

Metals, Non-metals, and Metalloids

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CONCEPT

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Metals, Non-metals, and Metalloids

Lesson Objectives

- Explain what is meant by the term periodic law.
- Describe the differences among metals, non-metals, and metalloids.
- Identify an element as a metal, non-metal, or metalloid given its properties or its position on the periodic table.

Introduction

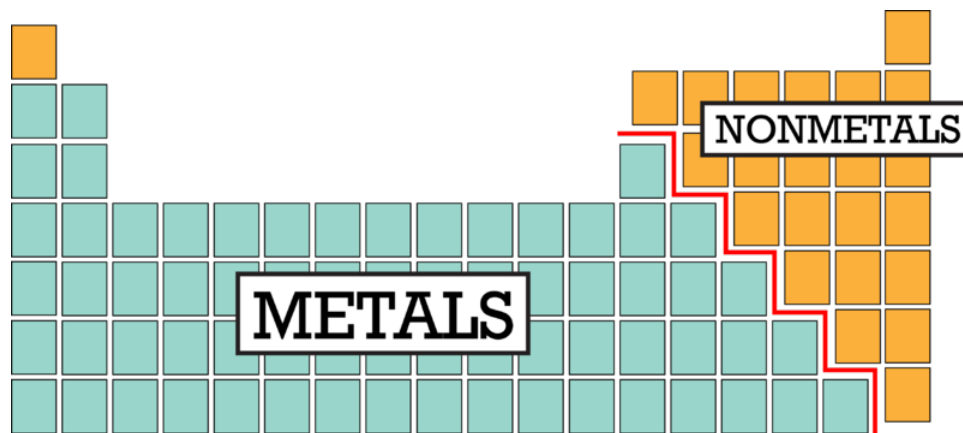
In the periodic table, the elements are arranged according to similarities in their properties. The elements are listed in order of increasing atomic number as you read from left to right across a period and from top to bottom down a group. In this lesson, you will learn the general behavior and trends within the periodic table that result from this arrangement in order to predict the properties of the elements.

The Periodic Law

The periodic table is a powerful tool that provides a way for chemists to organize the elements. The word “periodic” means happening or recurring at regular intervals. The **periodic law** states that the properties of the elements recur periodically with increasing atomic numbers. This makes sense, because valence electron configurations also repeat periodically, and many of the physical and chemical properties of the elements depend on their valence electrons.

Metals, Non-metals, and Metalloids

There is a progression from metals to non-metals across each row of elements in the periodic table. The diagonal line at the right side of the table separates the elements into two groups: the metals and the non-metals. The elements to the left of the line are considered metals, and the elements to the right are considered non-metals. The elements directly touching the diagonal line are referred to as metalloids. There are two exceptions to these classifications. First, hydrogen is placed at the top left of the table, but it is actually a non-metal. Second, aluminum is touching the diagonal line, but it is generally considered a metal, not a metalloid. Metallic character generally increases from top to bottom down a group and right to left across a period.



As you can see from the table, most of the chemical elements are metals. Most metals have the common properties of being shiny, very dense, and having high melting points. Metals tend to be **ductile** (can be drawn out into thin wires) and **malleable** (can be hammered into thin sheets). Metals are good conductors of heat and electricity. All metals are solids at room temperature except for mercury. In chemical reactions, metals easily lose electrons to form positive ions. Examples of metals are silver, gold, and zinc.

Non-metals are generally brittle, dull, and poor conductors of heat and electricity. They tend to have low melting points and to gain electrons in chemical reactions. Examples of non-metals are hydrogen, carbon, and nitrogen.

Metalloids have properties of both metals and non-metals and are sometimes called semi-metals. They can be shiny or dull. They are typically semi-conductors, which means that they are elements that conduct electricity better than insulators, but not as well as conductors. For this reason, they are valuable in the computer chip industry. Examples of metalloids are silicon and boron.

Lesson Summary

- There is a progression from metals to non-metals across each period of elements in the periodic table.
- Metallic character generally increases from top to bottom down a group and right to left across a period.

Vocabulary

Periodic law States that the properties of the elements recur periodically as their atomic numbers increase.

Ductile Can be drawn out into thin wires.

Malleable Can be hammered into thin sheets.

Review Questions

1. Label each of the following elements as a metal, non-metal, or metalloid.
 - a. Carbon
 - b. Bromine
 - c. Oxygen
 - d. Plutonium
 - e. Potassium

- f. Helium
2. What two exceptions are there to the how the diagonal separates the elements into a metal, non-metal, or metalloid?
 3. Given each of the following properties, label the property as that of a metal, non-metal, or metalloid.
 - a. Lustrous
 - b. Semiconductors
 - c. Brittle
 - d. Malleable
 - e. Insulators
 - f. Conductors
 - g. Along the diagonal
 4. Which of the following elements is a non-metal?
 - a. Oxygen
 - b. Lead
 - c. Iron
 - d. Zinc
 - e. All of these are metals
 5. Which of the following elements is a metalloid?
 - a. Chlorine
 - b. Magnesium
 - c. Rhenium
 - d. Boron
 - e. None of these
 6. The elements mercury and bromine are both liquids at room temperature, but mercury is considered a metal and bromine is considered a non-metal. How can that be? What properties do metals and non-metals have?