented by chemical symbols. 	<ul style="list-style-type: none"> are pure substances. are made of atoms or ions of two or more different elements. can be separated into simpler substances by chemical means. are represented by chemical formulas and models.

Use this space to write any questions or thoughts about this lesson.