

Periodic Table

Periodic Law

In 1829, the German chemist Döbereiner, became the first to propose a relationship between atomic weights and the properties of elements. He was able to show that strontium has properties about midway between calcium and barium.

The English chemist Newlands, in 1865, saw a correlation between the atomic weights and the properties of the elements. Mendeleev in Russia and Lothar Meyer in Germany, in 1870, working independently and unaware of Newlands, outlined this relationship in detail. This led to a statement that the properties of the elements are periodic functions of their atomic weights. The below series illustrates the point:

Li	Be	B	C	N	O	F	Ne
6.94	9.01	10.81	12.01	14.01	16.00	18.00	20.18
Na	Mg	Al	Si	P	S	Cl	Ar
22.00	24.31	26.98	28.09	30.97	32.06	35.45	39.95

In each row elements differ quite a bit in properties. There is, however, an interesting graduation of properties as atomic weight increases. Note that elements in a vertical column have similar properties. For example, lithium is similar to sodium.

Moseley showed that atomic number rather than atomic weights are the determining factor of chemical properties. If you check the Periodic Table you can see that argon (At. Wt. 39.948) precedes potassium (At. Wt. 39.098). There are other reversals in the table as well. This is due to the abundance of heavier isotopes of some elements. This affects the atomic weight which is an average.

The formal statement of the Periodic Law is:

Properties of elements are periodic functions of their atomic numbers.

Background of Periodic Table

The first periodic table was devised by Dmitri Mendeleev and published in 1869.

Mendeleev found he could arrange the 65 elements that were then known in a grid or table so that each element had:

1. A higher atomic weight than the one on its left.
2. Similar chemical properties to other elements in the same column.

He realized that the table in front of him lay at the very heart of chemistry. In his table he noted gaps - spaces where elements should be but none had yet been discovered.

In fact, just as Adams and Le Verrier could be said to have discovered the planet Neptune on paper, Mendeleev could be said to have discovered germanium (which he called *eka-silicon* because he observed a gap between silicon and tin), gallium (*eka-aluminum*) and scandium

(*eka*-boron) on paper, for he predicted their existence and their properties before their actual discoveries.

Although Mendeleev had made a crucial breakthrough, he made little further progress because the Rutherford-Bohr model of the atom had not yet been formulated.

In 1913, Henry Moseley, who worked with Rutherford, showed it is atomic number (charge) and not (as Mendeleev had proposed) atomic weight that is most fundamental to the chemical properties of any element. Like Mendeleev, Moseley was able to predict correctly the existence of new elements based on his work.

And today the elements are still arranged in order of increasing atomic number (Z) as you go from left to right across the table. We call the horizontal rows periods and the vertical rows groups.

We also know an element's chemistry is determined by the way its electrons are arranged - its electron configuration.

The noble gases are found in group 18, on the far right of each period. The reluctance of the noble gases to undergo chemical reactions indicates that the atoms of these gases strongly prefer their own electron configurations - featuring a full outer shell of electrons - to any other.

In contrast to the noble gases, the elements with the highest reactivity are those with the greatest need to gain or lose electrons in order to achieve a full outer shell of electrons.

Elements sitting in the same group (e.g. the alkali metals in Group 1) all have the same number of outer electrons, leading to similar chemical properties.

Likewise the halogens in Group 17 also have similar properties to one another. When halogens react, they gain an electron to form negatively charged ions. Each ion has the same electron configuration as the noble gas in the same period. The ions are therefore more chemically stable than the elements from which they formed.

There is a progression from metals to non-metals across each period.

The block of elements in groups 3 - 12 contains the transition metals. These are similar to one another in many ways; they produce colored compounds, have variable valency and are often used as catalysts. The rare earth elements can be divided into lanthanides (elements 58 - 71) and actinides (elements 90 - 103). The naturally occurring rare earths are found on earth in only very small amounts. The actinides include most of the well-known elements that take part in or are produced by nuclear reactions. No element with atomic number higher than 92 occurs naturally. These elements are produced artificially in nuclear reactors or particle accelerators.

Periodic table of the elements

group	Legend																18		
1*	alkali metals		alkaline earth metals		transition metals		other metals		other nonmetals		halogens		noble gases		rare earth elements (21, 39, 57–71) lanthanide elements (57–71 only)		actinide elements		0
1	2																	10	
1	2																	10	
3	4																	10	
3	4																	10	
11	12																	18	
11	12																	18	
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54		
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54		
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86		
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86		
87	88	89	104	105	106	107	108	109	110	111	112	113	114	115	116				
87	88	89	104	105	106	107	108	109	110	111	112	113	114	115	116				
lanthanide series		6	58	59	60	61	62	63	64	65	66	67	68	69	70	71			
actinide series		7	90	91	92	93	94	95	96	97	98	99	100	101	102	103			

* Numbering system adopted by the International Union of Pure and Applied Chemistry (IUPAC).

** Numbering system widely used, especially in the U.S., from the mid-20th century.

*** Discoveries of elements 112–116 are claimed but not confirmed. Element names and symbols in parentheses are temporarily assigned by IUPAC.

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Easy Way to Memorize the First 20 Elements of Periodic Table

Story – Letter of Codes

Note: This story is not a true story. It was created for students to memorize the first 20 elements in Periodic Table more easily.

Long time ago, there was a young man called Henry. He came from poor family. He was in love with a princess called Betty. Betty loved flowers very much. However, her step-mother, Nancy Margaret did not like Henry and disallowed their relationship. Nancy loved singing and her idol was Arron Kwok. She always sang a pop song called Arron Kwok's Cat.

As the relationship was objected, Henry was in sorrow. He could not meet Betty anymore. Hence, he wrote a 'letter of codes', which consisted of 20 elements to Betty to express his grief.

Interpretation of the codes

H: Henry
 He: He
 Li: Likes
 Be: Betty
 B: But
 C: Can
 N: Not
 O: Offer
 F: Flower

Ne: Next
 Na: Nancy
 Mg: Margaret
 Al: Always
 Si: Sings
 P: Pop
 S: Song
 Cl: Called
 Ar: Arron
 K: Kwok
 Ca: Cat

As summary:

1	2	3	4	5	6	7	8	9	10
H	He	Li	Be	B	C	N	O	F	Ne
11	12	13	14	15	16	17	18	19	20
Na	Mg	Al	Si	P	S	Cl	Ar	K	Ca

Letter of Codes story

1	2	3	4	5	6	7	8	9	10
Henry	He	Likes	Betty	But	Can	Not	Offer	Flowers	Next
11	12	13	14	15	16	17	18	19	20
Nancy	Margaret	Always	Sings	Pop	Song	Called	Arron	Kwok	Cat

So, now do you still find it hard to memorize the first 20 elements in Periodic Table? I am sure now it is so much easier.