

## Chemistry I Cycle I Lesson 4

Distinguish between Elements and Compounds

### Warmup: (Type I)

Hydrogen and Oxygen are both clear, colorless gases. Water is  $\text{H}_2\text{O}$ . Explain the difference between a mixture of hydrogen and oxygen, versus a sample of liquid water.

## Chemistry I Cycle I Lesson 4

Distinguish between Elements and Compounds

**Vocab (p. 21-24)**

Atom, Pure Substance, Element, Molecule, Compound

**Problems**

p. 28 #1-5

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### Classifying Matter

- An **atom** is the smallest unit of an element that maintains the properties of that element.
- Matter exists in many different forms but there are only 110 types of atoms.
- Atoms are joined together to make up all the different kinds of matter.





### Pure Substances

- A **pure substance** is a sample of matter, either a single element or a single compound, that has definite chemical and physical properties.
- **Elements** are pure substances that only contain one kind of matter. They cannot be separated or broken down into simpler substances by chemical means.
  - Each element has its own unique set of physical and chemical properties.



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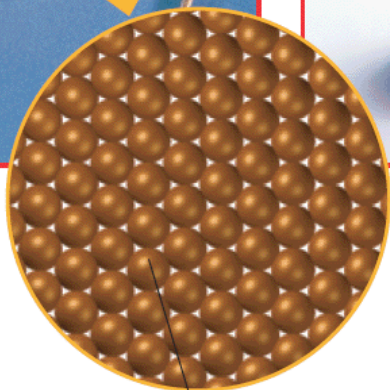




### Pure Substances



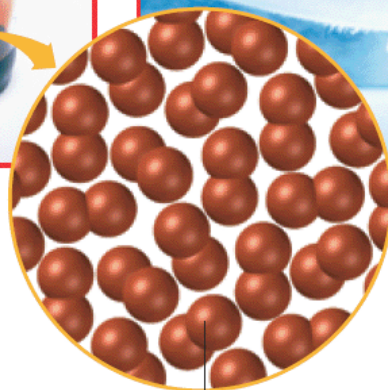
Leonard Lessin/Peter Arnold, Inc.



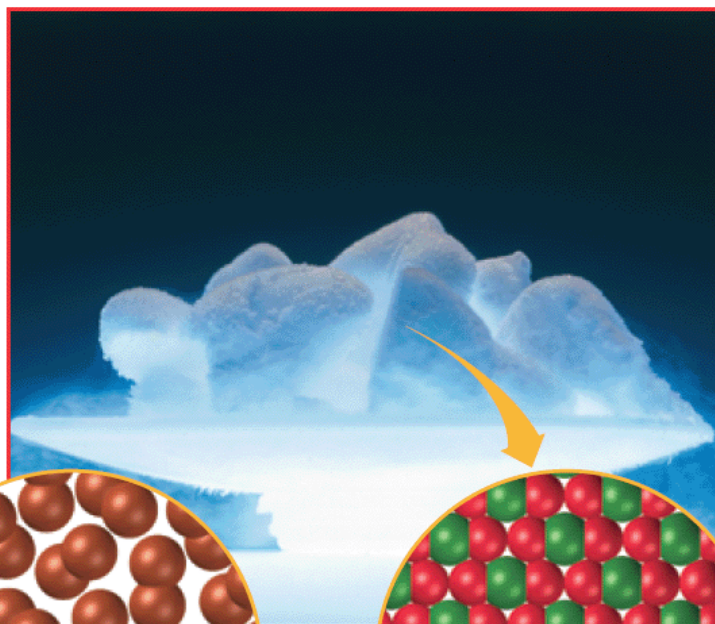
Copper atom, Cu



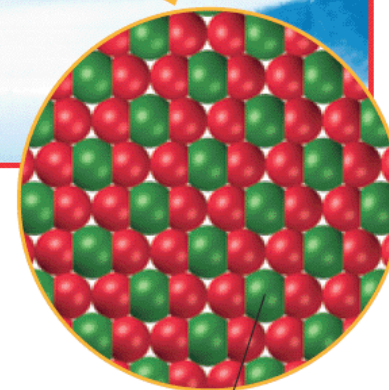
Tom Pantages Photography



Bromine molecule, Br<sub>2</sub>



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Carbon dioxide molecule, CO<sub>2</sub>



## Elements are Pure Substances

- Each element is represented by a distinct chemical symbol.

| Element name | Chemical symbol | Origin of symbol   |
|--------------|-----------------|--|
| Hydrogen     | H               | first letter of element name   |
| Helium       | He              | first two letters of element name  |
| Magnesium    | Mg              | first and third letters of element name  |
| Tin          | Sn              | from <i>stannum</i> , the Latin word for “tin”   |
| Gold         | Au              | from <i>aurum</i> , the Latin word meaning “gold”  |
| Tungsten     | W               | from <i>Wolfram</i> , the German word for “tungsten”   |
| Ununpentium  | Uup             | first letters of root words that describe the digits of the atomic number; used for elements that have not yet been synthesized or whose official names have not yet been chosen |





## The 7 Ancient Metals: Who speaks a Latin Language?

| Modern Symbol | Latin Name | Ancient Symbol | Spanish  | Portuguese | English |
|---------------|------------|----------------|----------|------------|---------|
| Fe            | Ferrum     | ♂              | Hierro   | Ferro      | Iron    |
| Cu            | Cuprum     | ♀              | Cobre    | Cobre      | Copper  |
| Ag            | Argentum   | ☾              | Plata    | Prata      | Silver  |
| Au            | Aurum      | ☼              | Oro      | Ouro       | Gold    |
| Hg            | Hydrargum  | ☿              | Mercurio | Mercúrio   | Mercury |
| Sn            | Stannum    | ♃              | Estaño   | Estanho    | Tin     |
| Pb            | Plumbum    | ♄              | Plomo    | Chumbo     | Lead    |





### Pure Substances, *continued* Elements as Single Elements or Molecules

- A **molecule** is the smallest unit of a substance that keeps all of the physical and chemical properties of that substance.
- A molecule usually consists of two or more atoms combined in a definite ratio.
- *Diatomic* elements exist as two atoms of the same element joined together.







### Pure Substances, *continued*

#### Some Elements Have More Than One Form

- Some elements, such as oxygen, phosphorus, sulfur, and carbon, have many different molecular forms.
- An *allotrope* is one of a number of different molecular forms of an element.
- The properties of allotropes vary widely.



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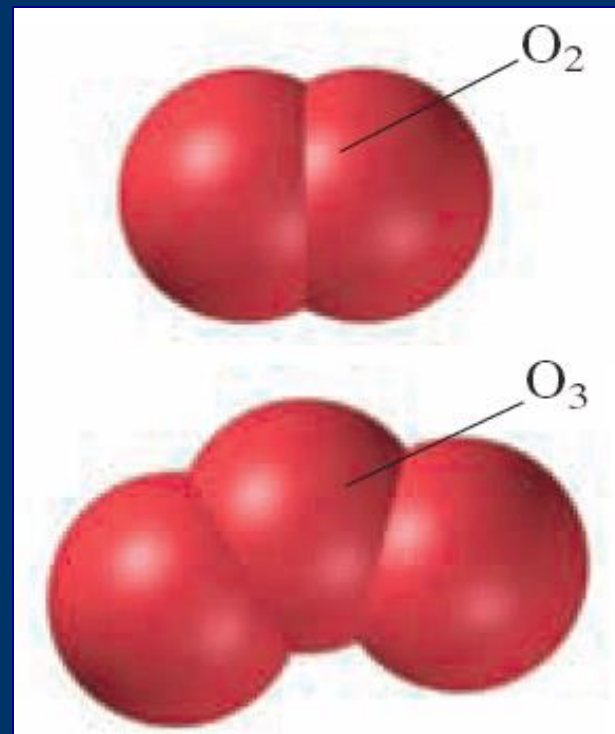




### Pure Substances, *continued*

### Some Elements Have More Than One Form, *continued*

- Oxygen exists as allotropes.
- Oxygen gas ( $O_2$ ) is colorless and odorless.
- Ozone ( $O_3$ ) is toxic and pale blue.



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### Pure Substances, *continued* Compounds are Pure Substances

- Pure substances that are not elements are **compounds**. Compounds are composed of more than one kind of atom.
  - example: carbon dioxide (CO<sub>2</sub>)
- There may be easier ways of preparing them, but compounds can be made from their elements.
- Compounds can be broken down into their elements, though often with great difficulty.





### Pure Substances, *continued* Compounds are Represented by Formulas

- Because every molecule of a compound is made up of the same kinds of atoms arranged the same way, a compound has characteristic properties and composition.
- Compounds can be represented by an abbreviation or *formula*.
  - A formula has subscripts which represent the ratio of different atoms in the compound.
  - **example:** H<sub>2</sub>O has 2 hydrogen atoms and one oxygen atom



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### Pure Substances, *continued*

### Compounds are Represented by Formulas, *continued*

- Molecular formulas give information only about what makes up a compound.
  - **example:** the molecular formula for aspirin is  $C_9H_8O_4$
- A **structural formula** shows how the atoms are connected
  - This two-dimensional model does not show the molecule's true shape.



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### Pure Substances, *continued* Compounds are Represented by Formulas, *continued*

- A *ball-and-stick model* shows the distances between atoms and the angles between them in three dimensions.
- A *space-filling model* attempts to represent the actual sizes of the atoms and not just their relative positions.
- A hand-held model can provide more information than models shown on the flat surface of the page.



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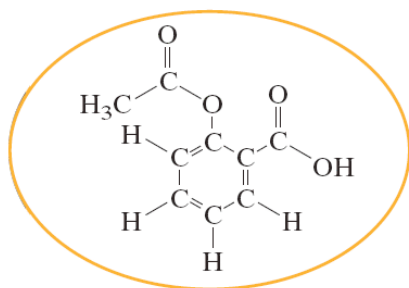


### Pure Substances, *continued* Compounds are Represented by Formulas, *continued*

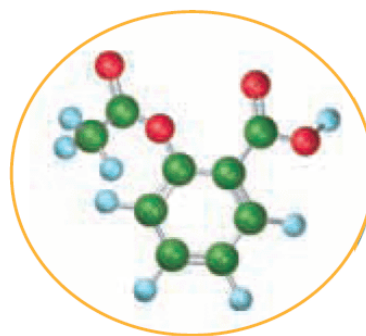
- These models convey different information about acetylsalicylic acid (aspirin).



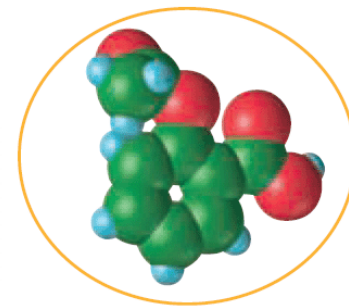
Molecular formula



Structural formula



Ball-and-stick model



Space-filling model

