The periodic table

Periods and Groups

Elements in the periodic table are arranged in periods (rows) and groups (columns). Atomic number increases as you move across a row or period.

Periods

Rows of elements are called periods. The period number of an element signifies the highest unexcited energy level for an electron in that element. The number of elements in a period increases as you move down the periodic table because there are more sublevels per level as the energy level of the atom increases

Groups

Columns of elements help define element groups. Elements within a group share several common properties. Groups are elements have the same outer electron arrangement. The outer electrons are called valence electrons. Because they have the same number of valence electrons, elements in a group share similar chemical properties. The Roman numerals listed above each group are the usual number of valence electrons. For example, a group VA element will have 5 valence electrons.

Representative vs. Transition Elements

There are two sets of groups. The group A elements are called the representative elements. The group B elements are the nonrepresentative elements.

What is on the Element Key?

Each square on the periodic table gives information about an element. On many printed periodic tables you can find an element's symbol, atomic number, and atomic weight.

Classifying Elements

Elements are classified according to their properties. The major categories of elements are the metals, nonmetals, and metalloids.

Metals

You see metals every day. Aluminum foil is a metal. Gold and silver are metals. If someone asks you whether an element is a metal, metalloid, or non-metal and you don't know the answer, guess that it's a metal.

What are Properties of Metals?

Metals share some common properties. They are lustrous (shiny), malleable (can be hammered), and are good conductors of heat and electricity. These properties result from the ability to easily move the electrons in the outer shells of metal atoms.

What are the Metals?

Most elements are metals. There are so many metals, they are divided into groups: alkali metals, alkaline earth metals, and transition metals. The transition metals can be divided into smaller groups, such as the lanthanides and actinides.

Group 1: Alkali Metals

The alkali metals are located in Group IA (first column) of the periodic table. Sodium and potassium are examples of these elements. Alkali metals form salts and many other compounds. These elements are less dense than other metals, form ions with a +1 charge, and have the largest atom sizes of elements in their periods. The alkali metals are highly reactive.

Group 2: Alkaline Earth Metals

The alkaline earths are located in Group IIA (second column) of the periodic table. Calcium and magnesium are examples of alkaline earths. These metals form many compounds. They have ions with a +2 charge. Their atoms are smaller than those of the alkali metals.

Groups 3-12: Transition Metals

The transition elements are located in groups IB to VIIIB. Iron and gold are examples of transition metals. These elements are very hard, with high melting points and boiling points. The transition metals are good electrical conductors and are very malleable. They form positively charged ions.

The transition metals include most of the elements, so they can be categorized into smaller groups. The lanthanides and actinides are classes of transition elements. Another way to group transition metals is into triads, which are metals with very similar properties, usually found together.

Metal Triads

The iron triad consists of iron, cobalt, and nickel. Just under iron, cobalt, and nickel is the palladium triad of ruthenium, rhodium, and palladium, while under them is the platinum triad of osmium, iridium, and platinum.

Lanthanides

When you look at the periodic table, you'll see there is a block of two rows of elements below the main body of the chart. The top row has atomic numbers following lanthanum. These elements are called the lanthanides. The lanthanides are silvery metals that tarnish easily. They are relatively soft metals, with high melting and boiling points. The lanthanides react to form many different compounds. These elements are used in lamps, magnets, lasers, and to improve the properties of other metals.

Actinides

The actinides are in the row below the lanthanides. Their atomic numbers follow actinium. All of the actinides are radioactive, with positively charged ions. They are reactive metals that form compounds with most nonmetals. The actinides are used in medicines and nuclear devices.

Groups 13-15: Not all Metals

Groups 13-15 include some metals, some metalloids, and some nonmetals. Why are these groups mixed? The transition from metal to nonmetal is gradual. Even though these elements aren't similar enough to have groups contained within single columns, they share some common properties. You can predict how many electrons are needed to complete an electron shell. The metals in these groups are called basic metals.

Nonmetals & Metalloids

Elements that don't have the properties of metals are called nonmetals. Some elements have some, but not all of the properties of the metals. These elements are called metalloids.

What are Properties of Nonmetals?

The nonmetals are poor conductors of heat and electricity. Solid nonmetals are brittle and lack metallic luster. Most nonmetals gain electrons easily. The nonmetals are located on the upper right side of the periodic table, separated from metals by a line that cuts diagonally through the periodic table. The nonmetals can be divided into classes of elements that have similar properties. The halogens and the noble gases are two groups of nonmetals.

Group 17: Halogens

The halogens are located in Group VIIA of the periodic table. Examples of halogens are chlorine and iodine. You find these elements in bleaches, disinfectants, and salts. These nonmetals form ions with a -1 charge. The physical properties of the halogens vary. The halogens are highly reactive.

Group 18: Noble Gases

The noble gases are located in Group VIII of the periodic table. Helium and neon are examples of noble gases. These elements are used to make lighted signs, refrigerants, and lasers. The noble gases are not reactive. This is because they have little tendency to gain or lose electrons.

Hydrogen

Hydrogen has a single positive charge, like the alkali metals, but at room temperature, it is a gas that doesn't act like a metal. Therefore, hydrogen usually is labeled as a nonmetal.

What are the Properties of the Metalloids?

Elements that have some properties of metals and some properties of nonmetals are called metalloids. Silicon and germanium are examples of metalloids. The boiling points, melting points, and densities of the metalloids vary. The metalloids make good semiconductors. The metalloids are located along the diagonal line between the metals and nonmetals in the periodic table.

Common Trends in Mixed Groups

Remember that even in mixed groups of elements, the trends in the periodic table still hold true. Atom size, ease of removing electrons, and ability to form bonds can be predicted as you move across and down the table.

Test your comprehension of the periodic table:

1. The modern periodic table isn't the only way to categorize the elements. What are some other ways you could list and organize the elements?

   _____
   _____
   _____

2. List the properties of the metals, metalloids, and nonmetals. Name an example of each type of element.

   _____
   _____
   _____

3. Where in their group would you expect to find elements with the largest atoms? (top, center, bottom)

   _____
   _____
   _____

4. Compare and contrast the halogens and noble gases.

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   _____
   _____

5. What properties can you use to tell the alkali, alkaline earth, and transition metals apart?

   _____
   _____
   _____

Periodic table:

1- http://www.uky.edu/Projects/Chemcomics/ (comics)
2- http://www.chemeddl.org/resources/ptl/index.html (interactive)