# Periodic Table of the Elements Notes

- Arrangement of the known elements **based on** atomic number and chemical and physical properties.
- Divided into three basic categories:
    - Metals (left side of the table)
    - Nonmetals (right side of the table)
    - Metalloids (touching the zig zag line)

**Basic Organization by:**

- Atomic structure
- Atomic number
- Chemical and Physical Properties

## Uses of the Periodic Table

**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 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 1 energy level and as many as 7 energy levels exist in atoms

**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)

- The electrons in the outermost level are called valence electrons.

    - Determine reactivity - how elements will react with others to form compounds
    - Outermost level does not usually fill completely with electrons

## 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.

- **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 have 1 or 2 valence electrons.
  - Groups 13–18 have **10 fewer than the group number**. For example:
  - Group 1**3** has **3** valence electrons.
  - Group 1**5** has **5** valence electrons.
  - Group 1**8** has **8** valence electrons (except He)

## Elements & Reactivity

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

- **What makes an element reactive?**
  - Number of valence electrons of each atom
  - When outer levels are full, atoms are stable.
  - When they are not full, they react:
    - gain, lose, or share 1 or 2 electrons

- The **most reactive metals** are the elements in Groups 1 and 2.

  - Elements in Group 1 generally lose an electron so their outer energy level is empty.
  - Elements in Group 2 generally lose two electrons so their outer energy level is empty.

- These groups **easily give up** their valence electrons to make a compound.

- The **most reactive nonmetals** are the elements in Groups 16 and 17.

  - Elements in Group 16 need two more electrons to fill their outer energy level.
  - Elements in Group 17 need one more electron to fill their outer energy level.

- These groups gain 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.
- Grouped elements behave chemically in similar ways.

**Group 1: Alkali Metals**

- Contains: Metals
- Valence Electrons: 1
- Reactivity: Very Reactive – most reactive group on the Periodic Table
- 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: 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 atomic numbers 57–70.
    - Actinides are atomic numbers 89–102.

**Groups 3-12 Rare Earth Elements ~ Lanthanides**

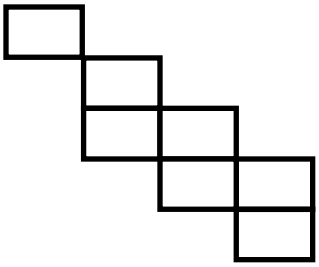
- Lanthanides follow the transition metal atomic number 57 Lanthanum in Period 6.
- Valence electrons: 3
- Reactivity: Very reactive
- Properties:
    - High luster, but tarnish easily
    - High conductivity for electricity
    - Very small differences between them

## Groups 3-12 Rare Earth Elements ~ Actinides

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

## Metalloids

- A zig-zag line that separates metals from metalloids
- Elements from Groups 13–16 contain some metalloids.
- Metalloids are Boron, Silicon, Germanium, Arsenic, Antimony, Tellurium and Polonium



- These elements have characteristics of metals and nonmetals.

## 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 2 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, 2 metalloids
- Valence Electrons: 6
- Reactivity: Reactive
- Other shared properties:
    - All but O are solid at room temperature.

**Groups 17: Halogens**

- Contain: Nonmetals
- 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: Nonmetals
- Valence Electrons: 8 (2 for He)
- Reactivity: Nonreactive (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, but loses 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 the 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.