Modern Periodic Table
Historical Background

In the 1860s, a scientist named Dmitri Mendeleev also saw the need to organize the elements. He created a table in which he arranged all of the elements by increasing atomic mass from left to right across each row. When he placed eight elements in each row and then started again in the next row, each column of the table contained elements with similar properties. He called the columns of elements groups. Mendeleev's table is called a periodic table and the rows are called periods. That's because the table keeps repeating from row to row, and periodic means "repeating."

In the 19^{th} century, Russian chemist Dmitri Mendeleev published his first attempt at grouping chemical elements according to their atomic rates. There were only about 60 elements known at the time, but Mendeleev realized that when the elements were organized by weight, certain types of elements occurred in regular intervals, or periods.

Today, 150 years later, chemists officially recognize 118 elements (after the edition of 4 new comers in 2016) and still use Mendeleev's periodic table of elements to organize them. The table starts with simplest atom, hydrogen, and then organizes the rest of elements by atomic number, which is the number of protons each contains. With a handful of exceptions, the order of elements corresponds with the increasing mass of each atom.

Modern Periodic Table

In modern periodic table the elements are arranged in increasing atomic number.

Atomic number is the number of protons in an atom, and this number is unique for each element. The modern table has more elements than Mendeleev's table because many elements have been discovered since Mendeleev in 1867.

How to read the table

In the Figure above, each element is represented by its chemical symbol, which consists of one or two letters. The first letter of the symbol is always written in upper case, and the second letter—if there is one—is always written in lower case. For example, the symbol for copper is Cu. It stands for cuprum, which is the Latin word for copper. The number above each symbol in the table is its unique atomic number. Notice how the atomic numbers increase from left to right and from top to bottom in the table.

Periods in the Periodic Table

Rows of the modern periodic table are called periods, as they are in Mendeleev's table. From left to right across a period, each element has one more proton than the element before it. Some periods in the modern periodic table are longer than others. There are seven periods in periodic table.

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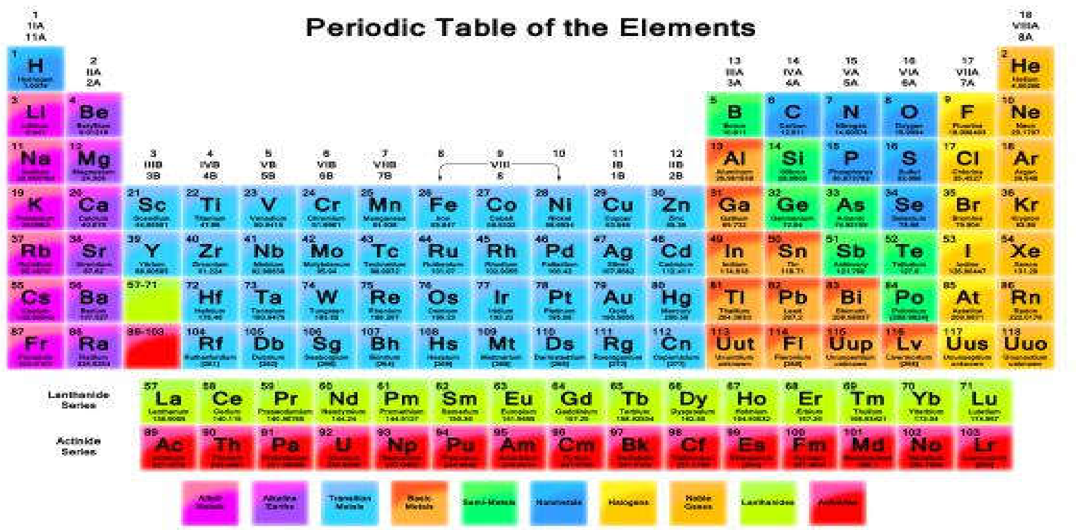

First Period:

A period 1 element is an element in the 1^{st} period (row) of the periodic table. The first period has less elements than any other periods in the periodic table. There are only two elements in the first period: hydrogen and helium.

Second Period:

The second period contains the elements lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine and neon.

Third Period:

It contain 8 elements: sodium, magnesium, aluminium, silicon, phosphorus, sulfur, chlorine and argon.

Fourth Period:

The fourth period contain 18 elements beginning with potassium and ending with krypton. It includes Potassium Calcium, Scandium, Titanium, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel, Copper, Zinc, Gallium, Germanium, Arsenic, Selenium, Bromine and Krypton.

Fifth Period:

It contain 18 elements beginning with Rubidium and ending with Xenon.

Sixth Period:

The sixth period contain 32 elements, tide for the most with period seven beginning with Cesium and ending with Radon.

Seventh Period:

For the last fifty or so years, the periodic table has been incomplete. Elements after Uranium on the periodic table have been synthesized for the past few decades, but there were always a few missing blocks in the periodic table. These elements with atomic numbers of 113, 115, 117 and 118 comprise the missing parts of period seven. Currently elements 113, 115, 117 and 118 are known as Ununtrium, Ununpentium, Ununseptium and Ununoctium respectively.

Groups of the Modern Periodic Table

Column of the periodic table, which contains elements of similar properties. The modern table has many more groups—18 compared with just 8 in Mendeleev's table. Elements in the same group have similar properties. For example, all elements in group 18 are colorless, odorless gases, such as neon (Ne). In contrast, all elements in group 1 are very reactive solids. They react explosively with water,

System for Numbering the Groups:

There are two different numbering systems that are commonly used to designate groups and we are familiar with both. **The Traditional system** used in United States involves the use of letters A and B. the first two groups are 1A and 2A, while the last six groups are 3A through 8A. The middle groups use B in their titles. Unfortunately, there was a slightly different system in Europe. To eliminate confusion the International Union of Pure and Applied Chemistry (IUPAC) decided that the official system for numbering the groups would be a simple 1 through 18 from left to right. Many periodic shows both systems.

Each group contains elements that tend to react chemically in similar ways because they all have atoms in which the arrangement of electron around the nuclear is similar. Some groups in the periodic table are given special names. Example:

- *Group 1 The alkali metals*
- *Group 2 The alkaline earth metals*
- *Group 15 The pnicogens*
- *Group 16 The chalcogens*
- *Group 17 The halogens*
- *Group 18 The noble gasses*

Representative elements in modern periodic table

The first two groups on extreme left and last six groups on extreme right involve the filling of s and p orbitals respectively, these groups represent the main groups of periodic table and are numbered as 1, 2, 13, 14, 15, 16, 17 and 18. The elements present in these groups are known as normal elements or representative elements.

Transition Series Element in Modern periodic Table

The ten groups lie in between first tow and last six groups i.e between group 2 and group 13. These are numbered from 3-12. The elements present in these groups are called transition elements. The name is derived from the fact that they represent transition (change) in character from reactive metals (element of group 1 and 2) on one side to the non-metals (elements of group 13-18) on the other side.

Inner transitions Series Elements in Modern Periodic Table

There are two more roles at the bottom of the periodic table. These groups consist of 14 elements after Lanthanum (Z=57) and 14 elements which follow Actinium (Z=89). These are placed separately in the periodic table to save space and avoid undue sidewise expansion of the periodic table. The elements in the first row, starting from Cerium are called Lanthanoids (or Lanthanides) and the element present in the second row starting from Thorium are called actinoids (or actinides). These lanthanoids and actinoids together are called inner transition elements or rare earth metals and these are built up by filling of f-orbitals.

Groups of Periodic Table

1.Alkali Metals:

The alkali metals makes up most of the group one, the table's first column. Shiny and soft enough to cut with a knife, these metals start with lithium and end with francium. They are also extremely reactive and will burst into flame or even explode or contact with water, so chemists store them in oils on inert gasses. Hydrogen, with its single electron, also lives in group 1, but the gas in considered a non-metal.

2.Alkaline-Earth Metals

Alkaline-earth metals make up group 2 of the periodic table from beryllium through radium. Each of these elements has two electrons in its outer most energy level which makes the alkaline earth reactive enough that they are rarely fund alone in nature. But they're not as reactive as alkali metals. Their chemical reactions typically occurs most slowly and produce less heat compared to alkali metals.

3.Lanthanides

The third group is much too long to fit in the 3rd column, so it is broken out and flipped sideways to become the top row of the Iceland that floats at the bottom of the table. This is the lanthanides, elements 57 through 71 – lanthanum (La) to lutetium (Lu). The elements in this group have a silvery white color and tarnish on contact with air.

4.Actinides

The actinides line the bottom row of the Iceland and comprise elements 89, actinium (Ac), through 103, lawrencium (Lr), of these elements, only thorium (Th) and uranium (U) occur naturally on earth in substantial amounts. All are radioactive. The actinides and the lanthinides together form a group called inner transition metals.

5.Transition Metals

Returning to the main body of the table, the remainder of the groups 3 through 12 represent the rest of the transition metals. Hard but malleable, shiny, and possessing good conductivity, these elements are what we typically think of when we hear the word metal. Many of the greatest hits of the metal world including gold, silver, iron and platinum-live here.

6.Inner Transition Metals

Ahead of the jump into non-metal word, shared characteristics are not neatly divided along the vertical group lines the post transition metals are, aluminium (Al), gallium(Ga), indium (In), thallium(Tl), tin (Sn), led (Pb) and bismuth (Bi) and they span group 13 to 17. These elements have some of the classic characteristics of transition metals, but they tend to be softer and conduct more poorly than other transition metals.

Many periodic tables will feature a bolded "staircase" line below the diagonal connecting boron with astatine. The post transition metals clustered to the lower left of this line.

Other Classification.

Metalloids:

The metalloids are boron (B), silicon (Si), germanium (Ge), Arsenic (As), Antimony (Sb), tellurium (Te) and polonium (Po). They form the staircase that represents the gradual transition from metal to non-metal. These elements sometimes behave as semiconductors (B, Si, and Ge) rather than as conductors. Metalloids are also called "semi-metals" or "poor metals"

Nonmetals:

Everything else to the upper right of the staircase _ plus hydrogen, stranded way back in the group 1 _ is a nonmetal. These include Carbon ©, Nitrogen (N), Phosphorus (P), Oxygen (O), Sulfur (S) and Selenium (Se).

Halogens:

The top 4 elements of group 17, from Fluorine (F) through Astatine (At), represent one of two subsets of the nonmetals. The halogen are quite chemically reactive and tend to pair up with alkali metals to produce various types of salt.

The table salt for example, is a combination between alkali metal sodium and halogen chlorine.

Noble Gasses:

Colorless, odorless, and almost completely nonreactive, the inert, or noble gasses round out the table in group18. Many chemist expects oganesson, one of the four newly named elements to share these characteristics. However, because this element has a half -life measuring in milliseconds, no one has been able to test it directly.

Groups of the Periodic Table

A block of the periodic table is a set of elements unified by the orbitals their valence electrons or vacancies lie in. There are four blocks named as s, p, d, and f.

1**. s-block elements:**

- *The block of alkali metals (group IA or 1) i.e. Li to Fr and alkaline earth metals (group IIA or 2) i.e. Be to Ra which are present at the left hand side of the periodic table*
- *These elements have the last electron in s-subshell*

2**. p- block elements:**

- *The bock of metals, non-metals, metalloids and inert gases which are present in group IIIA to VIII A constitute p-block elements e.g. B, C, O, N, F, Ne etc.*
- *present at the right hand side of the modern periodic table*
- *these elements have the last electron in p-subshell*

- *Elements belonging to s-block and p-block are "normal" or representative" elements.*

3**. d-block elements:**

- *the block of transitional metals which is present in middle part of the modern periodic table*
- *includes elements of group IB to VIIIB i.e. 3 to 12*
- *these elements have last electron in d-subshell*
- *their properties are midway between those of s-block & p-block, so they are called "Transitional elements"*

4**. f-block elements:**

- *the block of lanthanides and actinides present below the main periodic table*
- *the last electron of the valence shell of these elements enters f-subshell*

Merits of the Long Form of Periodic Table

The long form of periodic table has a number of merits over the Mendeleev's periodic table in the following respects:

- *the classification of elements I based on a more fundamental property "atomic number"*
- *it relates the position of an element to the electronic arrangement of its atoms and is therefor, nearly an ideal arrangement*
- *it reflects the similarities, differences and the trends in the chemical properties more clearly across the long periods*
- *the inert gasses having completely filled shells have been placed at the end of each period. Such a location of the inert gasses represent a logical completion of each period*
- *in this form of periodic table, the elements of the two sub-groups have been placed separately and thus dissimilar elements do not fall together*
- *it provides a clear demarcation of different types of the elements like active metals, transition metals, non-metals, metalloids, inert gasses, lanthanides and actinides*
- *the properties of transition elements are more clearly understood and their place in a long period is justified in the light of their electronic configuration*
- *the position of lanthanides and actinides as a separate group in the table again is based on their analogous chemical behavior*
- *it is easier to remember, understand and reproduced*

Defects of Long Form of Periodic Table

Although the long form of periodic table is superior to Mendeleev's periodic table in many respects, it retains some of the defects such as listed below:

1. *The group nomenclature A and B as mentioned earlier in arbitrary and confusing. The designation is often inverted for groups 3-7. To overcome this problem use is being made of new IUPAC nomenclature along with traditional nomenclature*
2. *the problem of position of hydrogen still remains unsolved*
3. *the presence of transition element between s and p blocks interrupts the regular change in character along the s and p blocks*
4. *Zn, Cd and Hg are not typical transition elements. they are in fact fairly typical representative elements, but don not fit easily into their scheme*
5. *In the long form of periodic table there is no attempt to systemize the elements into the useful classification of metals and non-metals*
6. *The term usually associated with the elements in the long form of the table such as representative, transition, etc. should be regarded merely as convenient labels and have no definite associated meanings*

7. *Like the Mendeleev's table, it fails to accommodate the lanthanides and actinides in the main body of the table*
8. *The arrangement is unable to reflect the electronic configuration of many elements.*