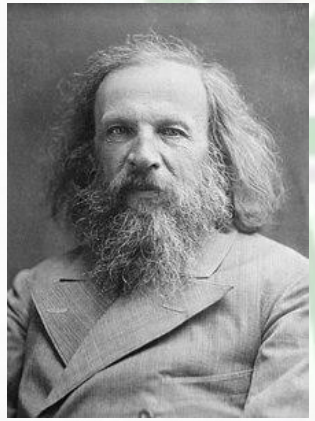
A Tour Around the Periodic Table



DESIGNED BY DR. ANURADHA MUKHERJEE

Chemistry Affinity

Conceptual, Real-world, Happy Learning

Overview

1. Timeline of Periodic Table

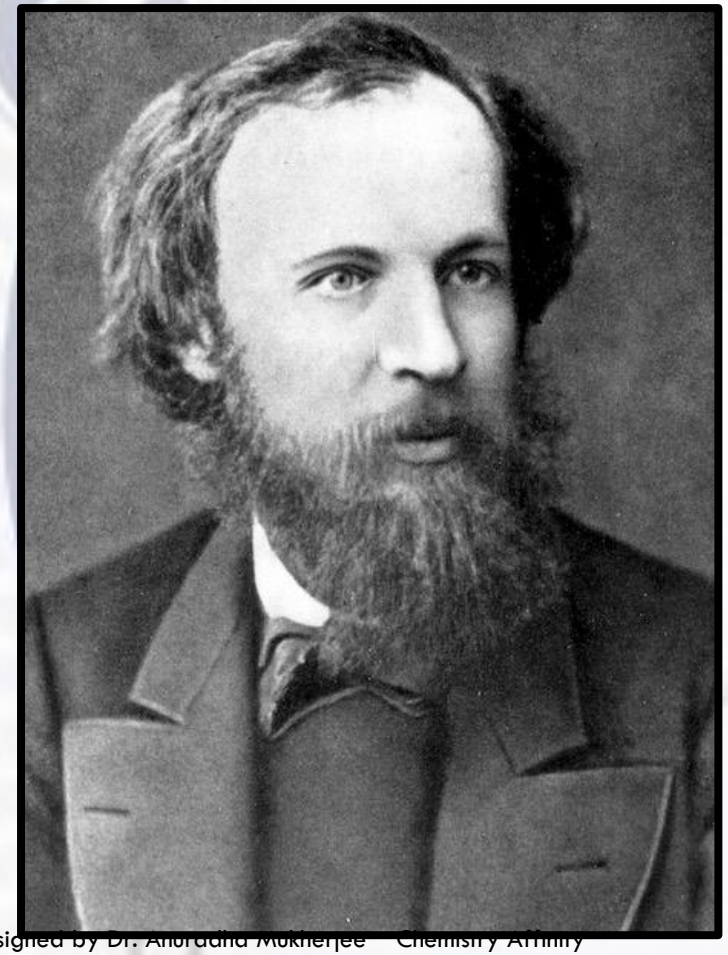
2. Antoine Lavoisier, Dobereiner's Triads, Newland's "law of octaves', Mendeleev's Periodic Table and Henry Moseley's Modern periodic table

3. Concept of atomic number. Advantage of modern periodic table

4. Arrangement of elements in periodic table: Classification of elements based on Periodic table

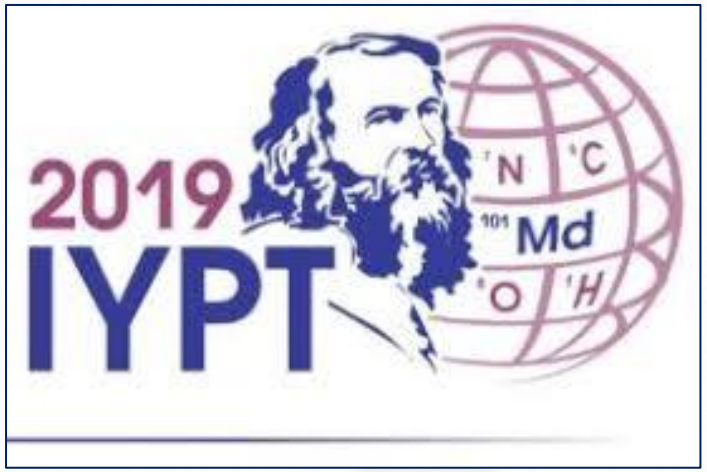
5. Periodic table and electronic configuration

1869 is considered as the year of discovery of the Periodic Table by Dmitri Mendeleev



2019 is the 150th anniversary of the Periodic Table of Chemical Elements

Therefore, 2019 has been proclaimed the "*International Year of the Periodic Table of Chemical Elements (IYPT2019)*" by the United Nations General Assembly and UNESCO



The International Year (2019) of Periodic Table

The Periodic Table is a roadmap of matter's building blocks that has successfully guided chemists for nearly a century and a half

Is Organized by

With the Partnership of

And 50 more organizations across the globe

Unleashing The Periodic Table

“He wrote the names of the 65 known elements on cards, much like playing cards, one element on each card. He then wrote the fundamental properties of every element on its card, including atomic weight

He saw that atomic weight was important in some way – the behavior of the elements seemed to repeat as their atomic weights increased – but he could not see the pattern

He was Convinced that he is close to discovering something significant, Mendeleev moved the cards about for hour after hour and finally he fell asleep at his desk

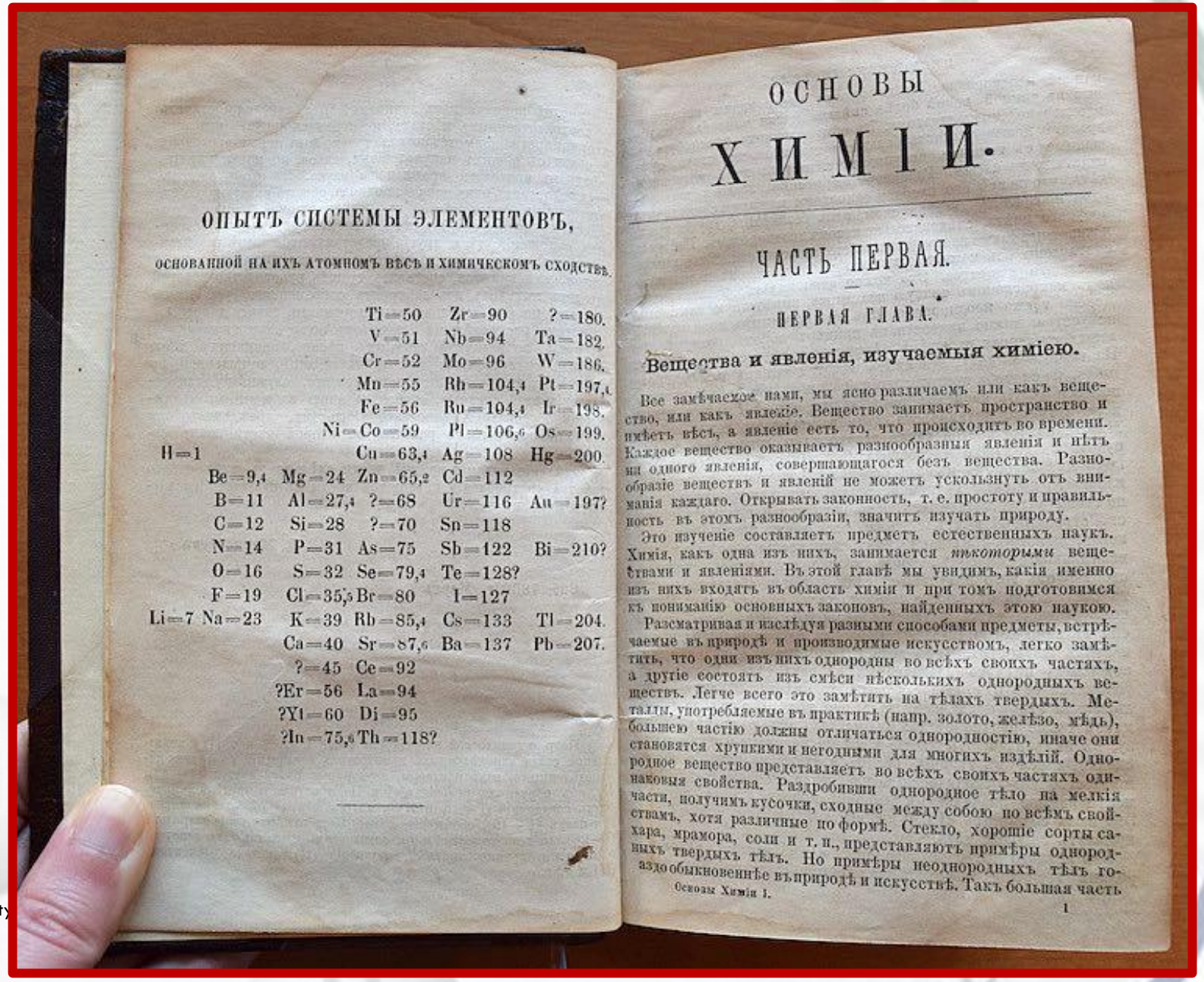
When he awoke, he found that his subconscious mind had done his work for him! He now knew the pattern the elements followed. He later wrote:”

“In a dream I saw a table where all the elements fell into place as required. Awakening, I immediately wrote it down on a piece of paper.”

DMITRI MENDELEEV, 1834 TO 1907

It took him only two weeks to publish *The Relation between the Properties and Atomic Weights of the Elements*. The Periodic Table had been unleashed on the scientific world

First Published Periodic Table



ОПЫТЪ СИСТЕМЫ ЭЛЕМЕНТОВЪ,

ОСНОВАННОЙ НА ИХЪ АТОМНОМЪ ВѢСѢ И ХИМИЧЕСКОМЪ СХОДСТВѢ.

			Ti=50	Zr=90	?=180.	
			V=51	Nb=94	Ta=182.	
			Cr=52	Mo=96	W=186.	
			Mn=55	Rh=104,4	Pt=197,4	
			Fe=56	Ru=104,4	Ir=198.	
			Ni=Co=59	Pl=106,6	Os=199.	
H=1			Cu=63,4	Ag=108	Hg=200.	
	Be=9,4	Mg=24	Zn=65,2	Cd=112		
	B=11	Al=27,4	?=68	Ur=116	Au=197?	
	C=12	Si=28	?=70	Sn=118		
	N=14	P=31	As=75	Sb=122	Bi=210?	
	O=16	S=32	Se=79,4	Te=128?		
	F=19	Cl=35,5	Br=80	I=127		
Li=7	Na=23	K=39	Rb=85,4	Cs=133	Tl=204.	
		Ca=40	Sr=87,6	Ba=137	Pb=207.	
		?=45	Ce=92			
		?Er=56	La=94			
		?Yt=60	Di=95			
		?In=75,6	Th=118?			

ОСНОВЫ

ХИМІИ.

ЧАСТЬ ПЕРВАЯ.

ПЕРВАЯ ГЛАВА.

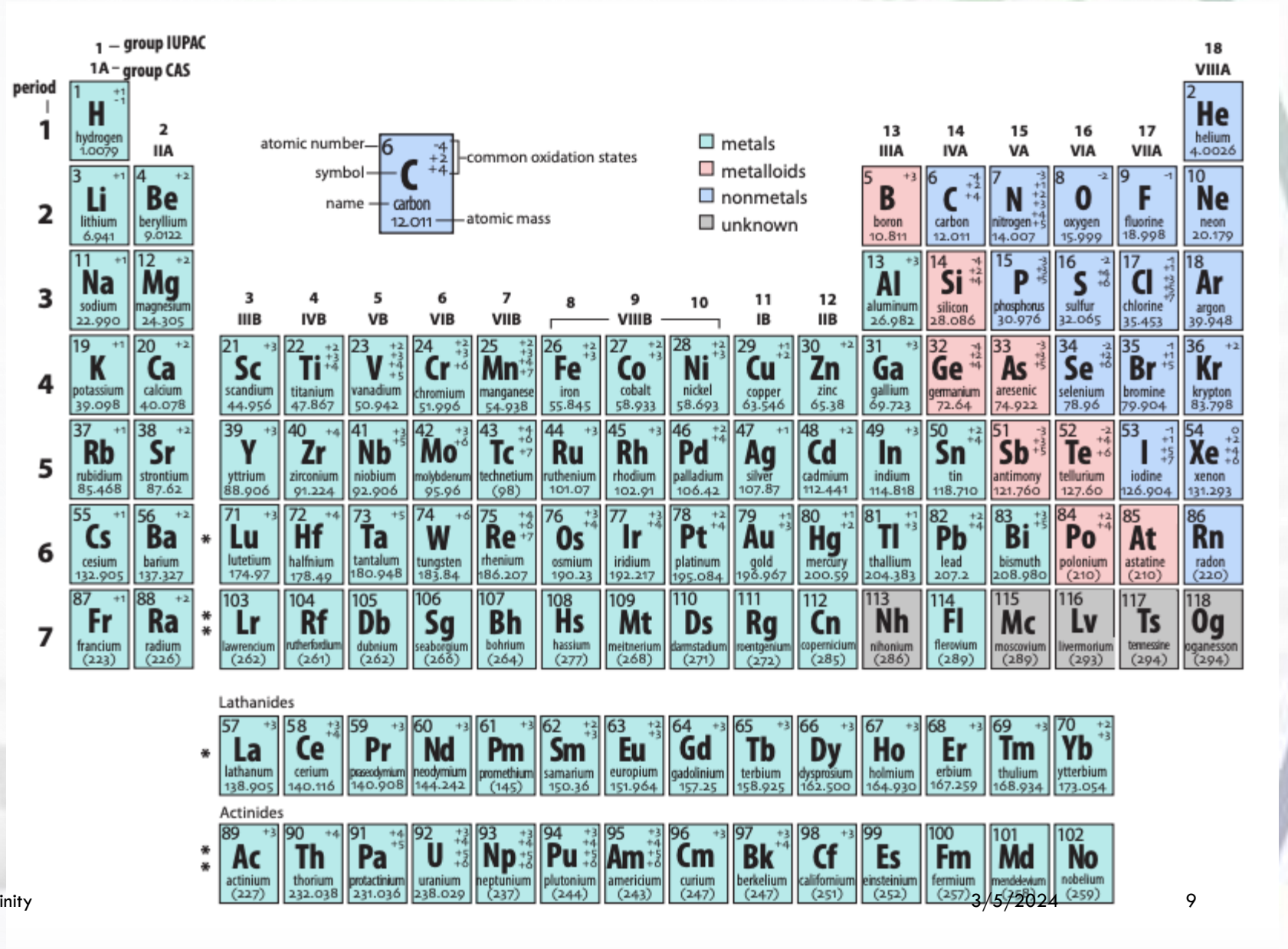
Вещества и явленія, изучаемыя химіею.

Все замѣчаемое нами, мы ясно различаемъ или какъ вещество, или какъ явленіе. Вещество занимаетъ пространство и имѣетъ вѣсъ, а явленіе есть то, что происходитъ во времени. Каждое вещество оказываетъ разнообразныя явленія и нѣтъ ни одного явленія, совершающагося безъ вещества. Разнообразіе веществъ и явленій не можетъ ускользнуть отъ вниманія каждаго. Открывать законность, т. е. простоту и правильность въ этомъ разнообразіи, значитъ изучать природу.

Это изученіе составляетъ предметъ естественныхъ наукъ. Химія, какъ одна изъ нихъ, занимается *нѣкоторыми* веществами и явленіями. Въ этой главѣ мы увидимъ, какія именно изъ нихъ входятъ въ область химіи и при томъ подготовимся къ пониманію основныхъ законовъ, найденныхъ этою наукою.

Разсматривая и изслѣдуя разными способами предметы, встрѣчаемые въ природѣ и производимые искусствомъ, легко замѣтить, что одни изъ нихъ однородны во всѣхъ своихъ частяхъ, а другіе состоятъ изъ смѣси нѣсколькихъ однородныхъ веществъ. Легче всего это замѣтить на тѣлахъ твердыхъ. Металлы, употребляемые въ практикѣ (напр. золото, желѣзо, мѣдь), большею частію должны отличаться однородностію, иначе они становятся хрупкими и негодными для многихъ издѣлій. Однородное вещество представляетъ во всѣхъ своихъ частяхъ одинаковыя свойства. Раздробивши однородное тѣло на мелкія части, получимъ кусочки, сходные между собою по всѣмъ свойствамъ, хотя различные по формѣ. Стекло, хорошіе сорты сахара, мрамора, соли и т. п., представляютъ примѣры однородныхъ твердыхъ тѣлъ. Но примѣры неоднородныхъ тѣлъ гораздо обыкновеннѣе въ природѣ и искусствѣ. Такъ большая часть

118 elements are present in the Earth



Periodic Table Contains Different types of Elements

Metals — Lithium (Li), Sodium (Na), Potassium (K), Calcium (Ca), Iron (Fe), Copper (Cu), Gold (Au), Silver (Ag)

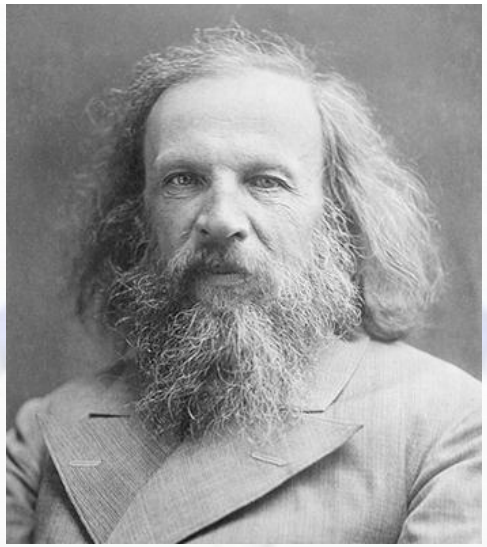
Metalloids — Boron (B), Silicon (Si), Germanium (Ge) Arsenic (As), Antimony (Sb), Tellurium (Te), Polonium (Po)

Non-Metals — Hydrogen (H), Carbon (C), Nitrogen (N), Oxygen (O), Fluorine (F) , Chlorine (Cl), Bromine (Br), Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (Xe)

Let's Explore Periodic Table and Its Discovery





from left, Antoine Lavoisier, Johann Wolfang Döbereiner, John Newlands, Henry Moseley, Lothar Mayer and Dimitri Mendeleev

3/5/2024

Designed by Dr. Anuradha Mukherjee Chemistry Affinity

Timeline: Periodic Table

French chemist Antoine Lavoisier

In 1789, French chemist Antoine Lavoisier proposed first time an extensive list of elements and tried to give a chemical nomenclature

He recognized two elements oxygen and hydrogen and named them

He discovered of the role of oxygen in the combustion process

He is famous for his law of "conservation of mass"

He predicted (1778) the existence of a new element silicon (Si)

Timeline: Periodic Table

Forty years later, German physicist Johann Wolfang Döbereiner noticed similarities in physical and chemical properties of certain elements

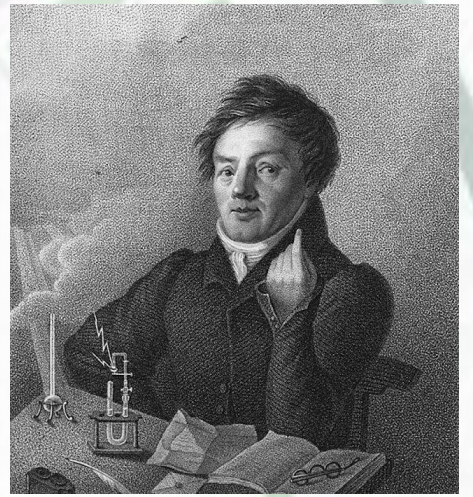
53 elements were known at his time

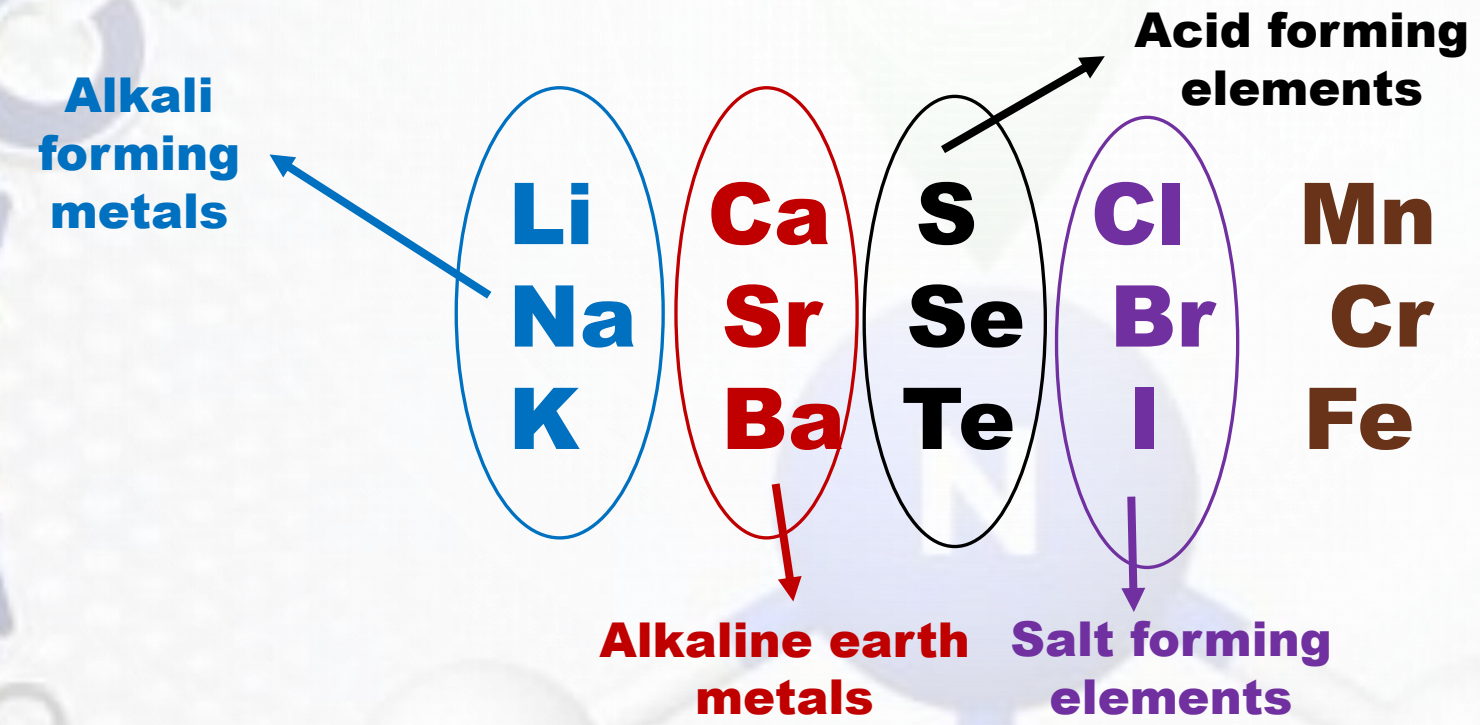
Then he discovered the existence of families of elements with similar chemical properties, because it was seemed to be three elements in these families, he called them *triads*

https://en.wikipedia.org/wiki/D%C3%B6bereiner%27s_triads

Timeline: Periodic Table

Dobereiner's Triads





Dobereiner's triads contain elements with similar chemical properties

Example: lithium, sodium, and potassium

Dobereiner's Triads

Li	Ca	S	Cl	Mn
Na	Sr	Se	Br	Cr
K	Ba	Te	I	Fe

1. Li, Na, K elements all react with water at room temperature

2. Li, Na, K react with chlorine to form compounds with similar formulas: LiCl, NaCl, and KCl

3. Li, Na, K combine with hydrogen to form compounds with similar formulas: LiH, NaH, and KH

4. Li, Na, K form hydroxides with similar formulas: LiOH, NaOH, and KOH

Johann Wolfgang Dobereiner (purdue.edu)

Dobereiner's Triads

Li	Ca	S	Cl	Mn
Na	Sr	Se	Br	Cr
K	Ba	Te	I	Fe

He noted that the physical properties of elements like atomic weight and the density of the middle element in each triad is about equal to the average of the atomic weights of the first and third elements

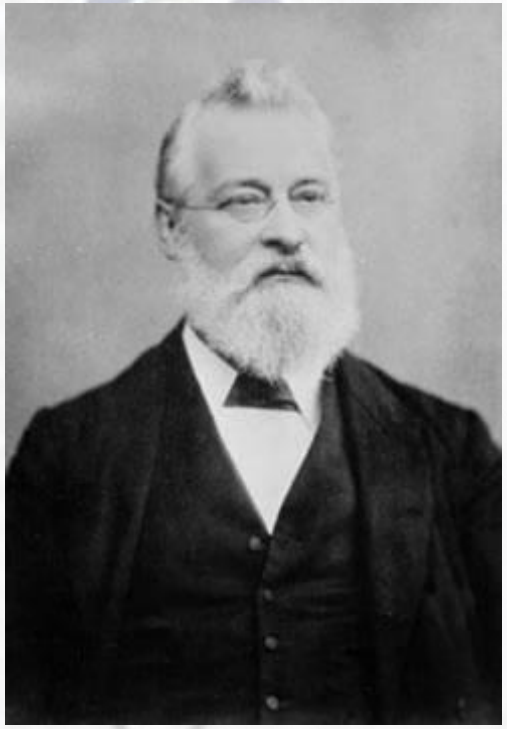
Example: The atomic weight of sodium (22.99 g/mol), is remarkably close to the average of the atomic weights of lithium (26.94 g/mol) and potassium (39.10 g/mol)

Example: The density of strontium (2.60 g/cm^3), is close to the average of the densities of calcium (1.55 g/cm^3) and barium (3.51 g/cm^3)

Limitation: Dobereiner's Triads

Not all the known elements could be arranged in the form of triads

Timeline: Periodic Table



British chemist John Newlands was the first to arrange (in 1864) the elements into a periodic table with increasing order of atomic masses

In 1865, he published his “law of octaves’ which stated that "any given element will exhibit analogous behaviour to the eighth element following it in the table."

https://en.wikipedia.org/wiki/John_Newlands_%28chemist%29

Newland's Law of octave

Sa (do)	re (re)	ga (mi)	ma (fa)	pa (so)	da (la)	ni (ti)
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co and Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce and La	Zr	-	-

When he made this table, he found a pattern among the elements. The pattern showed that each element was similar to the element eight places ahead of it

Example: Starting from Li (lithium), Be (beryllium), B (boron), Carbon, nitrogen, oxygen and Fluorine, sodium is the eighth element. He then put the similar elements into vertical columns, known as groups

He found that every eight elements had similar properties. He called this pattern as law of octaves

https://protonstalk.com/periodic-table/newlands-law-of-octaves/

Limitation: Newland's Law of Octave

1. While the groups should contain the elements of same properties, but there were some dissimilar elements in the same group. example, metals like platinum, cobalt and nickel, were in the same group as halogens like chlorine and bromine

Sa (do)	re (re)	ga (mi)	ma (fa)	pa (so)	da (la)	ni (ti)
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co and Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce and La	Zr	-	-

2. In some places, two elements shared the same place. For example, cobalt and nickel, or barium and vanadium. There was no clear explanation for this

https://www.geeksforgeeks.org/newlands-law-of-octaves/

Limitation: Newland's Law of Octave

Sa (do)	re (re)	ga (mi)	ma (fa)	pa (so)	da (la)	ni (ti)
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co and Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce and La	Zr	-	-

The law strictly worked well only up to Calcium, for heavier elements the relationship began to break down

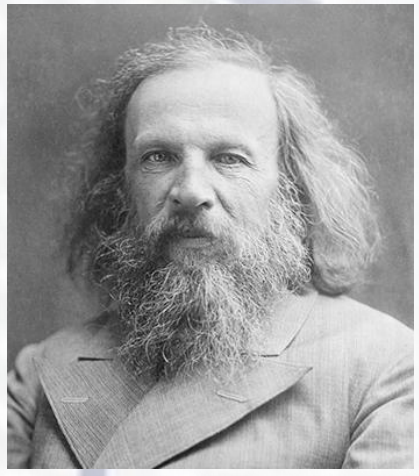
No spaces left for future elements that were discovered

This is one of the reason Newlands periodic table was not approved by Scientific community

Newlands' Periodic Table (corrosion-doctors.org)

Timeline: Periodic Table

Mendeleev's Periodic Table



In 1869, just five years after John Newlands' Law of Octaves, Russian chemist Dmitri Mendeleev created the framework of the periodic table which was later accepted by scientific communities across the world

Mendeleev also arranged the elements in order of relative atomic mass, but he left gaps his table for undiscovered elements and also predicted their properties which made his periodic table successful

Timeline: Periodic Table

Lothar Meyer

German chemist Lothar Meyer also produced a version of the periodic table similar to Mendeleev's in 1870

He left gaps for undiscovered elements like Dmitri Mendeleev but never predicted their properties. Somehow his periodic table was not accepted by the scientific communities

In 1882, both Meyer and Mendeleev received the Davy Medal from the Royal Society in recognition of their work on the Periodic law

The Davy Medal is awarded by the Royal society, London "for an outstandingly important recent discovery in any branch of chemistry“

It is Named after Humphry Davy

The medal is awarded with a monetary gift, initially of £1000 (currently £2000)

Receiving the Davy Medal has been identified as a potential precursor to being awarded the Nobel Prize in Chemistry

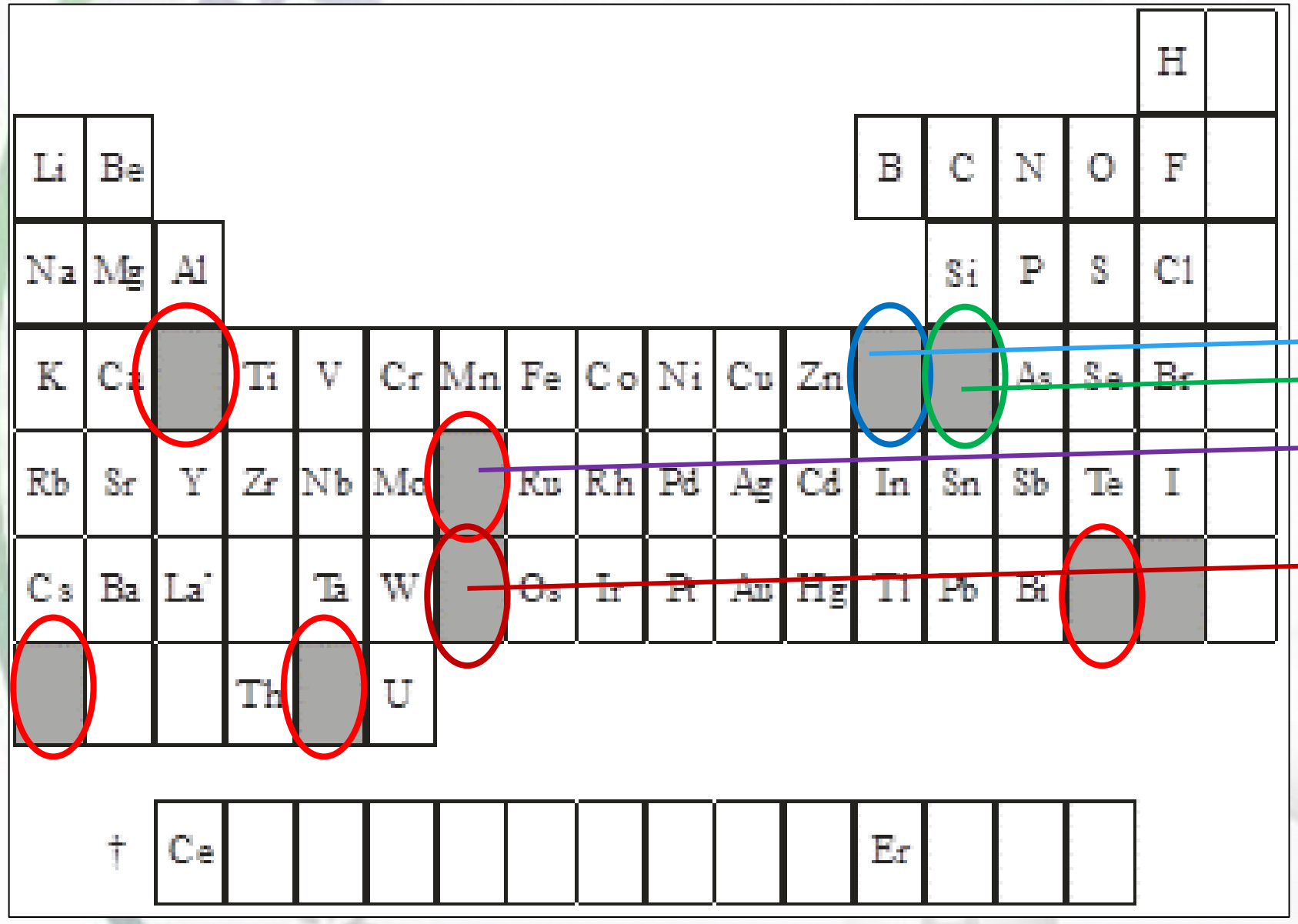
Why Was Mendeleev's Periodic Table Successful?

He not only showed how the elements could be organized, but he used his periodic table to propose that

1. Some of the elements, whose behavior did not agree with his predictions, must have had their atomic weights measured incorrectly

2. He predicted the existence of eight new elements and the properties of these elements would have

Mendeleev's Periodic Table



Mendeleev keep these places blank, because elements were not discovered at that time

Eka-boron

Eka-silicon

Eka-Manganese

Dvi-Manganese

In 1875, eka-aluminum was discovered in Paris, France, where it was re-named gallium (Ga), in honor of France's Gallic heritage

The new element Gallium was discovered hiding in a sample of zinc ore

Gallium's atomic mass and bonding characteristics perfectly matched Mendeleev's predictions for eka-aluminum

In 1886 eka-silicon was discovered in Germany and promptly named germanium (Ge)

All these discoveries reinforced Mendeleev's prediction

Mendeleev not only predicted the existence of these elements, he also described their properties

This facilitated the work of chemists greatly because they knew for what they were looking for.

All these elements were discovered within 10 years of Mendeleev's prediction

Mendeleev is called the father of the Periodic Table

Modern Periodic Table

Moseley's Periodic Table

Henry Moseley's Periodic Table

Mendeleev's periodic table was based on atomic mass. The concept of sub-atomic particles did not exist in the 19th century. Therefore, this periodic table also had limitation which was modified by English physicist Henry Moseley

Henry Moseley used X-rays to measure the wavelengths of elements and correlated these measurements to the atomic numbers of elements

He then rearranged the elements in the periodic table on the basis of atomic numbers. This helped explain disparities in Mendeleev's periodic table

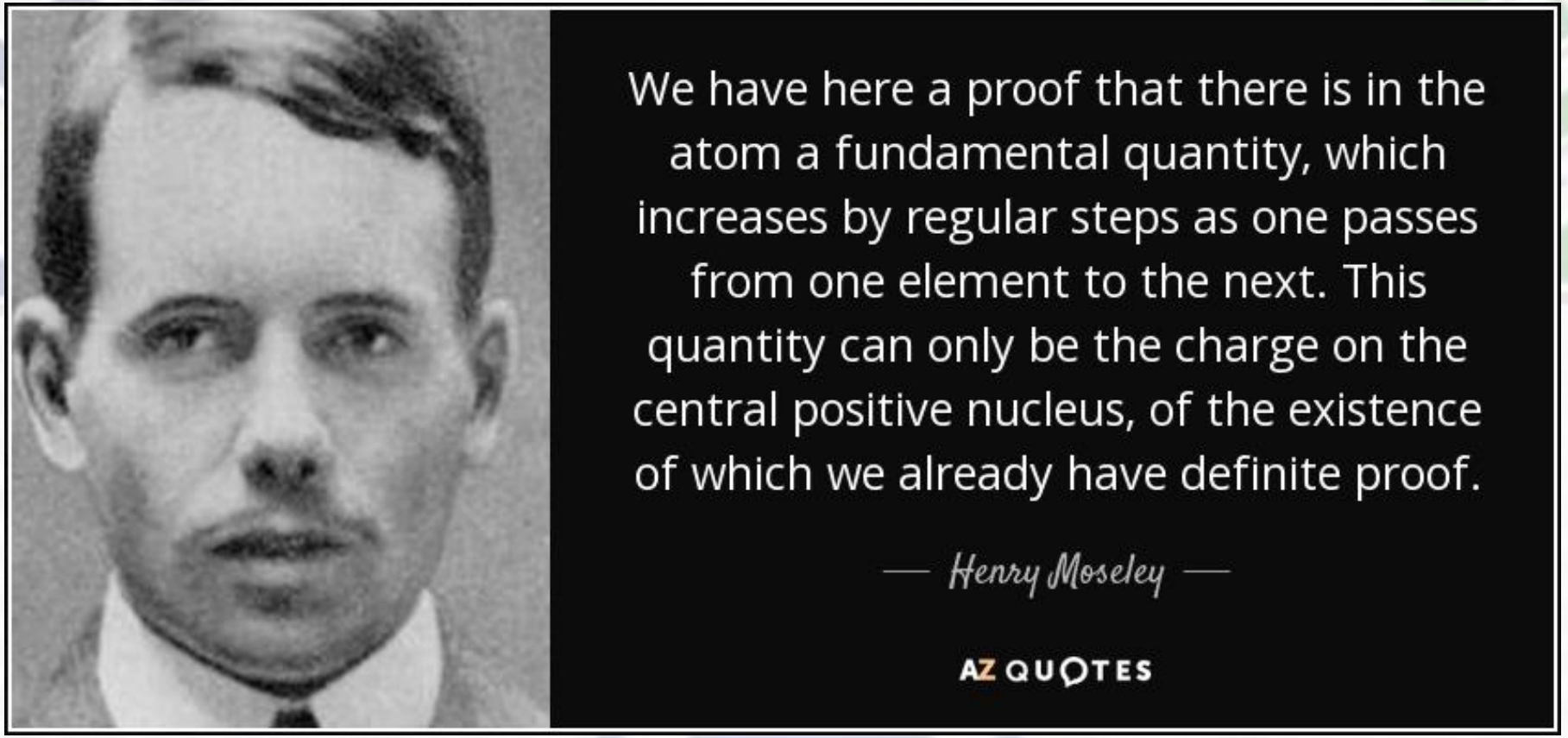
Henry Moseley' periodic table is the modern periodic table

Henry Mosely and Modern Periodic Table

After the 50 years of Mendeleev's periodic table discovery, in 1913, Henry Mosley discovered the concept of "*Atomic Number*" which was known as Mosely's Law

Later Ernest Rutherford at Cambridge identified this quantity as the atomic number

Atomic Number = Number of protons in nucleus



Henry Moseley (an English physicist in 1913) made the adjustments to the periodic law, and improved all the flaws of the Mendeleev table by the concept of Atomic Number

Advantages of Modern Periodic Table

In modern periodic table elements are arranged according to their Atomic Number rather than their Atomic mass

Atomic Number: Number of protons

Mass Number: Number of protons + Number of neutrons

Atomic Number is the unique for every elements. That means every elements on the planet has its unique **atomic number**

By doing so Mosely improved upon the previous table and removed some of its difficulties and anomalies

Modern Periodic Table

Advantages

1. Position of Hydrogen

Mendeleev could never figure out the correct position of hydrogen in his table

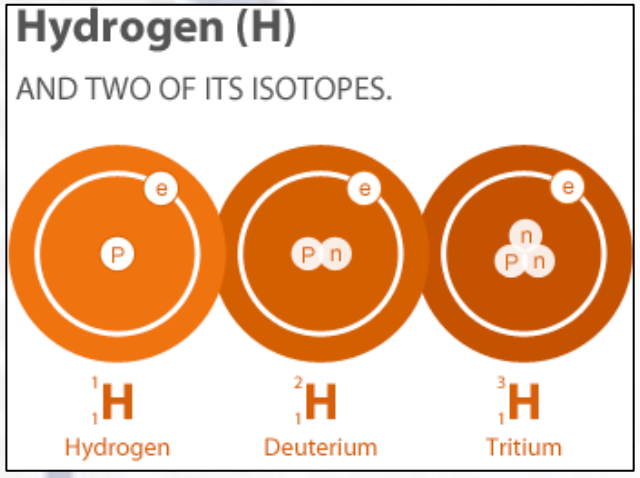
Because hydrogen can either gain or lose an electron, so it can find a place in Group 1 (alkali metal) or 17 (halogens)

Behavior like Gr-1: One electron in outer orbital

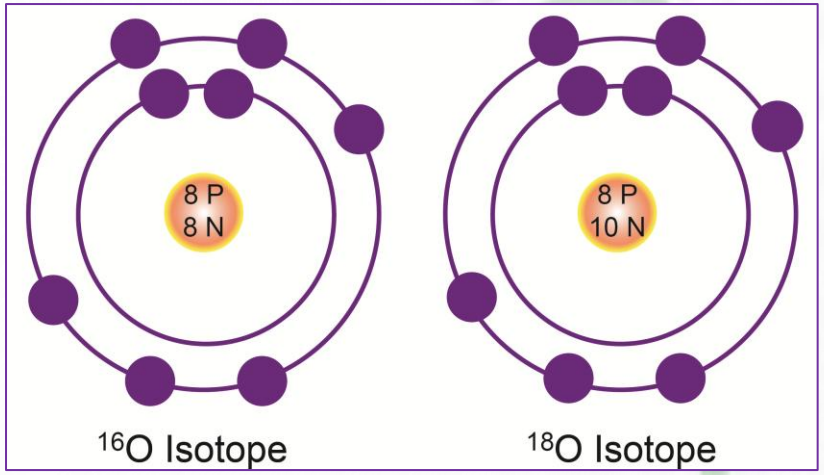
Behavior like Gr-17: It can combine with metal and non-metals forming covalent bonds like halogens. Example NaH (NaCl), KH (KCl), H_2O (Cl_2O), H_2S

But in the modern periodic table, there is no dilemma. Since the atomic Number of hydrogen is 1 that is where it finds its appropriate place *at the start of the table*

2. Position of Isotopes



When an element's atoms have different numbers of neutrons they are said to be isotopes of that element



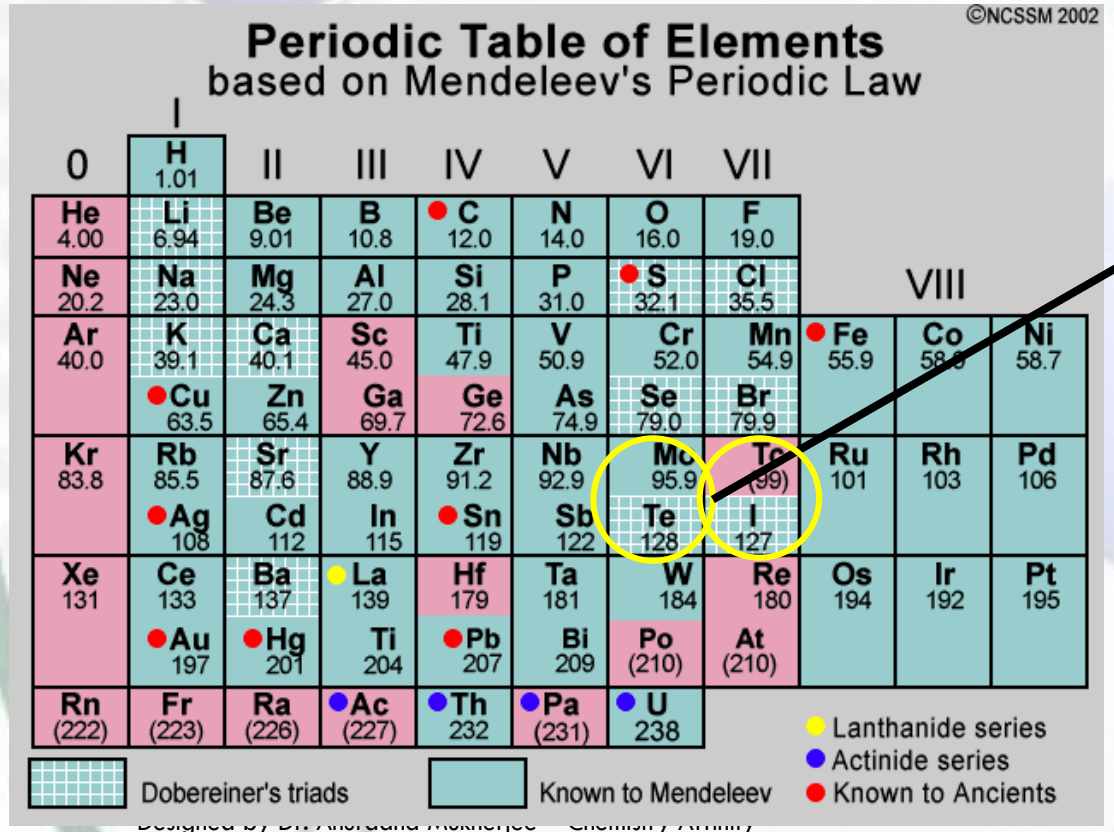
Their atomic mass varies but their atomic number is the same

Therefore, there was a problem for Mendeleev, since the table depended on atomic mass, but it is not an issue with the Modern Periodic table

All isotopes of same element places at same place

3. Order of few elements

Mendeleev arranged the elements in same group with similar properties. In certain cases he faced the problems, because he arranged according to atomic mass

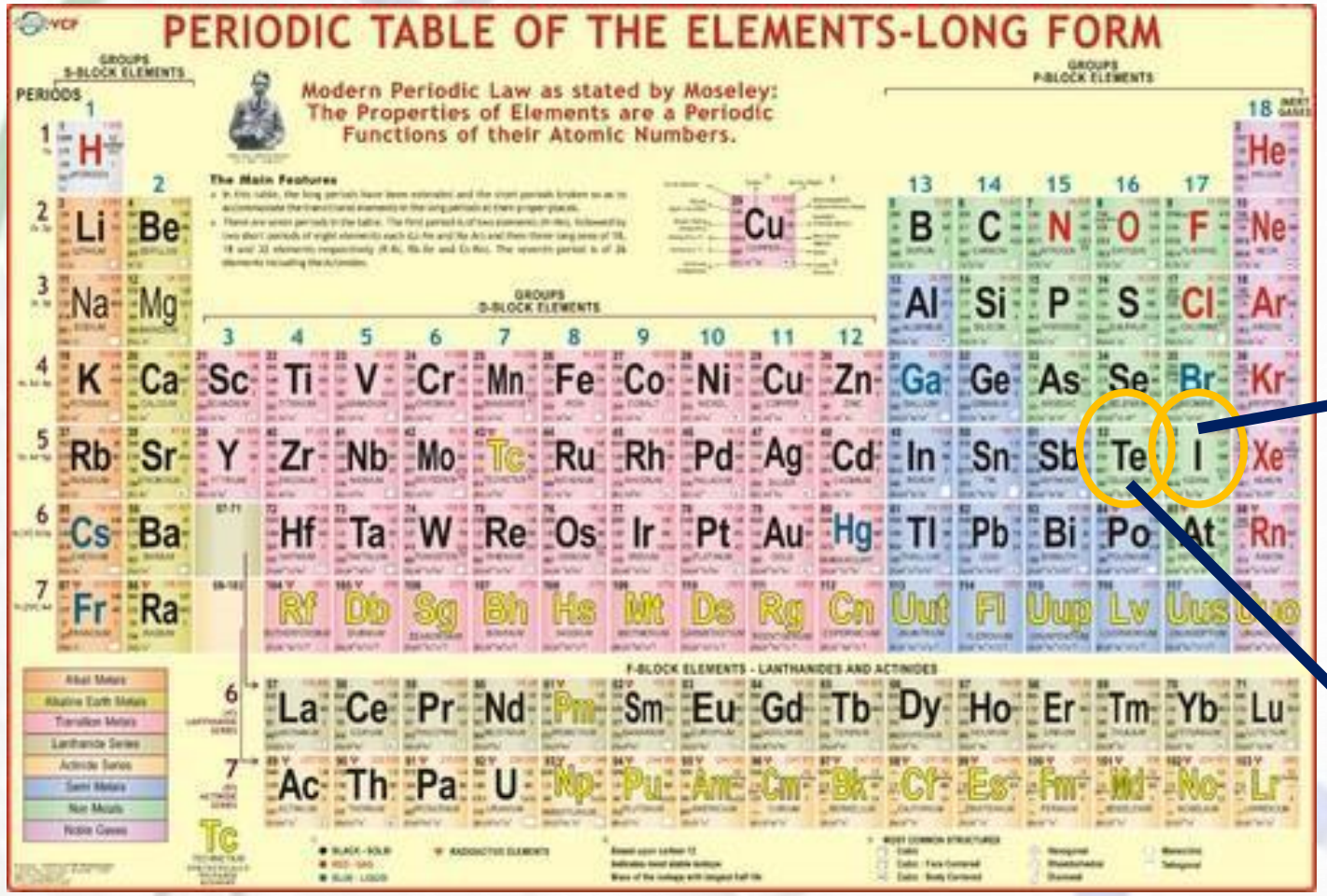


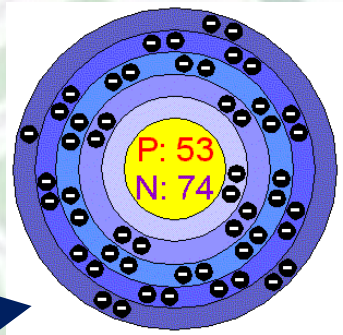
Example

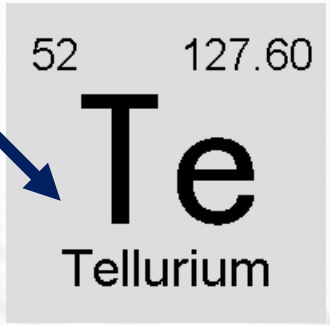
Iodine's atomic mass (127) is lower than tellurium (128). **Yet Mendeleev put it after tellurium so it could be in the same group as fluorine and chlorine**

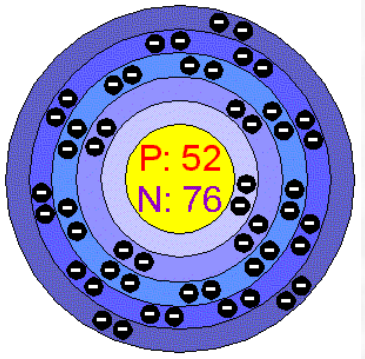
In the modern periodic table, the atomic mass becomes irrelevant and elements are grouped with similar elements based on their atomic number

3/5/2024







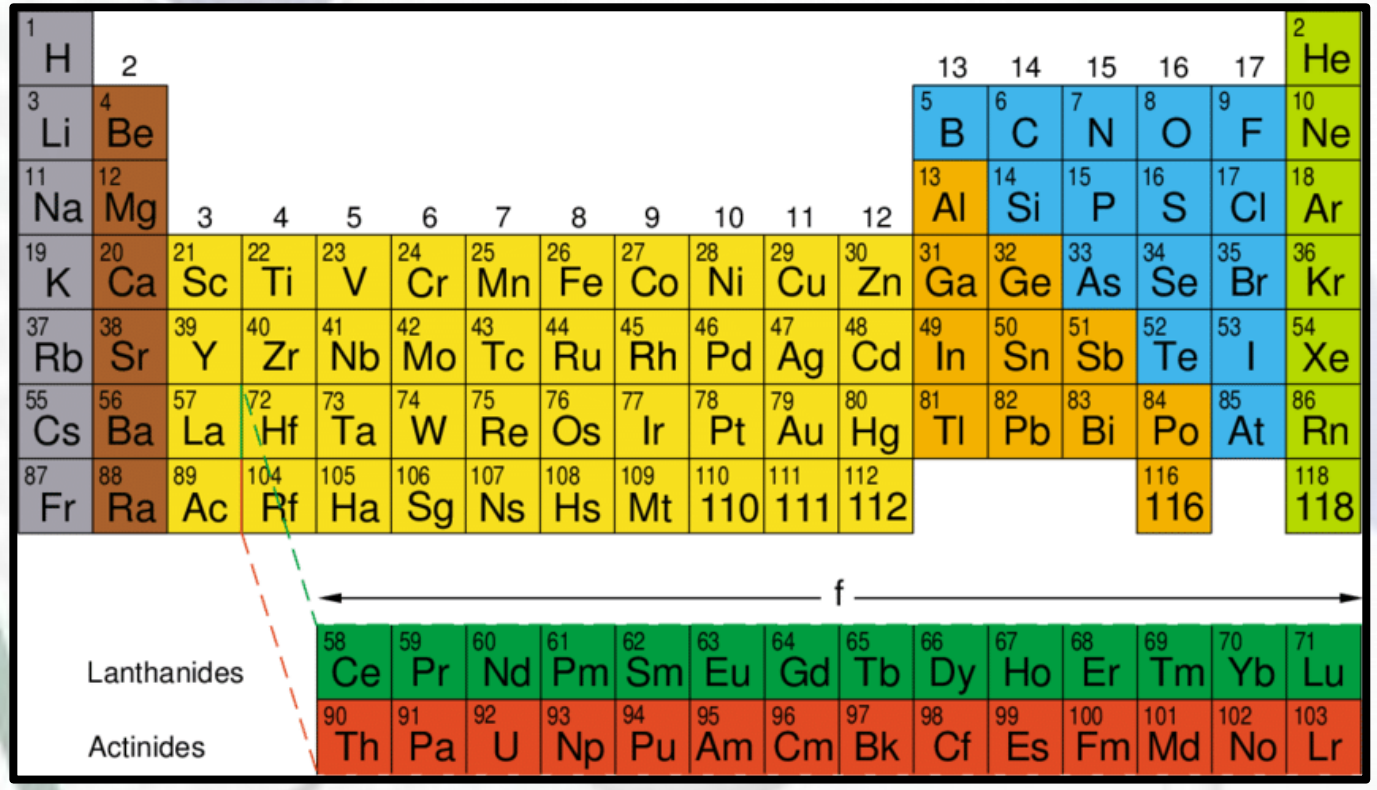


In the modern periodic table, the atomic mass becomes irrelevant and elements are grouped with similar elements based on their atomic number

4. Position of Rare Earth Elements

The modern periodic table solved another problem by placing the rare earth elements such as Cerium, Lanthanum, Erbium etc. in a separate table at the bottom of the Periodic table

Modern Periodic Table: Arrangement of Elements



The periodic table has 7 horizontal periods and 18 vertical columns

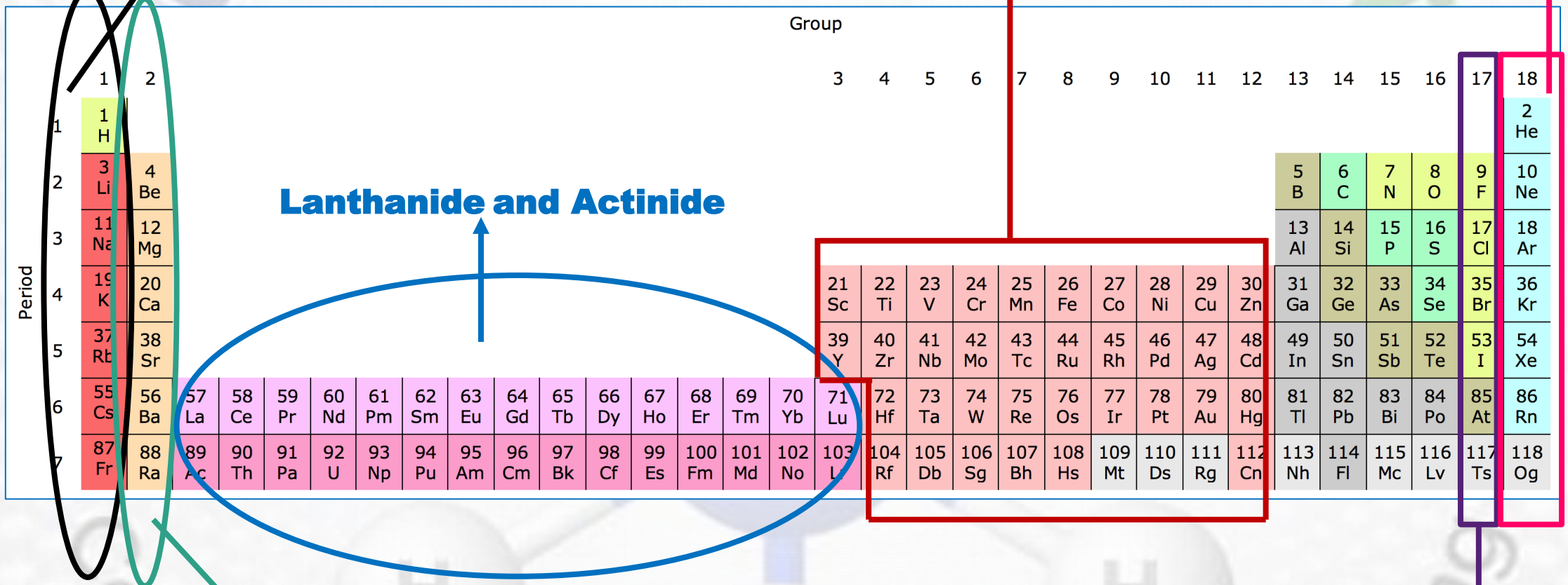
The periodic table arranges elements in periods in *increasing order of their atomic numbers*

Each period begins with an element having one electron in its outermost shell and ends with a completely filled outermost shell

Alkali metals.
Except Hydrogen

transition metals

Noble gas



Lanthanide and Actinide

Alkaline earth metal

Halogens

Elements

And

Every day Life

Alkali Metals: Gr-1

Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs), Francium (Fr)

Alkaline earth Metals: Gr 2

Beryllium (Be), Magnesium (Mg), calcium (ca), Strontium (Sr), Barium (Ba) Radium (Ra)

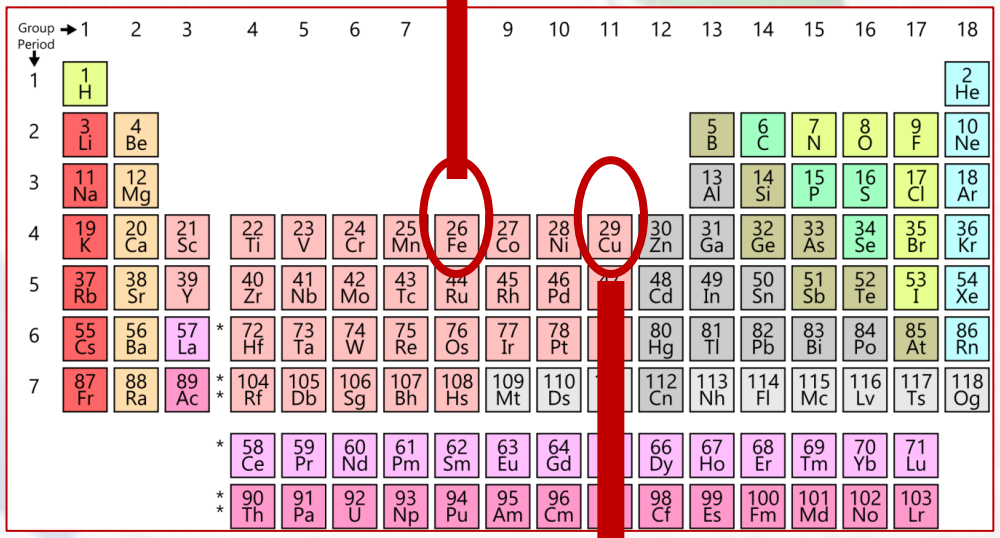
Alkaline earth metals are famous for being ingredients in fireworks. The ionic forms of strontium and barium make appearances in firework displays as the brilliant purples, reds and greens

Transition Metals: Gr 3 to Gr-12

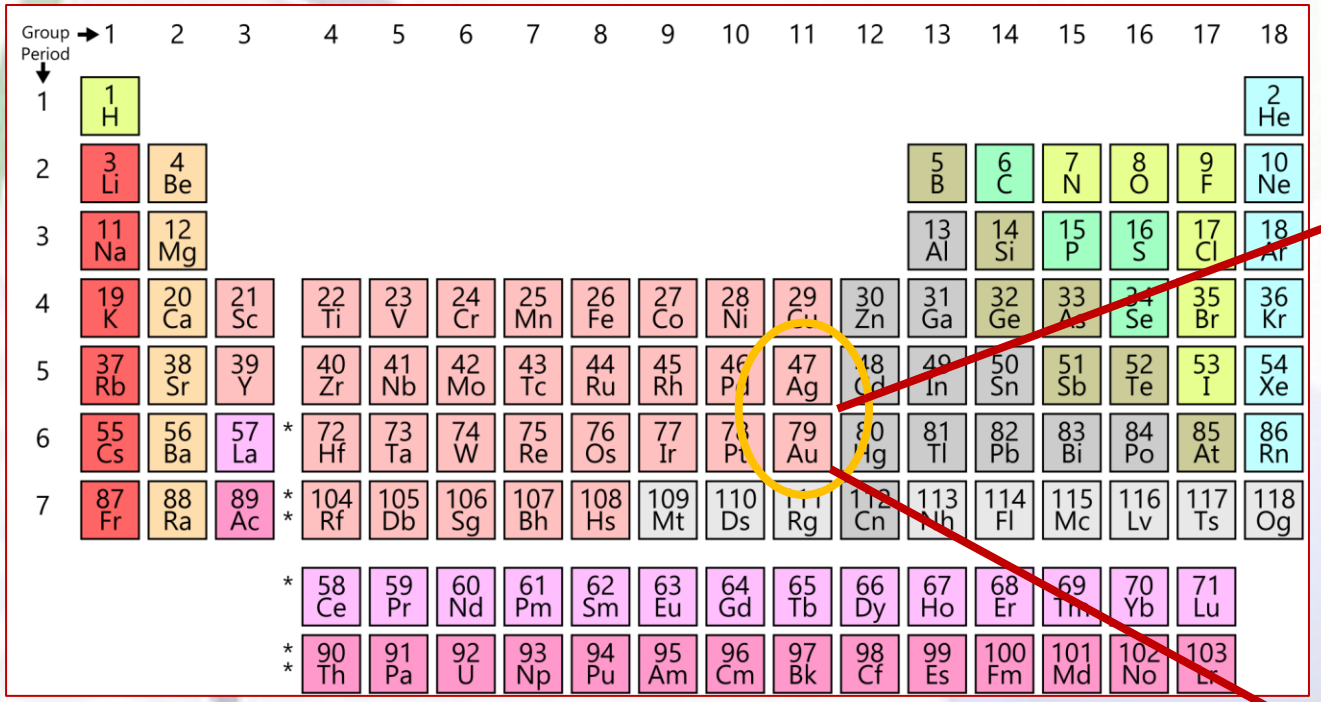
Period- 4: Scandium (Sc), Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn) Iron (Fe), cobalt (Co), Nickel (Ni), Copper (Cu), zinc (Zn)

Period- 5: Yttrium (Y), Zirconium (Zr), Niobium (Nb), Molybdenum (Mo), Technicism (Tc), Ruthenium (Ru), Rhodium (Rh), Palladium (Pd), Silver (Ag), cadmium (Zn)

Made by Iron, transition metal



Made by Copper, a transition


Group
Period
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
1 H He
2 Li Be B C N O F Ne
3 Na Mg Al Si P S Cl Ar
4 K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
5 Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Cd In Sn Sb Te I Xe
6 Cs Ba La Hf Ta W Re Os Ir Pt Au Hg Tl Pb Bi Po At Rn
7 Fr Ra Ac Rf Db Sg Bh Hs Mt Ds Rg Cn Nh Fl Mc Lv Ts Og
Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr

Transition Metals

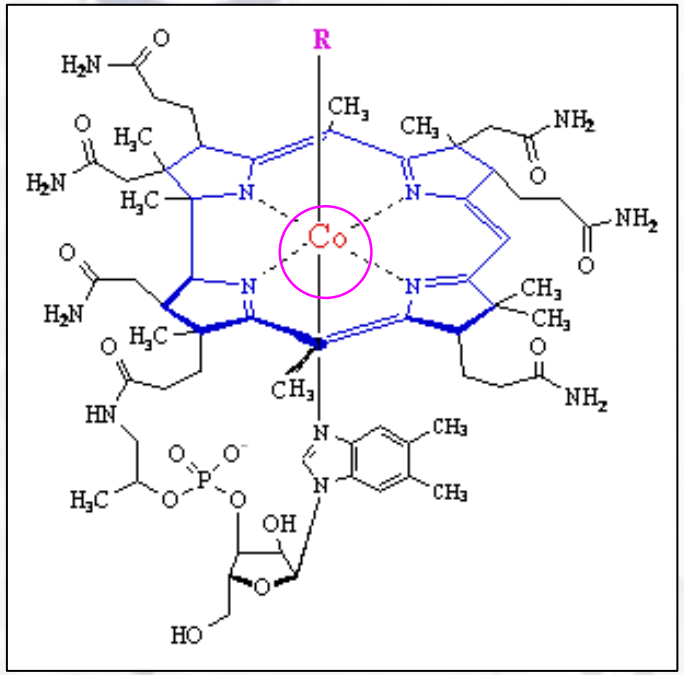
The color of many gemstones is due to the presence of transition metal ions

Rubies are red due to Cr

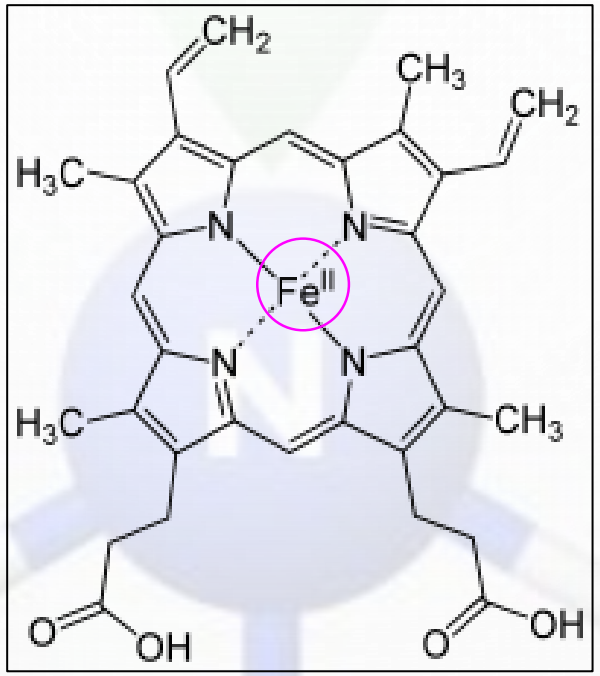
Sapphires are blue due to presence of Fe and Ti

Transition Metals

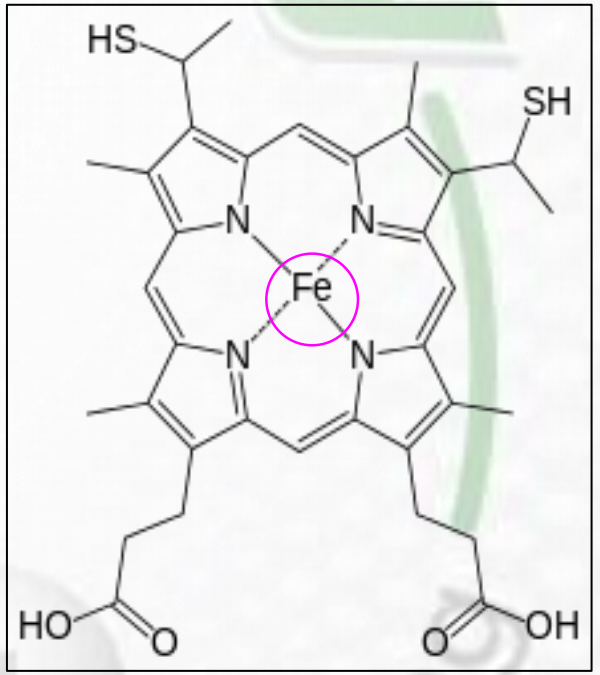
Many biomolecules contain transition metals that are involved in the functions of these biomolecules



Vitamin B12

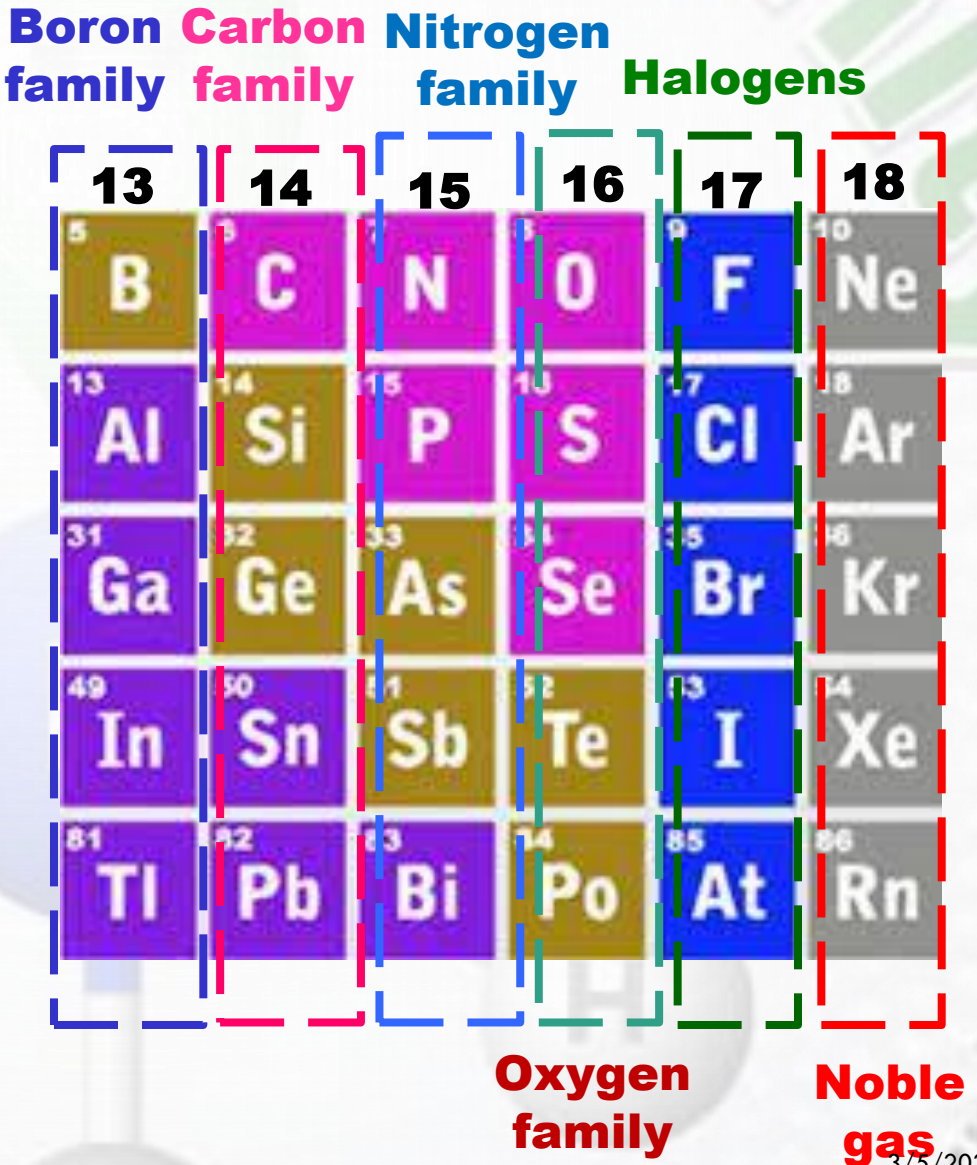


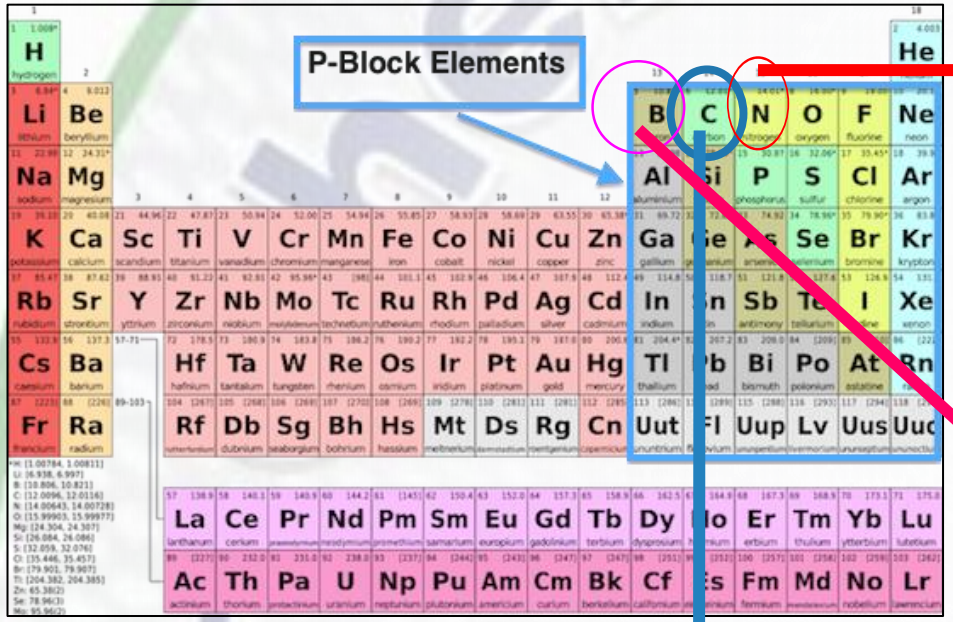
Hemoglobin



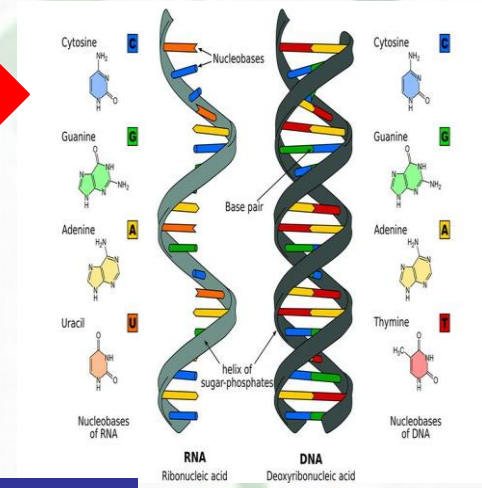
Cytochrome C

Post Transition Elements: Gr 13 to Gr-18





Nitrogen is present as one of the building blocks of amino acids, proteins, nucleic acids, chlorophyll, and other biomolecules

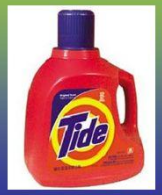


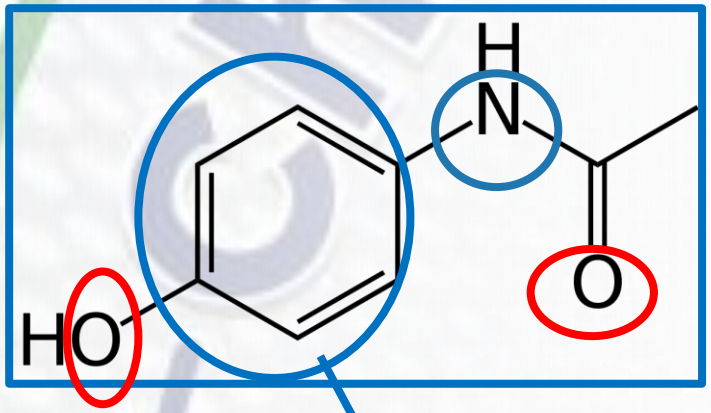
Carbon occurs extensively in all living organisms as proteins, fats, carbohydrates (sugars and starches), and nucleic acids

Carbon is such an important element that an entirely separate field of chemistry is devoted to this element and its compounds. **Organic chemistry** is the study of carbon compounds.

Common Applications

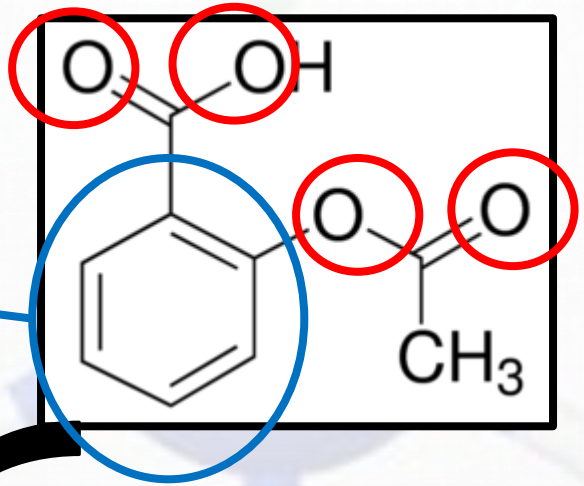
- Boron
  - Boron is an essential plant micronutrient, playing a key role in plant fertilization; also in the building of cell wall structures
  - Boric Acid also traditionally used as an insecticide
  - Borax is sometimes found in laundry detergent





p-Hydroxy acetanilide

Aromatic ring: Carbon and hydrogen elements are present



Acetyl salicylic acid

Periodic Table

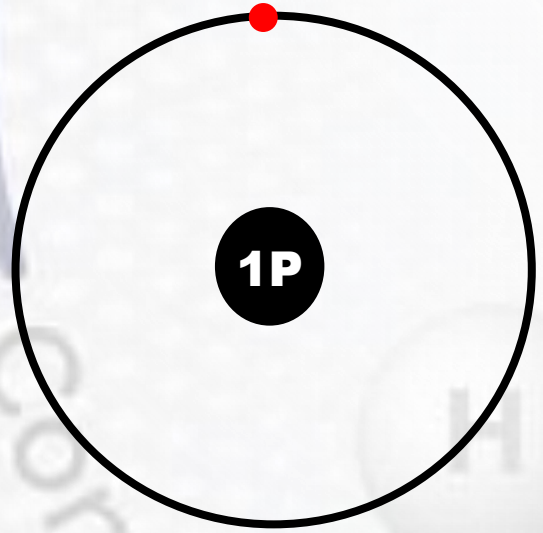
And

Electronic Configuration

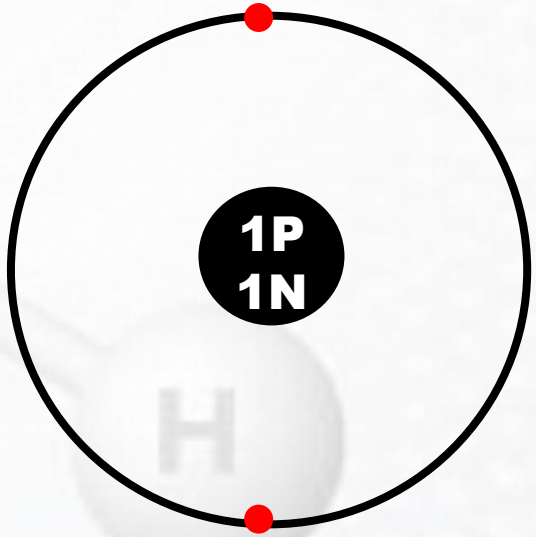
Period-1

There are two elements in period -1: Hydrogen (H) and Helium (He)

Hydrogen (H): Gr-1; Helium (He): Gr-18



Hydrogen (H) $_{1}^{1}H$



Helium (He) $_{2}^{4}He$

Period-2

There are eight elements in period -2

Lithium (Li), Beryllium (Be), Boron (B), Carbon (C), Nitrogen (N), Oxygen (O), Fluorine (F), Neon (Ne)

Gr-1	Gr 2	Gr 13	Gr 14	Gr 15	Gr 16	Gr 17	Gr-18
Li	Be	B	C	N	O	F	Ne

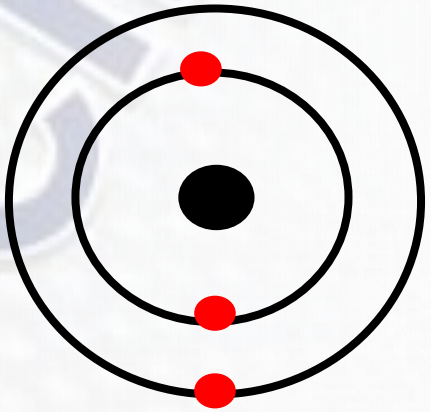
Period-3

There are eight elements in period -3

Sodium (Na), Magnesium (Mg), Aluminum (Al), Silicon (Si), Phosphorous (P), Sulphur (S), Chlorine (Cl), Argon (Ar)

Gr-1	Gr 2	Gr 13	Gr 14	Gr 15	Gr 16	Gr 17	Gr-18
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar

	Gr-1	Gr-2	Gr-13	Gr-14	Gr-15	Gr-16	Gr-17	Gr-18
Period-1								He
Period-2	Li	Be	B	C	N	O	F	Ne
Period-3	Na	Mg	Al	Si	P	S	Cl	Ar
Period-4	K	Ca	Ga	Ge	As	Se	Br	Kr
Period-5	Rb	Sr	In	Sn	Sb	Te	I	Xe
Period-6	Cs	Ba	Tl	Pb	Bi	Po	At	Rn
Period-7	Fr	Ra						Og
	Alkali metals	Alkaline earth metals					halogens	Noble gas

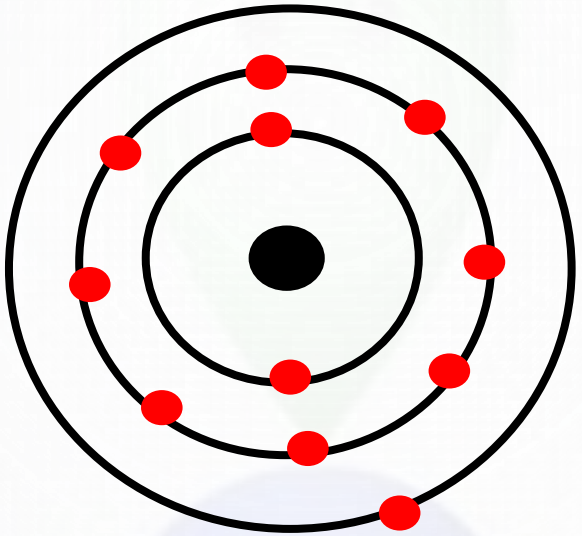


Li $^{7}Li_{3}$

Number of protons: 3

Number of electrons: 3

Number of neutrons: 4

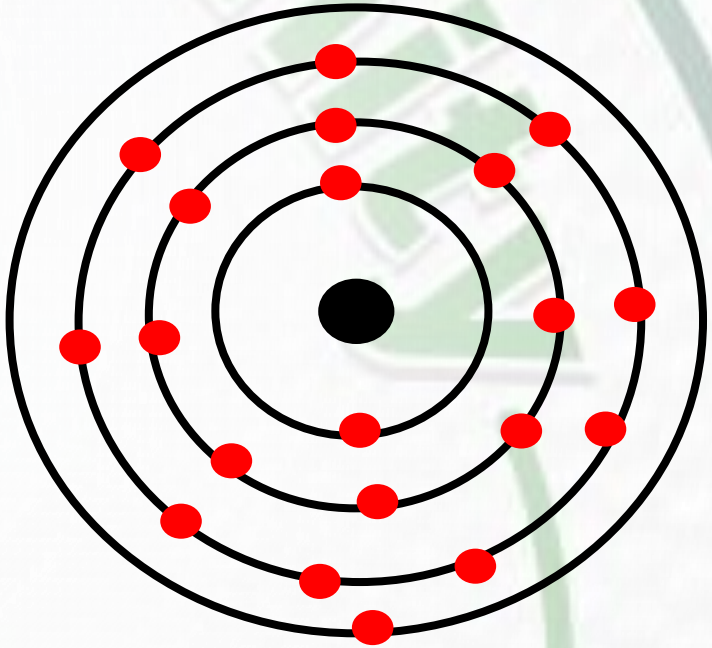


Na $^{23}Na_{11}$

Number of protons: 11

Number of electrons: 11

Number of neutrons: 12



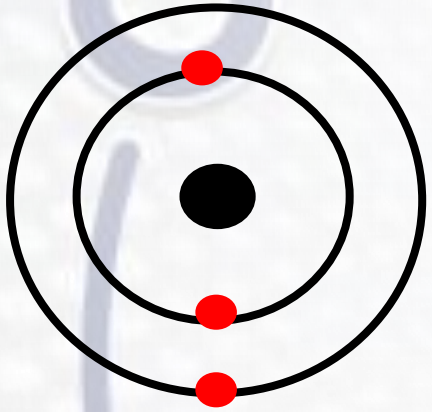
K $^{39}K_{19}$

Number of protons: 19

Number of electrons: 19

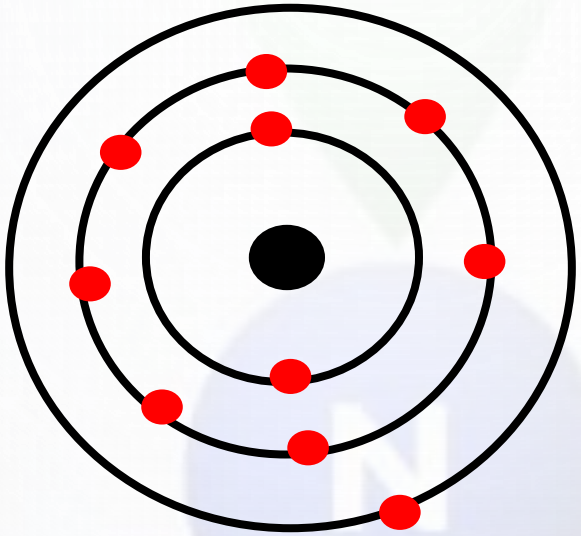
Number of neutrons: 20

Alkali Metals: Valence Shell and Valence Electron



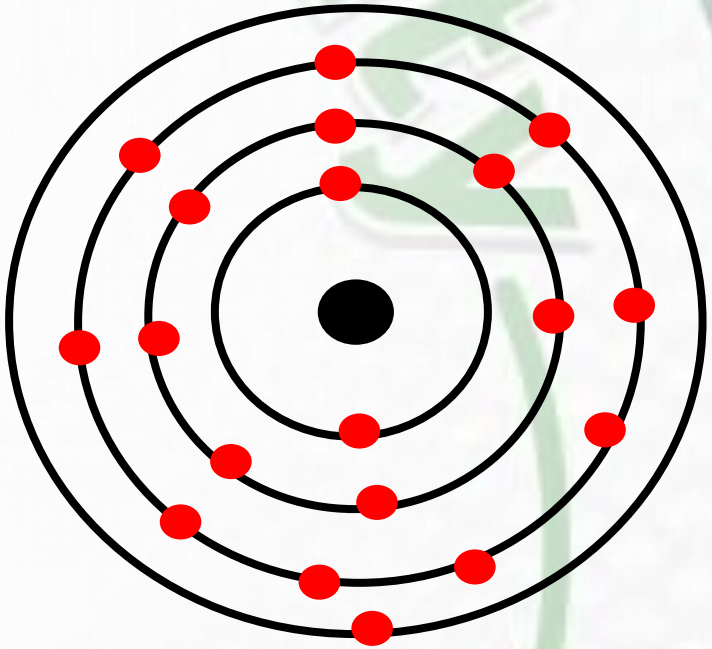
Li

Valence shell: K



Na

Valence shell: L

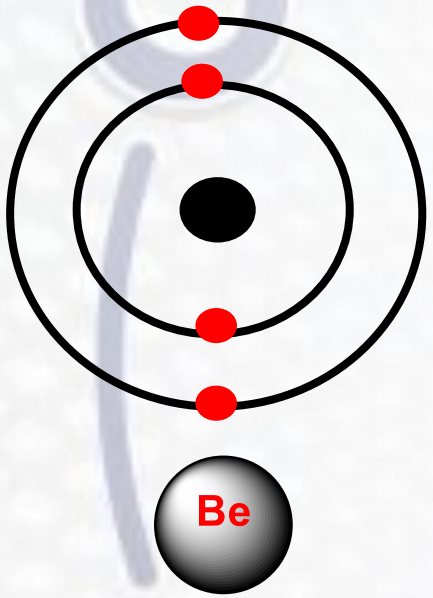


K

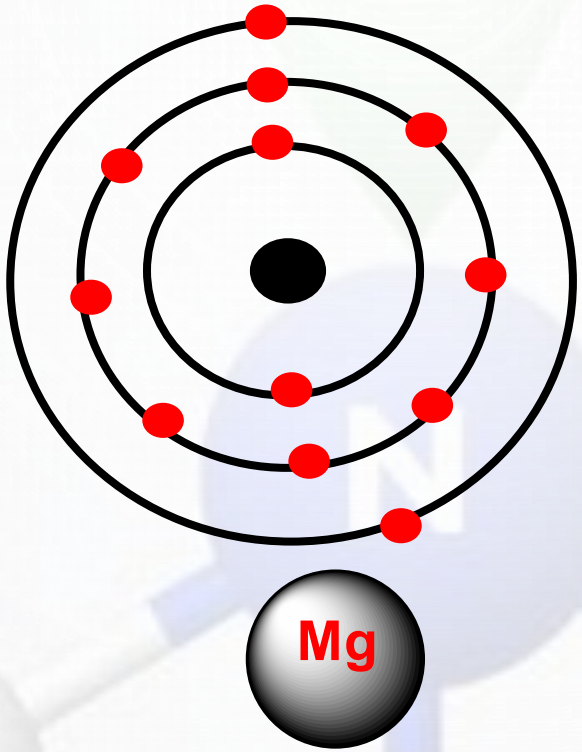
Valence shell: M

Alkaline Earth Metals

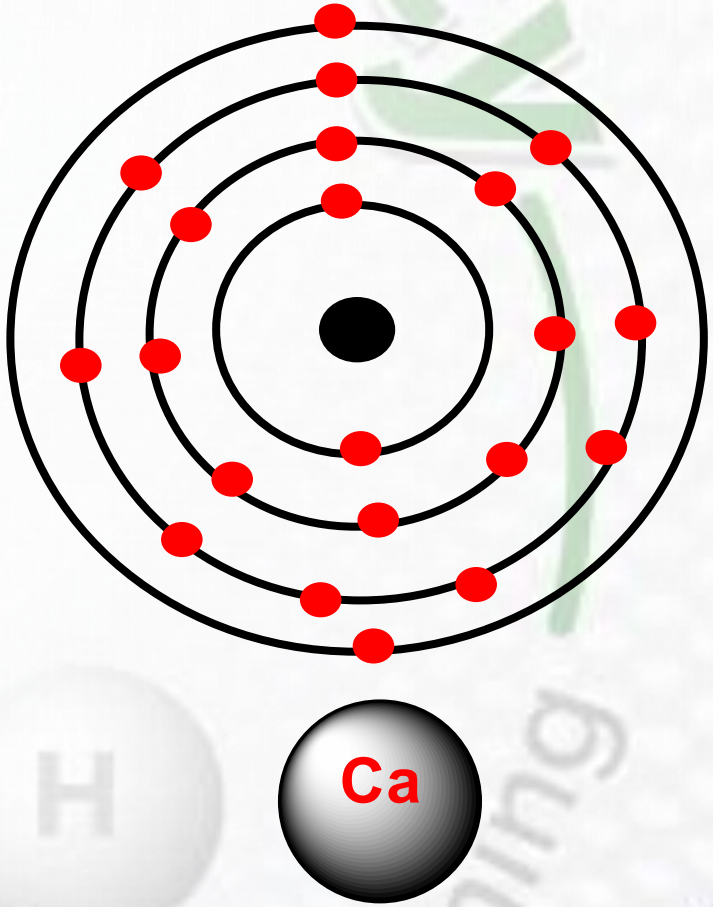
Alkaline earth metals are Gr-2 elements



Valence shell: K
Valence electron: 2



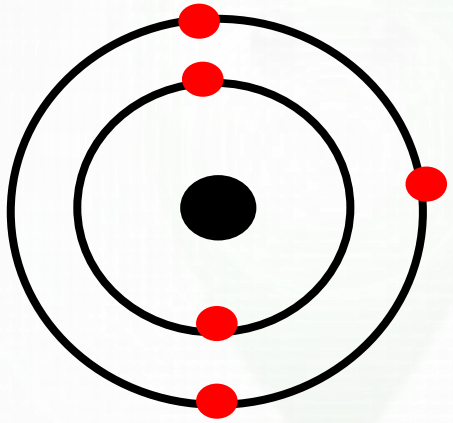
Valence shell: L
Valence electron: 2



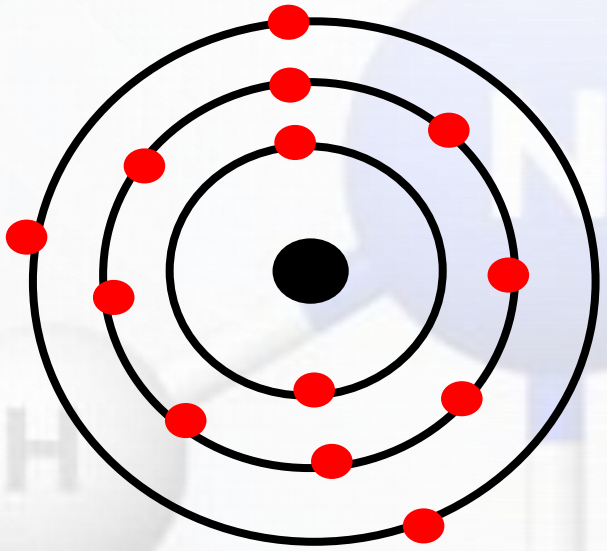
Valence shell: M
Valence electron: 2

Boron family

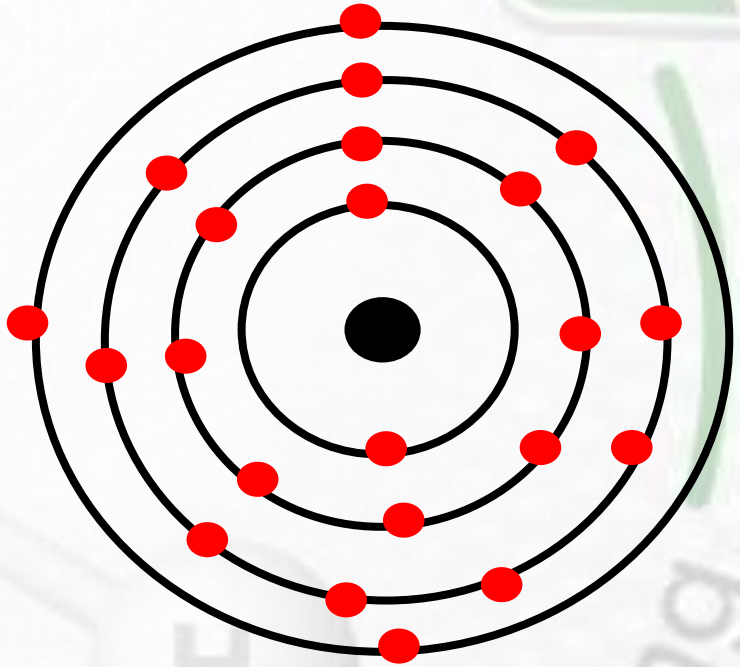
	Gr-13
Period 2	B
Period 3	Al
Period 4	Ga
Period 5	In
Period 6	Tl
Period 7	Nh



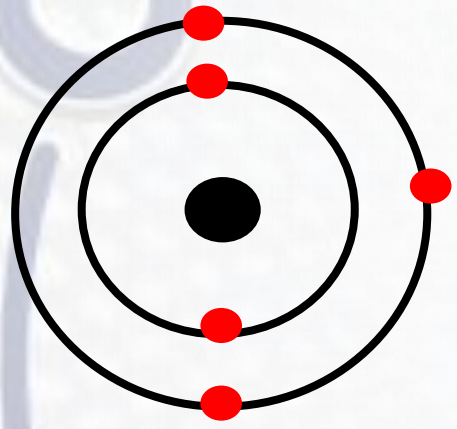
$_{5}B^{11}$



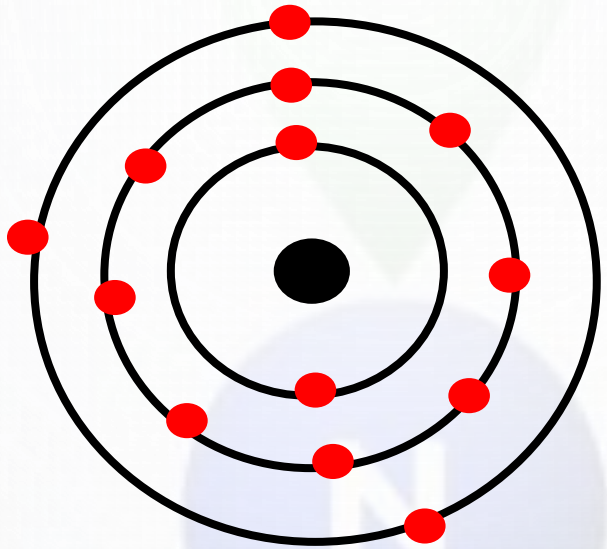
$_{13}Al^{27}$



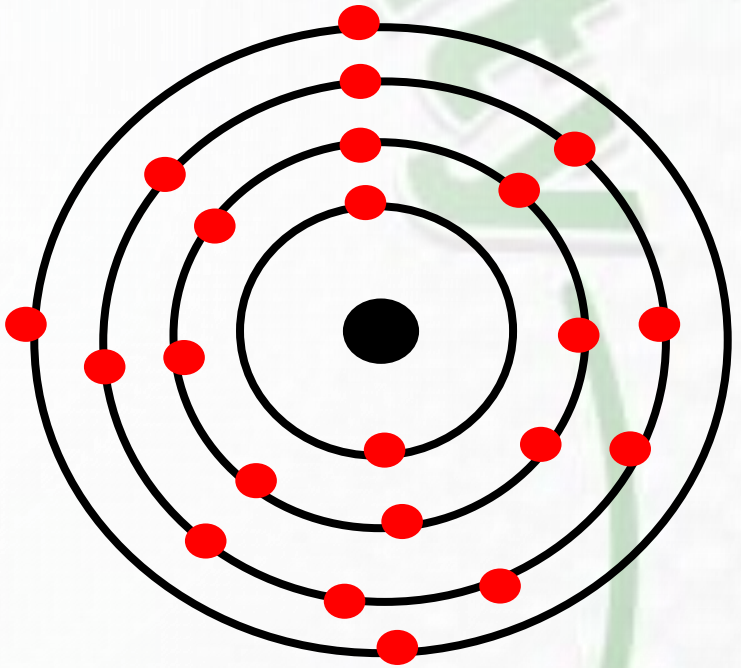
$_{31}Ga^{70}$



$_{5}B^{11}$



$_{13}Al^{27}$



$_{31}Ga^{70}$

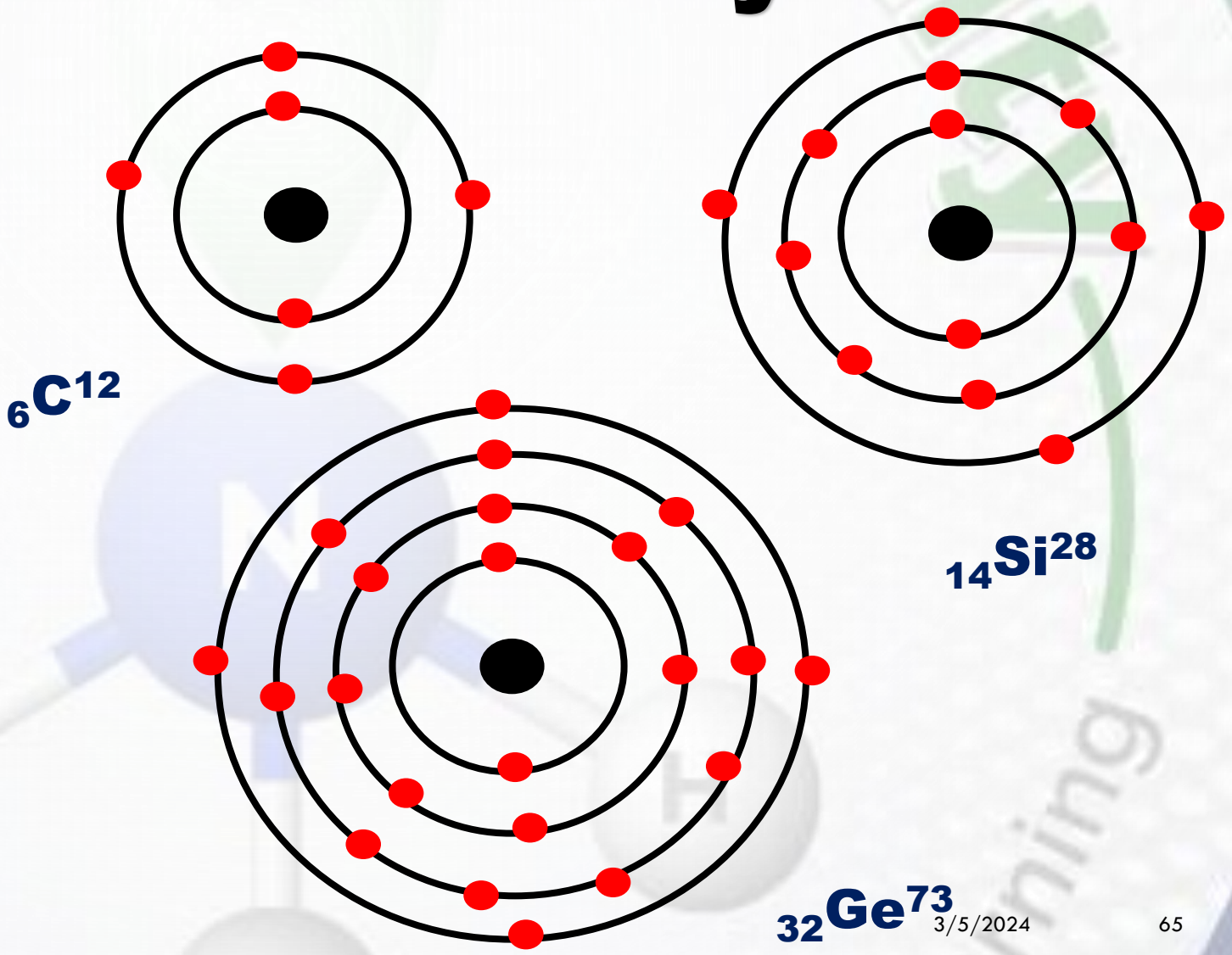
Valence orbital: K ,
Valence electrons: 3

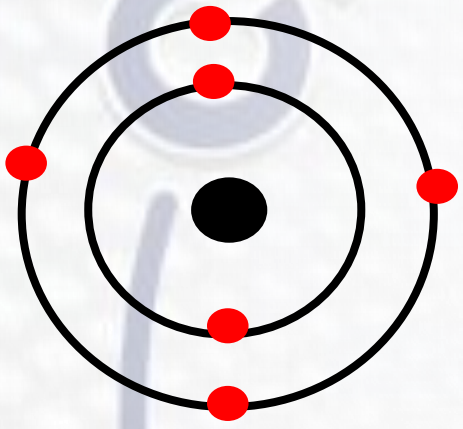
Valence orbital: L ,
Valence electrons: 3

Valence orbital: M ,
Valence electrons: 3

Carbon family

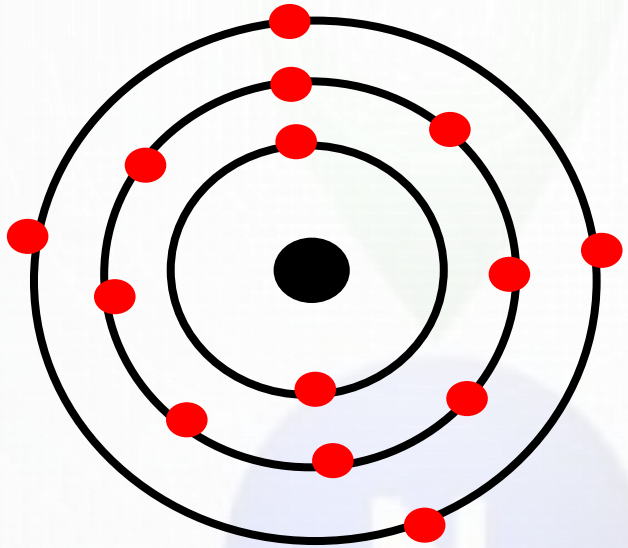
	Gr-14
Period 2	C
Period 3	Si
Period 4	Ge
Period 5	Sn
Period 6	Pb
Period 7	Fl





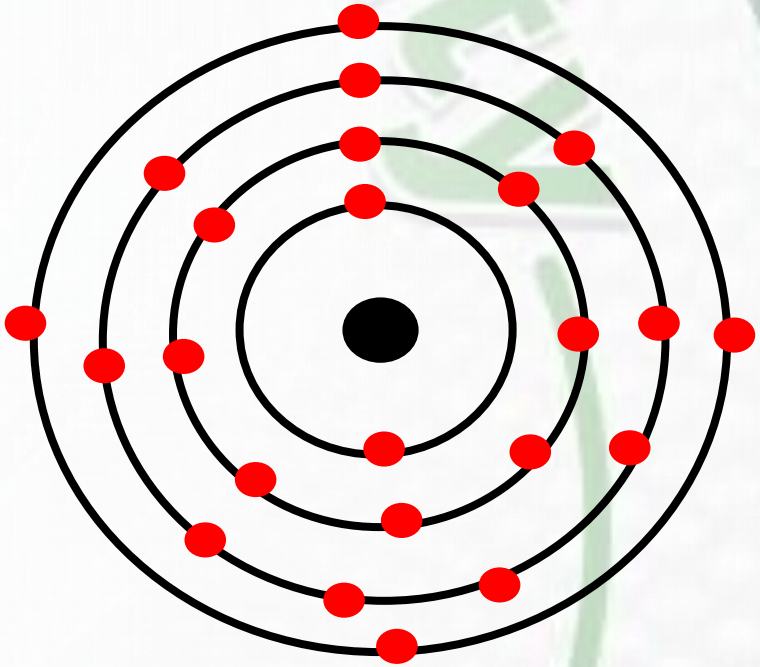
$_{6}C^{12}$

Valence orbital: K ,
Valence electrons: 4



$_{14}Si^{28}$

Valence orbital: L ,
Valence electrons: 4



$_{32}Ge^{73}$

Valence orbital: M ,
Valence electrons: 4

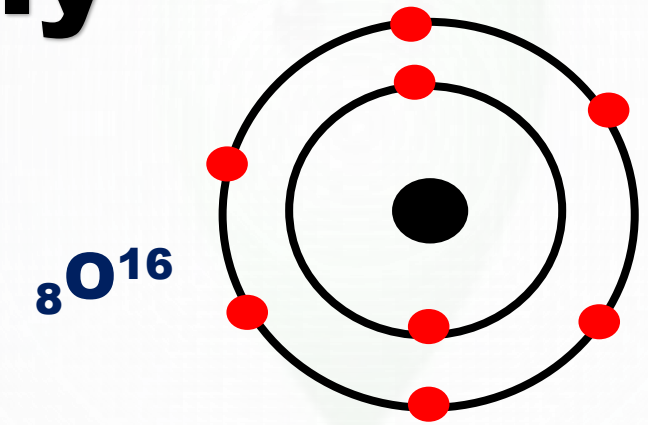
Nitrogen family

Do by yourself

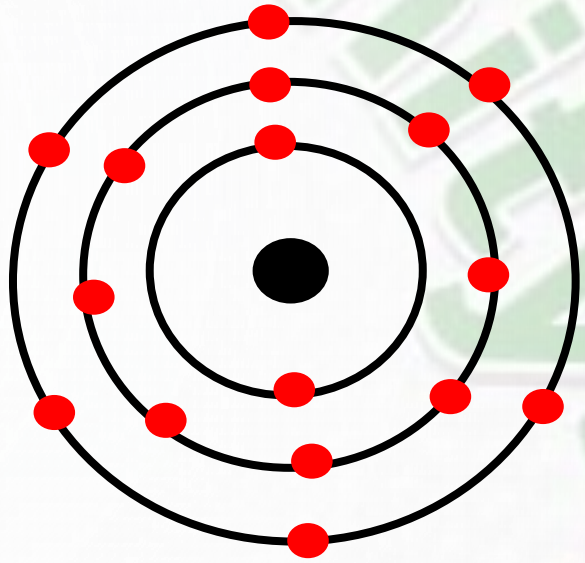
	Gr-15
Period 2	N
Period 3	P
Period 4	As
Period 5	Sb
Period 6	Bi
Period 7	Mc

Oxygen family

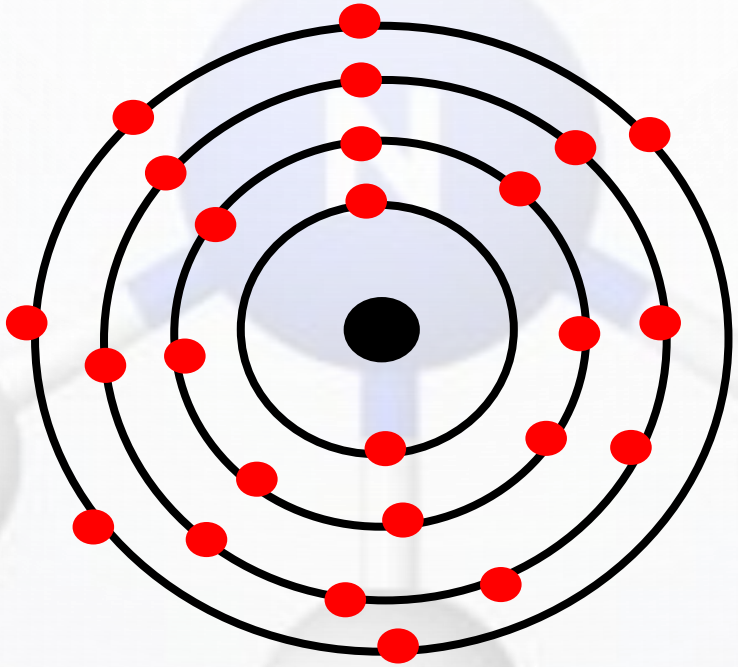
	Gr-16
Period 2	O
Period 3	S
Period 4	Se
Period 5	Te
Period 6	Po
Period 7	Lv



$_{8}O^{16}$



$_{16}S^{32}$



$_{34}Se^{34}$

Curious *Facts* Periodic table

1. Do you know out of 118 elements how many elements are naturally occurring?

98 elements occur naturally. Out of these 80 are stable and 18 are radioactive

2. Most dense element

Osmium is the most dense element

3. Least dense element

Hydrogen is the Least dense element

4. Most Expensive Metal in the Earth

Lutetium (lanthanide) is a metal and the most expensive chemical element available

Alkali metal Francium (Fr) is considered to be the most rare naturally occurring elements in the Earth. It has very unstable nucleus, undergoes nuclear decay rapidly. So to prepare a small amount will cost a few billion

Curious Facts of Periodic Table

5. Man-made Nobel gas

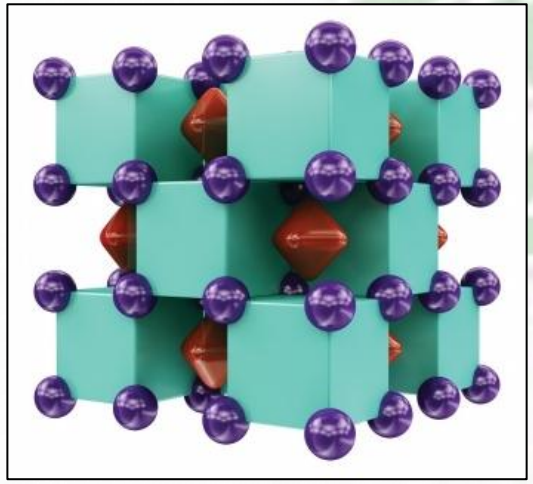
Oganesson ($_{118}Og^{294}$)

6. Most Radioactive Element

Polonium, is the most radioactive element that has no stable isotope. Lawrencium and nobelium are also highly radioactive elements

Periodic Table: New Modification Awaiting

Helium forms stable molecule Na_2He at high pressures.
Na_2He should be thermodynamically stable at pressures greater than roughly 115 GPa, which is about 1 million times as high as Earth's atmospheric pressure



Most tables place helium atop the noble gases. **Recent experiments showing helium can form stable bonds.** So it belongs to Gr-2 with alkaline earth metals, with other reactive, rather than inert, elements

https://cen.acs.org/articles/95/i7/Helium-forms-stable-molecules-high.html

Nat. Chem. **2017, DOI: 10.1038/nchem.2716**

At high pressures, Na_2He forms a stable compound with a three-dimensional checkerboard-like structure. Sodiums are the purple spheres, heliums are the green cubes, and electrons are the red regions

Check Your Learning

1. Determine whether the following elements are metals, non-metals or metalloids,

(a) calcium, (b) phosphorus, (3) silicon, (4) krypton

2. Which element is most similar to Sodium

(a) Potassium, (b) Aluminum, © Oxygen, (d) Calcium

3. Which element is most similar to Calcium?

(a) Carbon, (b) Oxygen, © Strontium, (d) Iodine

4. Who were the two chemists that came up with the periodic law?

(a) John Dalton and Michael Faraday
(b) Dmitri Mendeleev and Lothar Meyer
(c) Michael Faraday and Lothar Meyer
(d) John Dalton and Dmitri Mendeleev

5. Identify the group and period that the following elements are in:

(a) hydrogen, (b) aluminum,, © silver

6. According to the periodic law, would argon be in front of potassium or after? Explain why.

7. Classify which elements are considered as the main group or transition metals. If they are transition metals, state if they are lanthanides or actinides. The elements are:

(a) Magnesium, (b) Lanthanide, © Uranium, (d) Holmium, (e) Selenium

8. Arrange the elements from the lowest to highest group number: nitrogen, fluorine, boron, oxygen and carbon.

9. Arrange the following elements from the lowest to highest period number: aluminum (Al), polonium (Po), germanium (Ge), and antimony (Sb).

10. From looking at the periodic table, information about the following elements:

(a) cobalt, (b) barium, © chromium.

Next

We Will Explore

Periodic Trends