


The Periodic Table of The Elements



The Periodic Table

- The periodic table is a chart that organizes all the elements according to different categories
- Divided into three basic categories:
 - Metals
 - Non-Metals
 - Metalloids

Basic Organization

The periodic table is organized by:

- Atomic structure
- Atomic number
- Chemical and physical properties

Uses of The Periodic Table

The periodic table is useful in predicting:

- Chemical behavior of the elements
- Trends
- Properties of the elements

Atomic Structure Review

- Atoms are made of **protons**, **electrons**, and **neutrons**.
- **Elements** are **atoms** of only one type.
- **Elements** are identified by the **atomic number** (# of protons in the nucleus).

Energy Levels Review

- **Electrons** are arranged in a region around the nucleus called **an electron cloud**. **Energy levels** are located within the cloud.
- At least one energy level and as many as seven energy levels exist in atoms.

Energy Levels Review

- **Electrons in levels farther away from the nucleus have more energy.**
- **Inner levels will fill first before outer levels.**

Energy Levels & Valence Electrons

- Energy levels hold a specific amount of electrons:
 - 1st level = up to 2
 - 2nd level = up to 8
 - 3rd level = up to 8 (first 18 elements only)

What are Valence Electrons?

- They are electrons in the outermost level are called... **valence electrons**.
- They are located in the outer most energy level
- They determine reactivity - how elements will react with others to form compounds since the outermost level does not usually fill completely.

Using the Table to Identify Valence Electrons

- Elements are grouped into vertical columns because they have similar properties.
- These are called groups or families.
- Groups are numbered 1–18.

Using the Table to Identify Valence Electrons

- Group numbers can help you determine the number of valence electrons:
 - Group 1 has 1 valence electron.
 - Group 2 has 2 valence electrons.
 - Groups 3–12 are transition metals and commonly have 1 or 2 valence electrons, but may have more.

Using the Table to Identify Valence Electrons (cont.)

- **Groups 13–18 have 10 fewer than the group number. For example:**
 - **Group 13 has 3 valence electrons.**
 - **Group 15 has 5 valence electrons.**
 - **Group 18 has 8 valence electrons.**

Elements & Reactivity

- **Reactivity is a chemical property that determines how elements will react with others to form compounds.**

Elements & Reactivity

- **What makes an element reactive?**
 - Number of valence electrons each atom has
 - When outer levels are full, atoms are stable.
 - When they are not full, they react:
 - Gain, lose, or share electrons

Elements & Reactivity

- The most reactive metals are the elements in Groups 1 and 2.
 - Elements in Group 1 need seven more electrons to fill their outer level.
 - Elements in Group 2 need six more electrons to fill their outer level.
- These groups are known as the “givers” because they easily give up their valence electrons to make a compound.

Elements & Reactivity

- The most reactive nonmetals are the elements in Groups 16 and 17.
 - Elements in Group 16 only need two more electrons to fill their outer level.
 - Elements in Group 17 only need one more electron to fill their outer level.
- These groups are known as the “takers” because they easily receive valence electrons to make a compound.

Groups

- **Groups run vertically in the periodic table.**
- **They are numbered from 1–18.**
- **Elements in the same groups have the same number of valence electrons in the outer energy level with the exception of some transition metals.**
- **Grouped elements behave chemically in similar ways.**

Group 1: Alkali Metals

- **Contains: Metals**
- **Valence Electrons: 1**
- **Reactivity: Very reactive**
- **Properties:**
 - **Solids**
 - **Soft**
 - **React violently with water**
 - **Shiny**
 - **Low density**

Group 2: Alkaline-Earth Metals

- **Contains: Metals**
- **Valence Electrons: 2**
- **Reactivity: Very reactive, but less reactive than alkali metals (Group 1)**
- **Properties:**
 - **Solids**
 - **Silver colored**
 - **More dense than alkali metals**

Groups 3-12 Transition Metals

- **Contain: Metals**
- **Valence electrons: Commonly 1 or 2**
- **Reactivity: Less reactive than alkali and alkaline-earth metals**
- **Properties:**
 - **Higher density**
 - **Good conductors of heat and electricity**

Groups 3-12 Transition Metals Below Main Table

- **Contain: The Lanthanide and Actinide Series**
 - These two rows are pulled out of sequence and placed below the main table to keep the table from being too wide.
 - Lanthanides are #'s 58–71.
 - Actinides are #'s 90–103.

Groups 3-12 Rare Earth Elements ~ Lanthanides

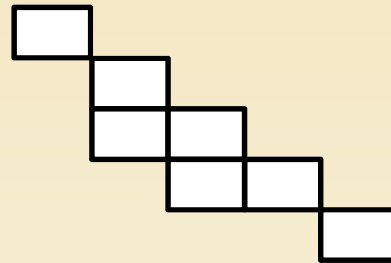
- Lanthanides follow the transition metal # 57 Lanthanum in Period 6
- Valence electrons: Commonly 3
- Reactivity: Very reactive
- Properties:
 - High luster, but tarnish easily
 - High conductivity for electricity
 - Very small differences between them

Groups 3-12 Rare Earth Elements ~ Actinides

- Actinides follow the transition metal # 89 Actinium in Period 7
- Valence electrons: Commonly 3 (but up to 6)
- Reactivity: Unstable
 - All are radioactive.
 - Most are made in laboratories.

Metalloids

- A zig-zag line that separates metals from metalloids
- Elements from Groups 13–17 contain some metalloids.



- These elements have characteristics of metals and non-metals.

Group 13: Boron Group

- **Group 13: Boron Group**
- **Contains: 1 metalloid and 4 metals**
- **Valence Electrons: 3**
- **Reactivity: Reactive**
- **Other shared properties:**
 - **Solid at room temperature**

Group 14: Carbon Group

- **Contains: 1 non-metal, 2 metalloids, and 3 metals**
- **Valence Electrons: 4**
- **Reactivity: Varies**
- **Other shared properties:**
 - **Solid at room temperature**

Group 15: Nitrogen Group

- Contains: 2 non-metals, 2 metalloids, and 1 metal
- Valence electrons: 5
- Reactivity: Varies
- Other shared properties:
 - All but N are solid at room temperature.

Group 16: Oxygen Group

- Contains: 3 non-metals, 1 metalloid, and 2 metals
- Valence Electrons: 6
- Reactivity: Reactive
- Other shared properties:
 - All but O are solid at room temperature.

Groups 17: Halogens

- **Contain: Non-metals**
- **Valence Electrons: 7**
- **Reactivity: Very reactive**
- **Other shared properties**
 - **Poor conductors of electric current**
 - **React violently with alkali metals to form salts**
 - **Never found uncombined in nature**

Group 18: Noble Gases

- **Contains: Non-metals**
- **Valence Electrons: 8 (2 for He)**
- **Reactivity: Unreactive (least reactive group)**
- **Other shared properties:**
 - **Colorless, odorless gases at room temperature**
 - **Outermost energy level full**
 - **All found in atmosphere**

Hydrogen Stands Apart

- H is set apart because its properties do not match any single group.
- Valence electrons: 1
- Reactivity: Very reactive, but loses or shares the 1 electron easily
- Properties:
 - Similar to those of non-metals rather than metals

Periods

- **Periods run horizontally across the periodic table.**
- **Periods are numbered 1–7.**
- **All elements in a period will have the same number of energy levels, which contain electrons. Examples:**
 - **Period 1 atoms have 1 energy level.**
 - **Period 2 atoms have 2 energy levels.**
 - **Period 5 atoms have 5 energy levels.**

Periods (cont.)

- In elements 1-20, moving from left to right across a period, each element has one more electron in the outer shell of its atom than the element before it. (You will learn about the others in HS Chemistry.)
- This leads to a fairly regular pattern of change in the chemical behavior of the elements across a period.