

# **Ions and Ionic Compounds**

# Ionic and Molecular Compounds

Ionic compounds are usually formed between metals and nonmetals.

Molecular compounds are usually formed between two nonmetals.

# Ions

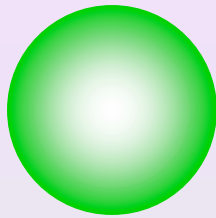
**When electrons are removed from or added to a neutral atom or molecule, a charged particle called an ion is formed.**

Positively charged ions are called  
**cations**

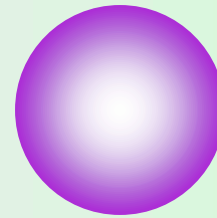
Negatively charged ions are called  
**anions**

# Atoms vs Ions

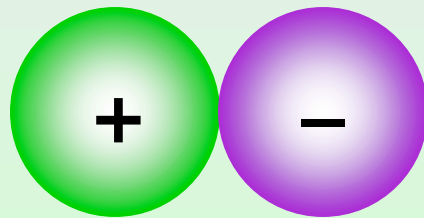
---



Na: 11 protons;  
11 electrons



Cl: 17 protons;  
17 electrons



Na<sup>+</sup>: 11 protons;  
10 electrons

Cl<sup>-</sup>: 17 protons;  
18 electrons

# Ions

---

positively charged: cations

most common type is metal cation

$\text{Na}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$

negatively charged: anions

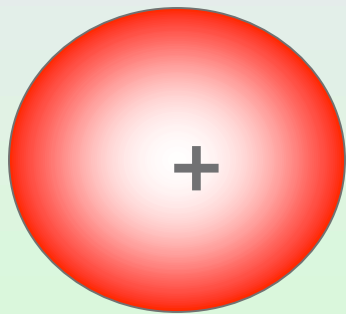
most common type is nonmetal anion

$\text{Cl}^-$ ,  $\text{O}^{2-}$

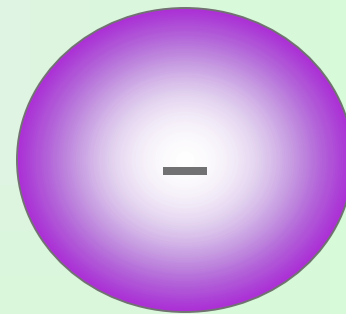
# Ionic Bonding

---

electrostatic attraction between oppositely charged ions



cation



anion

# Ionic Compounds

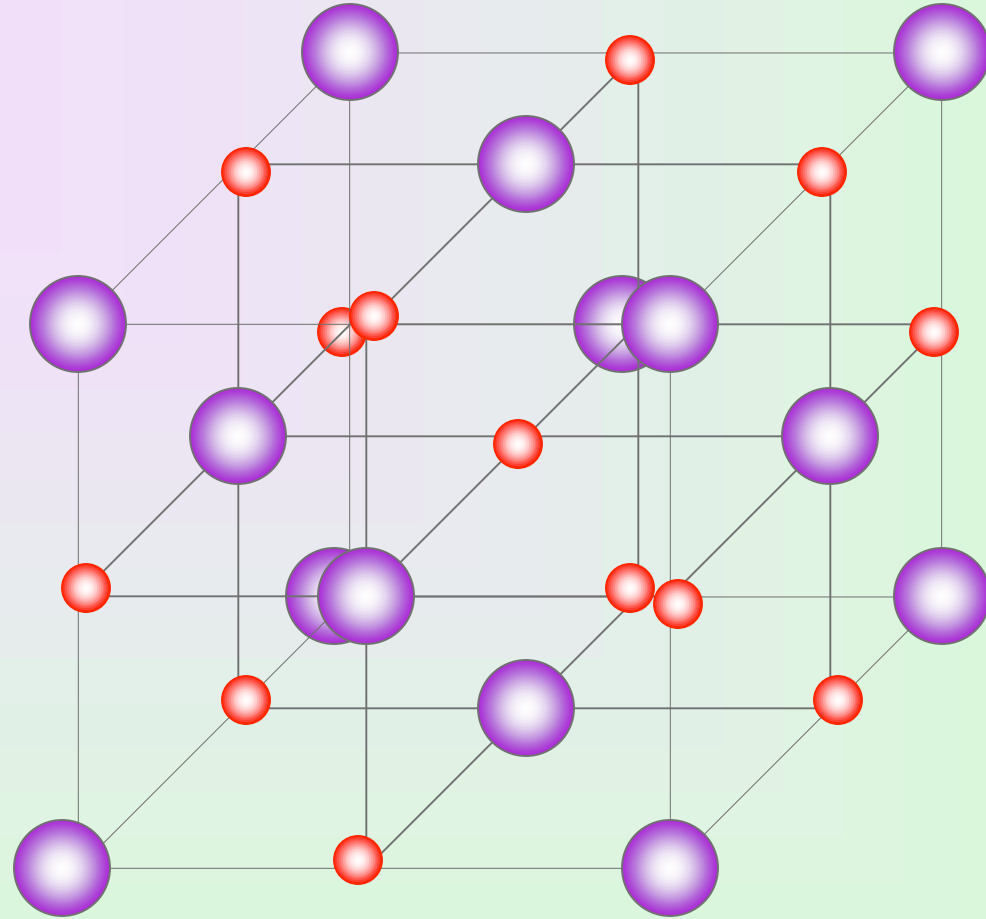
discrete molecules are not present, so ionic compounds are represented by their **empirical formulas**

some times referred to as **formula units**

# Chemical Formulas

Express the composition of molecules and ionic compounds in terms of the symbols for the elements they contain.

**Empirical formula** tells us which elements are present and the simplest whole-number ratio of their atoms.



**Structure of solid NaCl. In reality, the cations are in contact with the anions. The smaller spheres (red) represent Na<sup>+</sup> ions and the larger spheres (purple) the Cl<sup>-</sup> ions.**

**Molecules:  
Atoms in Combination**

## Definition

**Molecule** —is an aggregate of at least **two** atoms in a definite arrangement held together by chemical forces.

bonds



structure



A molecule is not necessarily a compound.

## Example



A compound is not necessarily molecular.

**ionic compounds**

## Molecular formula

shows the exact number of atoms of each element in the smallest unit of a substance

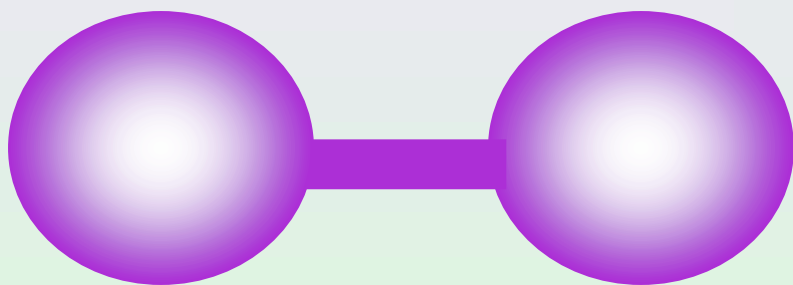
# Hydrogen

stable form of element is diatomic  
molecule  $H_2$

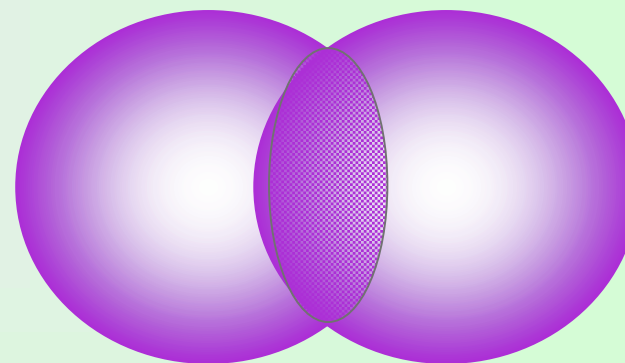
# Hydrogen

the stable form of the element is diatomic a molecule  $H_2$

The subscript indicates the number of atoms in the formula



ball-and-stick model

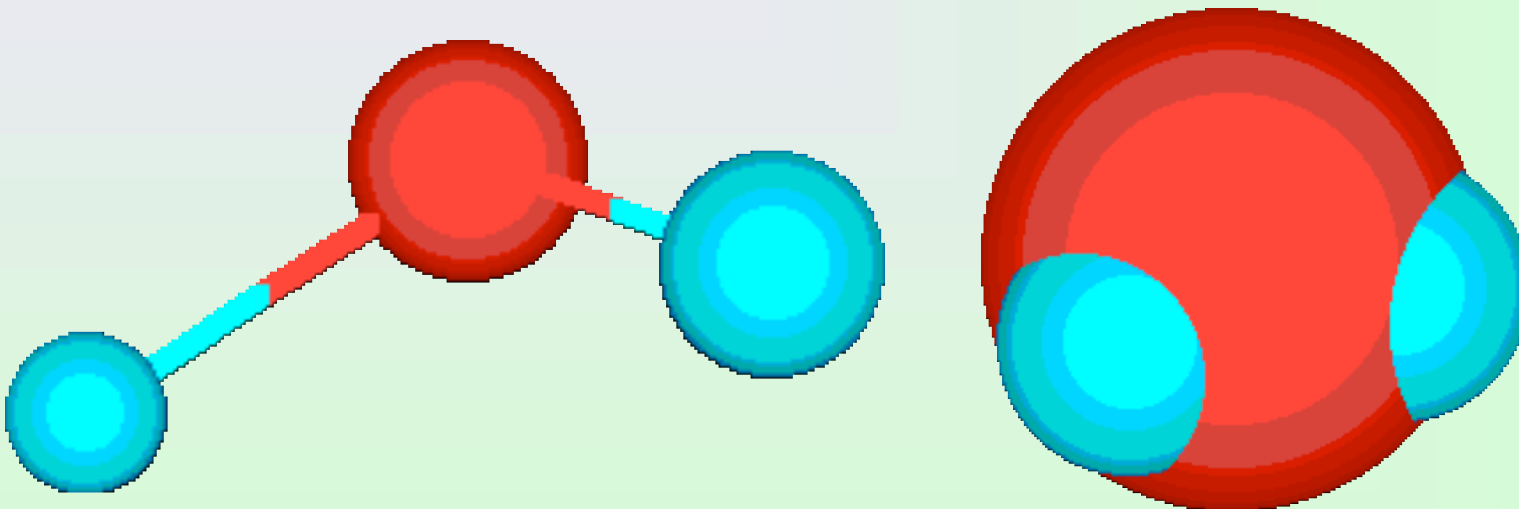


space-filling model

other diatomic elements include  
 $O_2$ ,  $N_2$ ,  $F_2$ ,  $Cl_2$ ,  $Br_2$ , and  $I_2$

# Water (H<sub>2</sub>O)

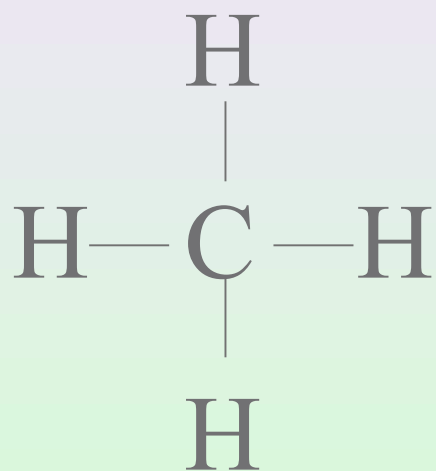
is a polyatomic molecule (contains three atoms connected in the order HOH).



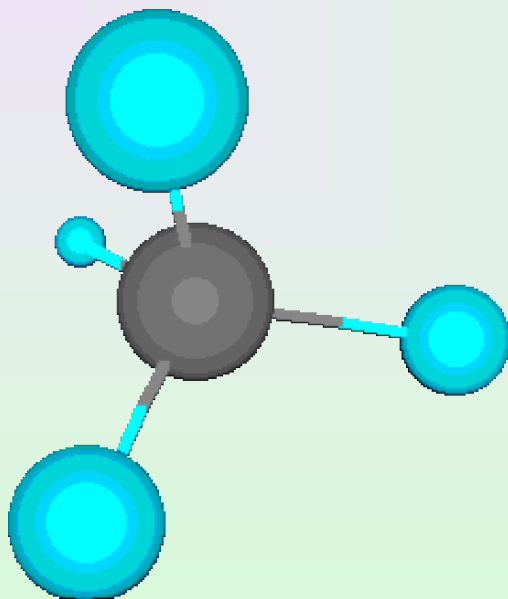
# Methane

---

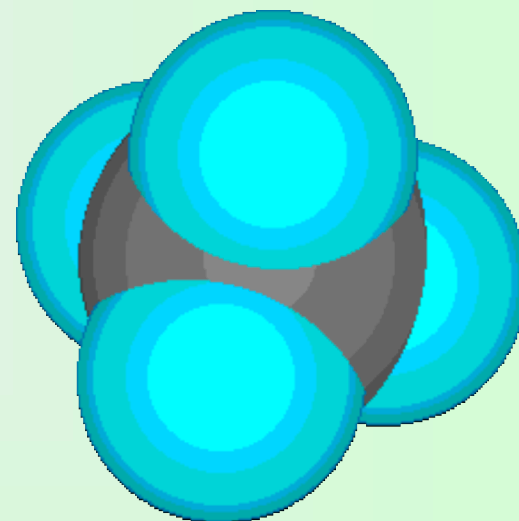
Molecular formula:  $\text{CH}_4$   
*shows the way in which the atoms are joined*



structural formula



ball-and-stick model



space-filling model

