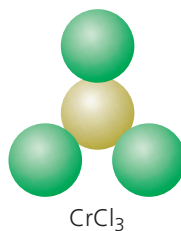
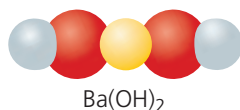
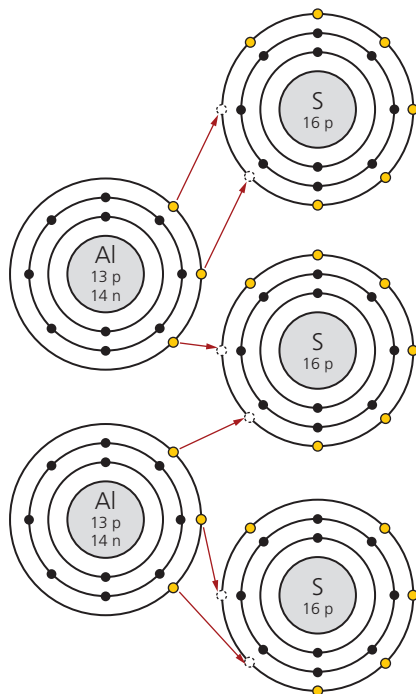
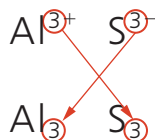


**Key Ideas****Elements combine to form compounds in exact proportions.**

- Metals and non-metals combine by forming ions.
- To form ions, atoms of an element must gain or lose specific numbers of electrons.
- In order to form ionic compounds, the total number of electrons given up by the metal ions must exactly balance the total number of electrons gained by the non-metal ions.

**The formulas of ionic compounds can be determined from their names.**

- The name of a compound identifies the metal and non-metal ions in the compound. Each ion has a specific ion charge, which is used to determine the formula.
- To determine the number of each ion in a formula, the total ion charges must balance.

**Vocabulary**

chemical formula, p. 234

polyatomic ion, p. 234

Law of Definite Proportions,  
p. 238

monovalent, p. 242

multivalent, p. 242

chemical family, p. 248

alkali metal, p. 248

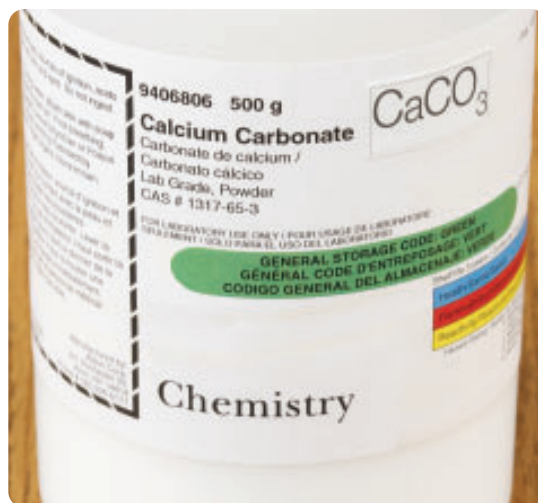
alkaline earth metal, p. 250

halogen, p. 251

noble gas, p. 251

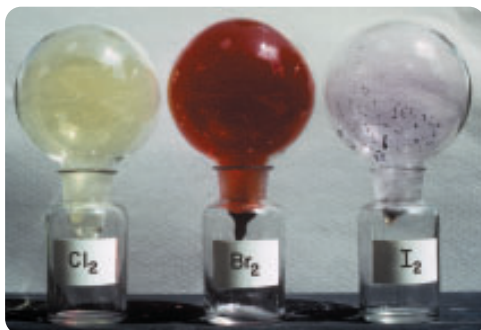
## The names of ionic compounds can be determined from their formulas.

- Metal ions have the same name as the metal element.
- Some metal ions (multivalent) can have more than one ion charge. Each ion is identified with a Roman numeral:  $\text{Fe}^{3+}$  is iron(III).
- Polyatomic groups, or polyatomic ions, have special names.  $\text{CO}_3^{2-}$  is called the carbonate ion.
- Single non-metals in compounds are given the *ide* suffix. The ion of oxygen is called the oxide ion.
- The name of an ionic compound is the name of the two ions, with the name of the metal ion first.  $\text{CaCO}_3$  is calcium carbonate.



## Chemical families are groups of elements that have similar chemical and physical properties.

- The elements in Group 1 (except hydrogen) are the alkali metals. They are low-density, soft metals that react with water to form hydrogen gas and an alkaline solution.
- The elements in Group 2 are the alkaline earth metals. They are low-density, hard metals, and are common elements in minerals.
- The elements in Group 17 are the halogens. They have bright colours as gases, and are all toxic in elemental form. They are highly reactive.
- The elements in Group 18 are the noble gases. They are non-toxic, colourless, non-reactive gases.



## Review Key Ideas and Vocabulary

- Which of the following best describes a chemical family?
  - a group of elements with the same name
  - a group of compounds with similar properties
  - a group of elements with similar physical properties
  - a group of elements with similar physical and chemical properties
- List the elements in each of the following chemical families.
  - noble gases
  - halogens
  - alkaline earth metals
  - alkali metals
- What is the ion charge of an alkaline earth metal?
  - 0
  - 1+
  - 2+
  - 3+
  - 4+
- A gaseous element has a vivid colour and is toxic. Which chemical family does it belong to?
  - the noble gases
  - the halogens
  - the alkaline earth metals
  - the alkali metals
- Which of the following elements is a member of the alkaline earth metals and reacts with water to form hydrogen gas?
  - sodium
  - aluminum
  - strontium
  - calcium
- List three members of the noble gas family.
- Element A and element B belong to the same chemical family. Element A is soft and ductile, conducts electricity, and reacts with ammonia. What properties would you expect element B to have?
- Write the formula for each of the following compounds.
  - sodium chloride
  - potassium chloride
  - potassium oxide
  - magnesium oxide
  - aluminum oxide
  - aluminum nitride
- Write the formula for each of the following ions. Include the ion charge.
  - iron(III)
  - calcium
  - oxide
  - carbonate
  - ammonium
  - bromide
- Write the formula for each of the following compounds.
  - ammonium fluoride
  - ammonium sulfide
  - magnesium chlorate
  - magnesium carbonate
  - magnesium phosphate
  - aluminum phosphate
- Write the formula for each of the following compounds.
  - copper(II) nitrate
  - copper(I) nitrate
  - iron(II) carbonate
  - iron(III) carbonate
  - lead(IV) chloride
  - lead(II) fluoride
- Write the name of each of the following compounds.
  - $\text{Al}_2\text{O}_3$
  - $\text{CaCO}_3$
  - $\text{NH}_4\text{Cl}$
  - $\text{Fe}_2\text{S}_3$
  - $\text{Cr}_3(\text{PO}_4)_2$
  - $\text{KOH}$
- Some compound formulas such as  $\text{Mg}(\text{HCO}_3)_2$  include brackets. Explain why the brackets are necessary.

## Use What You've Learned


- Copper is reacted with chlorine and the ratio of the ions is determined to be 1:1. In another reaction of the same elements, the ratio of ions is determined to be 1:2. Write the formula for each compound.
- Many people use the compound sodium bicarbonate to settle an upset stomach. "Bicarbonate" is an older name for the polyatomic ion "hydrogen carbonate." Write the formula for this compound.
- The compound strontium dihydrogen phosphate has the formula  $\text{Sr}(\text{H}_2\text{PO}_4)_2$ . What is the ion charge of the dihydrogen phosphate ( $\text{H}_2\text{PO}_4$ ) ion? How did you determine the charge?
- Examine the image in Figure 1. Which chemical family does the metal belong to? What other properties does the metal have?



Figure 1


- Baking soda and baking powder are two leavening agents that are used by bakers. Baking powder is a dry mixture of baking soda (sodium hydrogen carbonate) and cream of tartar (potassium hydrogen tartrate).
  - Define the term "leavening" as it applies to baking. Name one other leavening agent.
  - Write a short description of how baking powder and baking soda produce their effects. Include the chemical formulas of the compounds involved.
  - Do you think that it is important for bakers and cooks to have some knowledge of chemistry? Explain.

## Think Critically


- Examine the labels of several household items, such as toothpaste, shampoos, breakfast cereals, and cleaners for the chemical ingredients they contain. Write the names of the chemical compounds. Use text and electronic resources to determine their formulas, and research the purposes of the compounds.  
[www.science.nelson.com](http://www.science.nelson.com) 
- You may find older chemical names still in use. The table below gives some examples.

Formula	IUPAC name	Old name
$\text{Na}_2\text{HPO}_4$	sodium monohydrogen phosphate	disodium phosphate
$\text{Na}_3\text{PO}_4$	sodium phosphate	trisodium phosphate or TSP
$\text{SnF}_4$	tin(IV) fluoride	stannous fluoride
$\text{CuSO}_4$	copper(II) sulfate	cuprous sulfate

Conduct research to learn about older naming systems. Why do you think the old names are still used? Should there be a difference between the compound names that scientists use and the names used to market products to consumers?

- [www.science.nelson.com](http://www.science.nelson.com)   
Silver bromide is a light-sensitive compound used for photographic films and papers. Do you think silver iodide could be substituted instead? Explain.

## Reflect on Your Learning

- The International Union of Pure and Applied Chemistry (IUPAC) determines what naming systems and other standards will be used by chemists. Write a short paragraph to explain why this organization is important for scientists.  
[www.science.nelson.com](http://www.science.nelson.com) 
- Describe everyday situations in which your knowledge of chemical names and formulas could be useful.

Visit the Quiz Centre at

[www.science.nelson.com](http://www.science.nelson.com) 