

## SECTION 2-2

## SECTION SUMMARY

## Atoms in the Periodic Table

**Guide for Reading**

- ◆ How is the periodic table organized?
- ◆ What do elements in a family have in common?

**2**

The periodic table is a system used worldwide for organizing elements into categories based on how they react. An element's **atomic number** is the number of protons in the nucleus of any atom of that element. **Look at any periodic table and you will see that elements are arranged from left to right and top to bottom in order of increasing atomic number.**

A row across the periodic table is called a **period**. The atomic number increases one at a time from left to right across the table. The number of valence electrons also increases from left to right.

Elements in the same column of the periodic table are called a **group**, or **family**. The groups are numbered 1 through 18 across the tops of the columns. **Each family in the periodic table has its own characteristic properties based on the number of valence electrons.**

The elements in Group 18 at the far right side of the table are known as the noble gases. Except for helium, atoms of these elements have eight valence electrons. The Group 18 elements are also known as the inert gases. *Inert* means "inactive." The inert gases don't react very easily with other atoms. Helium only has two valence electrons, but it has the same unreactive properties as the other noble gases.

Elements in Group 17 are known as the **halogen** family. These elements are very reactive. Each halogen atom has seven valence electrons. A gain of just one electron leads to the more stable number of eight. As a result, these elements react easily with other elements whose atoms can give up electrons.

On the far left side of the table is Group 1, known as the alkali metal family. Atoms of these elements only have one valence electron. They are very reactive because they easily lose one electron.

Recall that atoms of halogens easily gain electrons. Atoms of alkali metals easily lose electrons. When these two types of elements come in contact with each other, they react violently. For example, the elements sodium and bromine react with an explosion when they form the compound sodium bromide.

Hydrogen is located above Group 1 on the periodic table. Like the alkali metals, its atoms only have one valence electron. Hydrogen is also extremely reactive.



**SECTION 3-2****SECTION SUMMARY****Metals****Guide for Reading**

- ◆ What are the properties of metals?
- ◆ How can you characterize each family of metals?

**3**

Most of the elements are metals, which are found to the left of the zigzag line in the periodic table.

Chemists classify an element as a metal based on physical properties such as **hardness, shininess, malleability, and ductility**. **Malleable** material can be pounded into shapes. **Ductile** material can be pulled out or drawn into a long wire. Many metals are good **conductors**. They transmit heat and electricity easily. Several metals are **magnetic**. They are attracted to magnets, and can be made into magnets. Most metals are solids at room temperature and have a high melting point.

**Metals show a wide range of chemical properties.** The ease and speed with which an element combines with other elements and compounds is called its **reactivity**. Some metals react with oxygen in the atmosphere forming metal oxides. A metal can wear away as the soft metal oxide flakes off. This process is called **corrosion**.

A mixture of metals is called an **alloy**. Useful alloys combine the best properties of two or more metals into a single substance.

**The metals in a group, or family, have similar properties, and these properties change gradually as you move across the table.** The reactivity of the metals tends to decrease as you move from left to right across the periodic table.

The metals in Group 1 are the **alkali metals**. They are so reactive they are never found uncombined in nature.

Group 2 of the periodic table contains the **alkaline earth metals**. While not as reactive as the alkali metals, they are also so reactive that they cannot be found uncombined in nature.

The elements in Groups 3 through 12 are called **transition metals**. They form a bridge between the very reactive metals on the left and the less reactive metals and other elements on the right.

Groups 13 through 16 of the periodic table include metals, nonmetals, and metalloids. The metals in these groups are not nearly as reactive as those on the left side of the table.

The elements at the bottom of the periodic table are called the **lanthanides** and **actinides**. They are also known as rare earth elements. These elements fit in Periods 6 and 7 between the alkaline earth metals and the transition metals, but they are placed below the periodic table for convenience. Of the actinides, only thorium (Th) and uranium (U) exist on Earth in any significant amounts. All of the elements after uranium in the periodic table were created artificially in laboratories.

Section 3-2 Metals

**Directions:** Complete the table below by writing the name of each metal under the correct heading.

Beryllium - Be	Sodium - Na	Zinc - Zn	Nickel - Ni	Mercury - Hg
Strontium - Sr	Cadmium - Cd	Calcium - Ca	Radium - R	Silver - Ag
Gold - Au	Lithium - Li	Copper - Cu	Cesium - Cs	
Potassium - K	Iron - Fe	Magnesium - Mg	Francium - Fr	

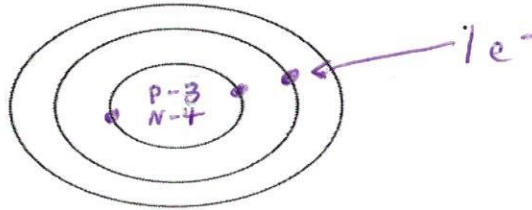
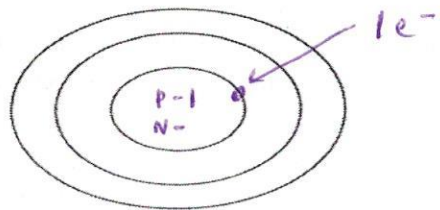
Alkali Metals Group <u>1</u>	Alkaline Earth Metals Group <u>2</u>	Transition Metals Groups <u>3-12</u>	
Li	Be	Ni	Cu
Na	Mg		Ag
K	Ca	Fe	Au
	Sr		Zn
Cs	R		Cd
Fr			Hg

1. Metals can be found on the left/center side of the Periodic Table. Metals lose (1 or 2) electrons in a chemical reaction (bond) in order to become stable. lose/gain

*"left of zig-zag line"*

2. Draw a Bohr Model of Hydrogen and Lithium below.

In what way are these Bohr Models similar? They both have 1 valence e<sup>-</sup>



3. Hardness, shininess, malleability and ductility are physical properties based on how metals are classified.

4. The reactivity of metals tends to decrease as you move from left to right on the table.

5. Groups 12 through 16 on the periodic table are composed of three categories metals, metalloids and non-metals.

## SECTION 3-3

## SECTION SUMMARY

## Nonmetals and Metalloids

**Guide for Reading**

- ◆ Where are nonmetals and metalloids located on the periodic table?
- ◆ What are the properties of nonmetals and metalloids?

**3**

**N**onmetals are elements that lack most of the properties of metals. **There are 17 nonmetals, each located to the right of the zigzag line in the periodic table.**

**In general, the physical properties of nonmetals are opposite to those that characterize the metals.** Most nonmetals are dull. Solid nonmetals are brittle. Nonmetals usually have lower densities than metals. They are also poor conductors of heat and electricity.

Except for Group 18, most nonmetals readily form compounds with other elements. Many metals and nonmetals react with each other. Many nonmetals also form molecules of two identical atoms such as  $O_2$ . These are called **diatomic molecules**.

The elements in Group 14, the carbon family, have atoms with 4 valence electrons. Carbon is the only nonmetal element in the group.

Group 15 is also known as the nitrogen family. Each element in the nitrogen family has atoms with 5 valence electrons. The two nonmetals in the group are nitrogen and phosphorus.

The elements in Group 16, the oxygen family, have 6 valence electrons in their atoms. These atoms typically gain or share 2 electrons in a reaction. The oxygen we breathe is  $O_2$ . Ozone is  $O_3$ .

Group 17 is known as the **halogen family**. All but one of the elements in the halogen family are nonmetals. A halogen atom has 7 valence electrons and typically gains or shares one electron when it reacts. In their elemental form, all of the halogens are very reactive.

The elements in Group 18, the **noble gases**, do not ordinarily form compounds. That is because the atoms of these elements do not gain, lose, or share valence electrons.

Hydrogen is the simplest element. Its atoms generally contain only one proton and one electron. Because hydrogen's chemical properties are so different from the other elements, it cannot be grouped into a family.

**On the border between the metals and the nonmetals are seven elements called metalloids.** The **metalloids** have some of the characteristics of metals and some of the characteristics of nonmetals. **The most useful property of the metalloids is their varying ability to conduct electricity.** Some metalloids are used to make semiconductors. **Semiconductors** are substances that under some circumstances can carry electricity, and under other conditions cannot carry electricity. Semiconductors are used to make computer chips, transistors, and lasers.

### Section 3-4 Nonmetals and Metalloids

**Directions:** Complete the following table using your notes and periodic table.

Element	Metal, Nonmetal, or Metalloid	Group Number
Arsenic	metalloid	15
Sulfur	nonmetal	16
Tin	Metal	14
Neon	Nonmetal	18
Chlorine	nonmetal	17
Silicon	metalloid	14

1. Nonmetals are found on the right side of the Periodic Table.
2. Elements that have properties of *both* metals and nonmetals are called metalloids.
3. The metalloids are Boron, Silicon, Germanium, Arsenic, Antimony, Tellurium, and sometimes Polonium, Astatine, carbon, Aluminium, Selenium
4. Most nonmetals are dull, brittle, and poor conductors of heat and electricity.
5. Group 17 is called Halogens. Halogens have 7 valence electrons. Generally gains one electron to become stable. They are also compound forming. or, shares
6. Noble gases are found in Group 18. Noble gases have 8 valence e<sup>-</sup> and are very stable.
7. Hydrogen is not grouped into a family because its chemical properties are different from the other elements.