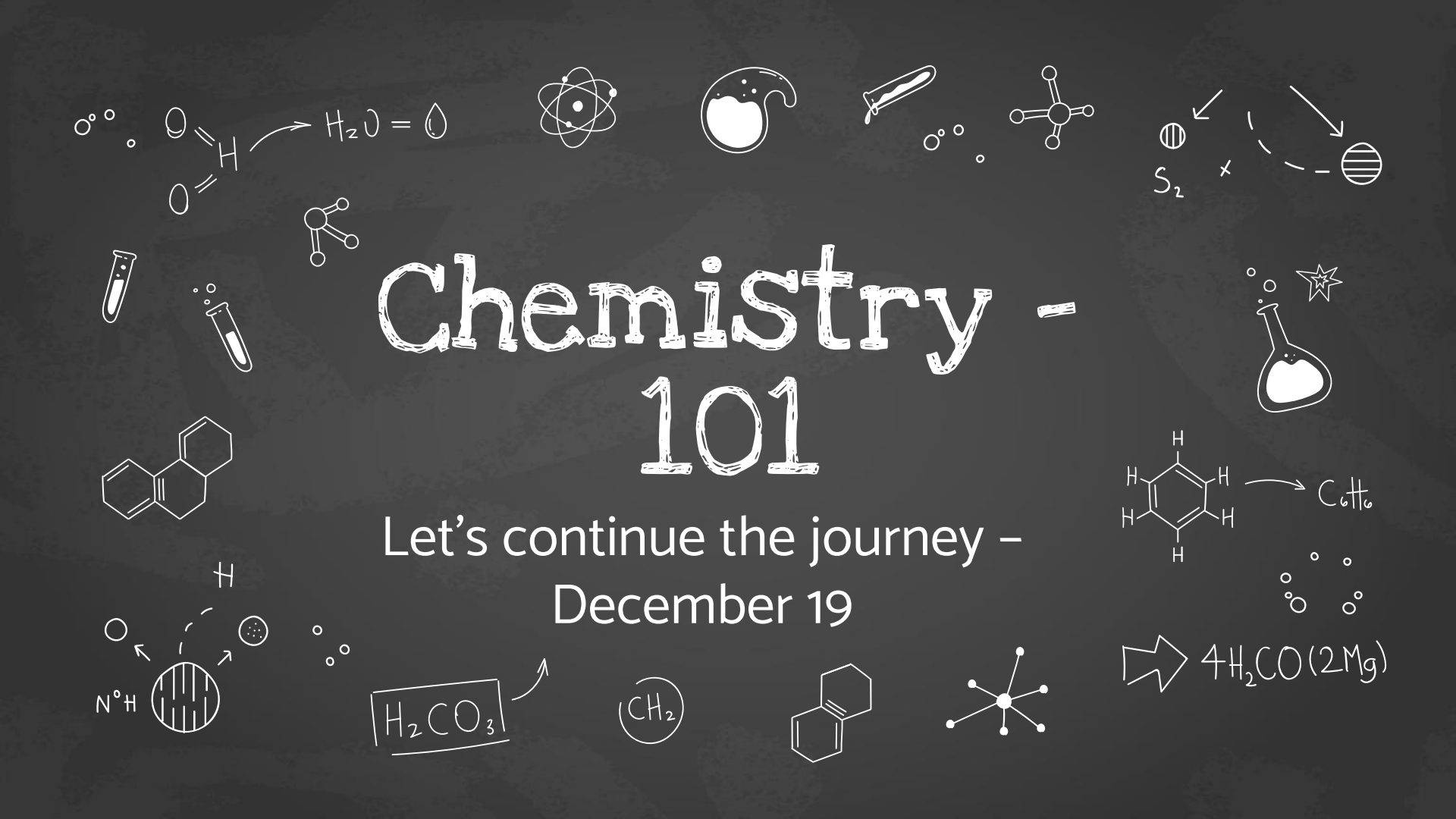

Chemistry - 101
Let's continue the journey – December 19

Atoms' electron configurations and the periodic law of elements

Periodic Table of Elements

Chemical properties of elements change periodically according to the charge of their nuclei

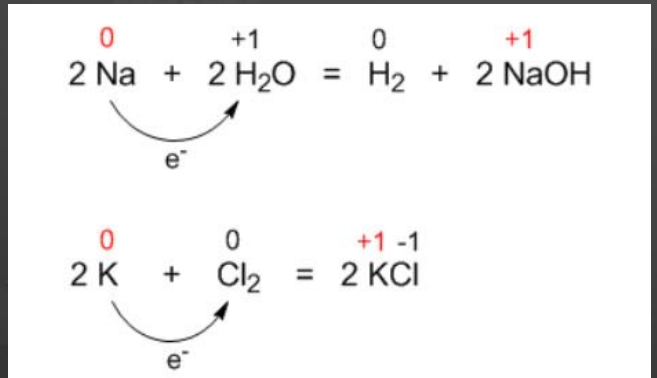
Element	Charge of the nuclei	Outer Shell
H	1	$...1s^1$
Li	3	$...2s^1$
Na	11	$...3s^1$
K	19	$...4s^1$
Rb	37	$...5s^1$
Cs	55	$...6s^1$
Fr	87	$...7s^1$

These elements have similar chemical properties:

Valence 1

Electron donors → reducers

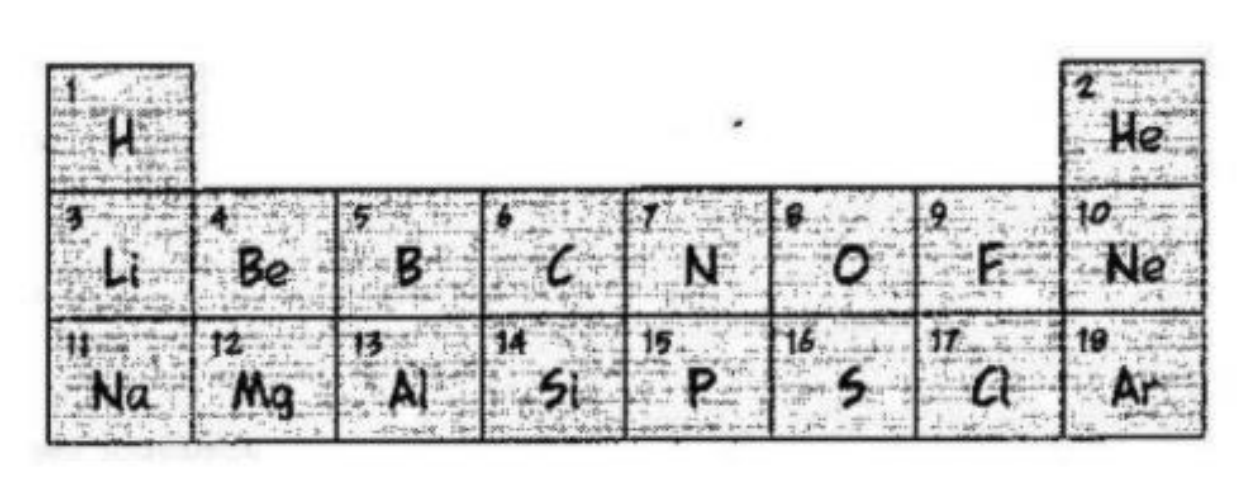
Na ($1s^12s^22p^63s^1$)-1 electron = Na^+ ($1s^12s^22p^6$ Ne electron configuration)



Oxidation state - I

Valence shell	s^1	s^2	s^2p^1	s^2p^2	s^2p^3	s^2p^4	s^2p^5	s^2p^6
Groups	I	II	III	IV	V	VI	VII	VIII
Electrons Element Atomic number	$1s^1$ H 1	$1s^2$ He 2	There are no “p” orbitals in the first shell					He should be here?
Electrons Element Atomic number	$2s^1$ Li 3	$2s^2$ Be 4	$2s^2p^1$ B 5	$2s^2p^2$ C 6	$2s^2p^3$ N 7	$2s^2p^4$ O 8	$2s^2p^5$ F 9	$2s^2p^6$ Ne 10
Electrons Element Atomic number	$3s^1$ Na 11	$3s^2$ Mg 12	$3s^2p^1$ Al 13	$3s^2p^2$ Si 14	$3s^2p^3$ P 15	$3s^2p^4$ S 16	$3s^2p^5$ Cl 17	$3s^2p^6$ Ar 18
Electrons Element Atomic number	$4s^1$ K 19	$4s^2$ Ca 20	And so on… But we need to put electrons on the inner 3d orbital first…					

The outer shells of elements have repeated configurations and the elements have repeated properties



In any column (group), all the atoms have the same outer electron configuration.

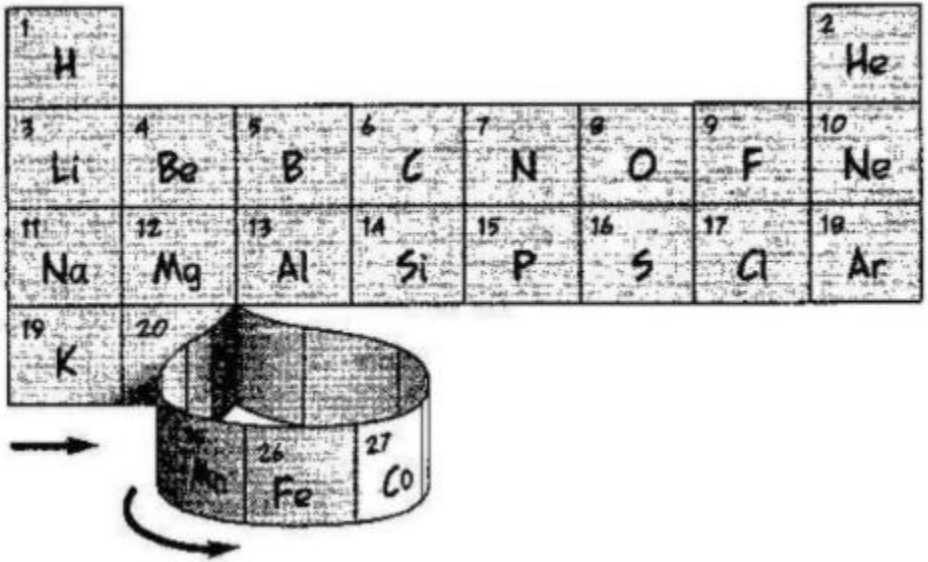
In any line the properties of elements are changing as electrons fill the outer shell.

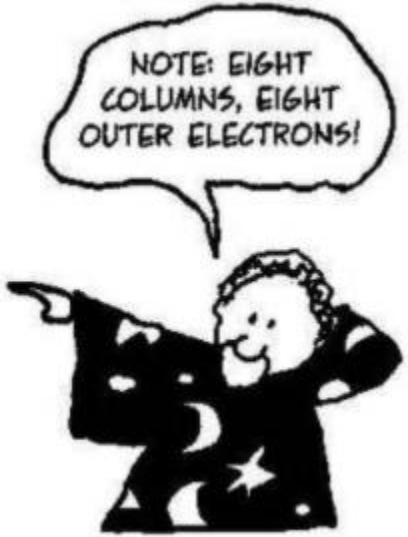
Each period starts with the active (alkali) metal and ends with an inert gas.

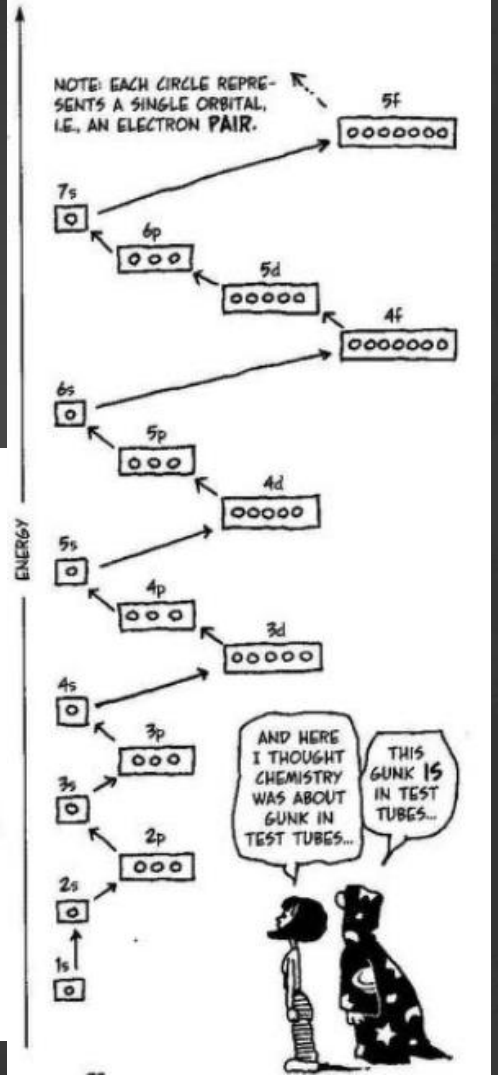
The group number corresponds to the number of valent electrons that can participate in the formation of chemical bonds.

Now we fill the 4th orbital, next, according to the energy levels electrons begin to occupy the 3d orbitals before we can continue in the fourth shell, ten electrons must go into there inner orbitals. We will write these ten elements on a loop.

1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, ...

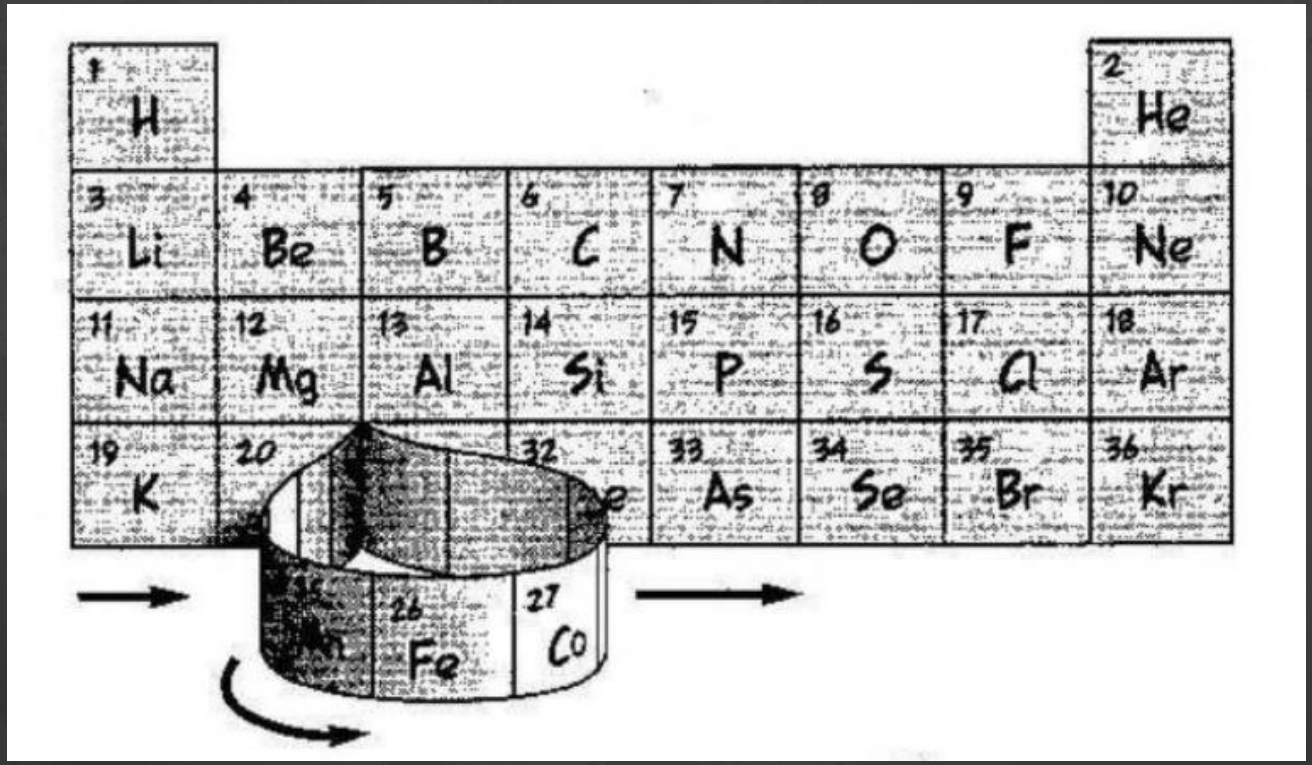




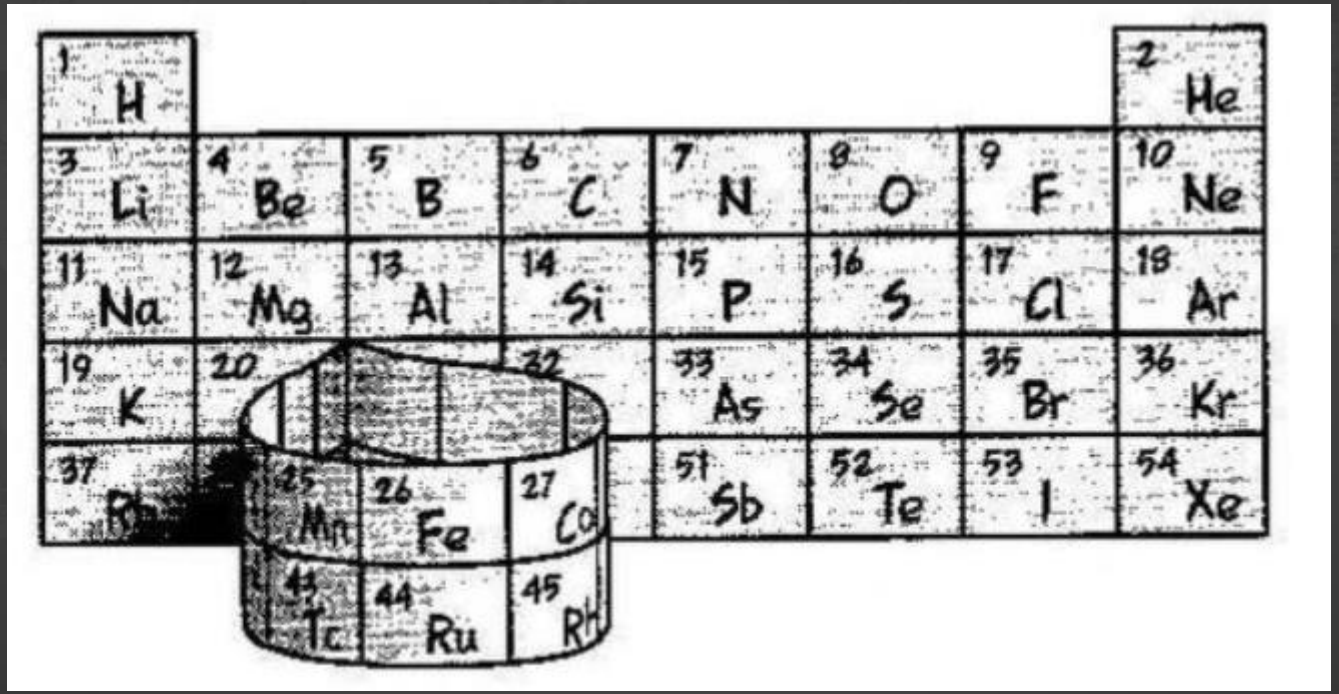


After those ten, we can resume putting electrons in the fourth shell, until all the 4s and 4p orbitals are full at element 36, krypton, Kr

1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, ...



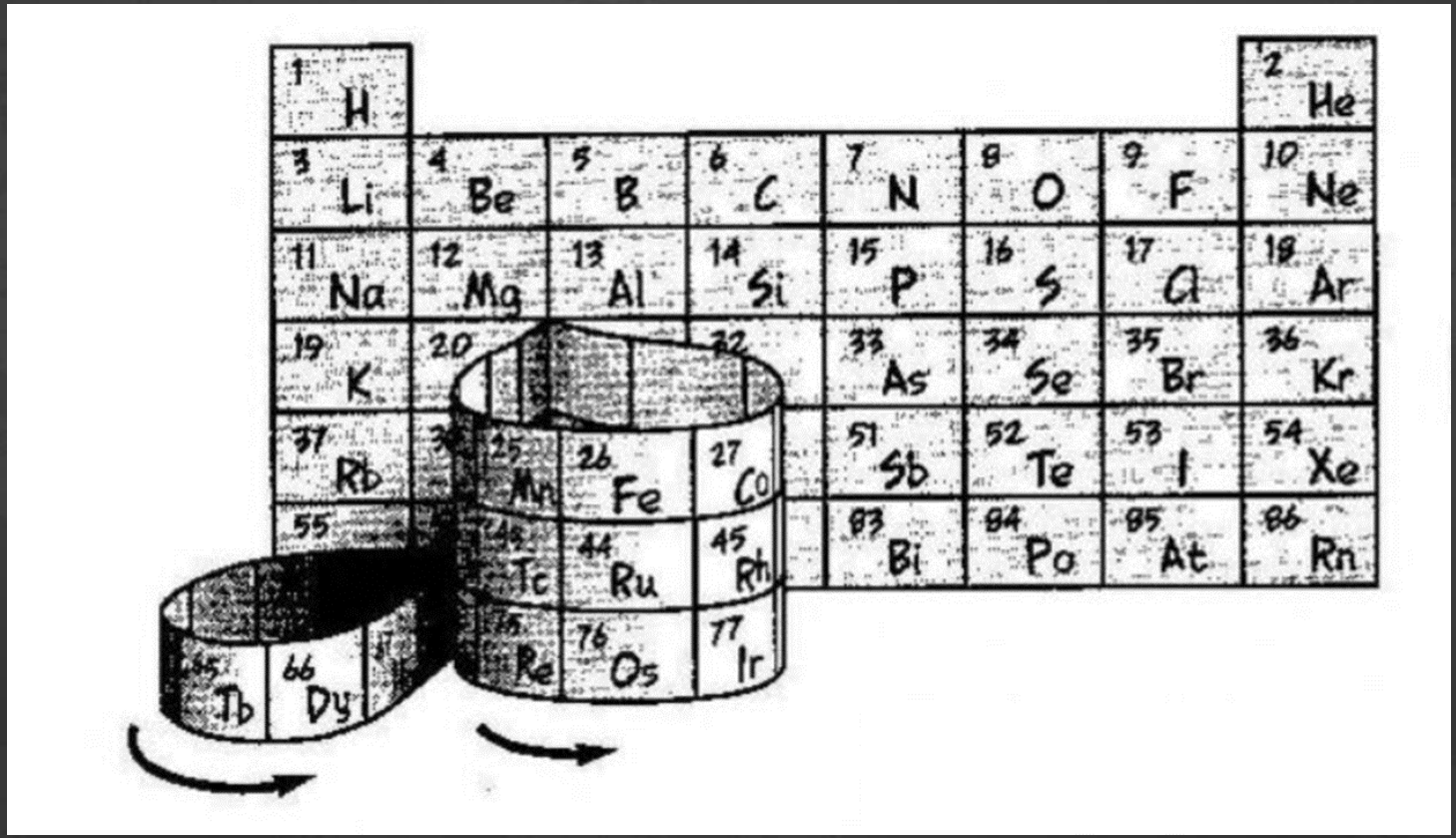
The fifth row fills up in exactly the same way as the fourth: first the outers, then inner d, then the outer p.

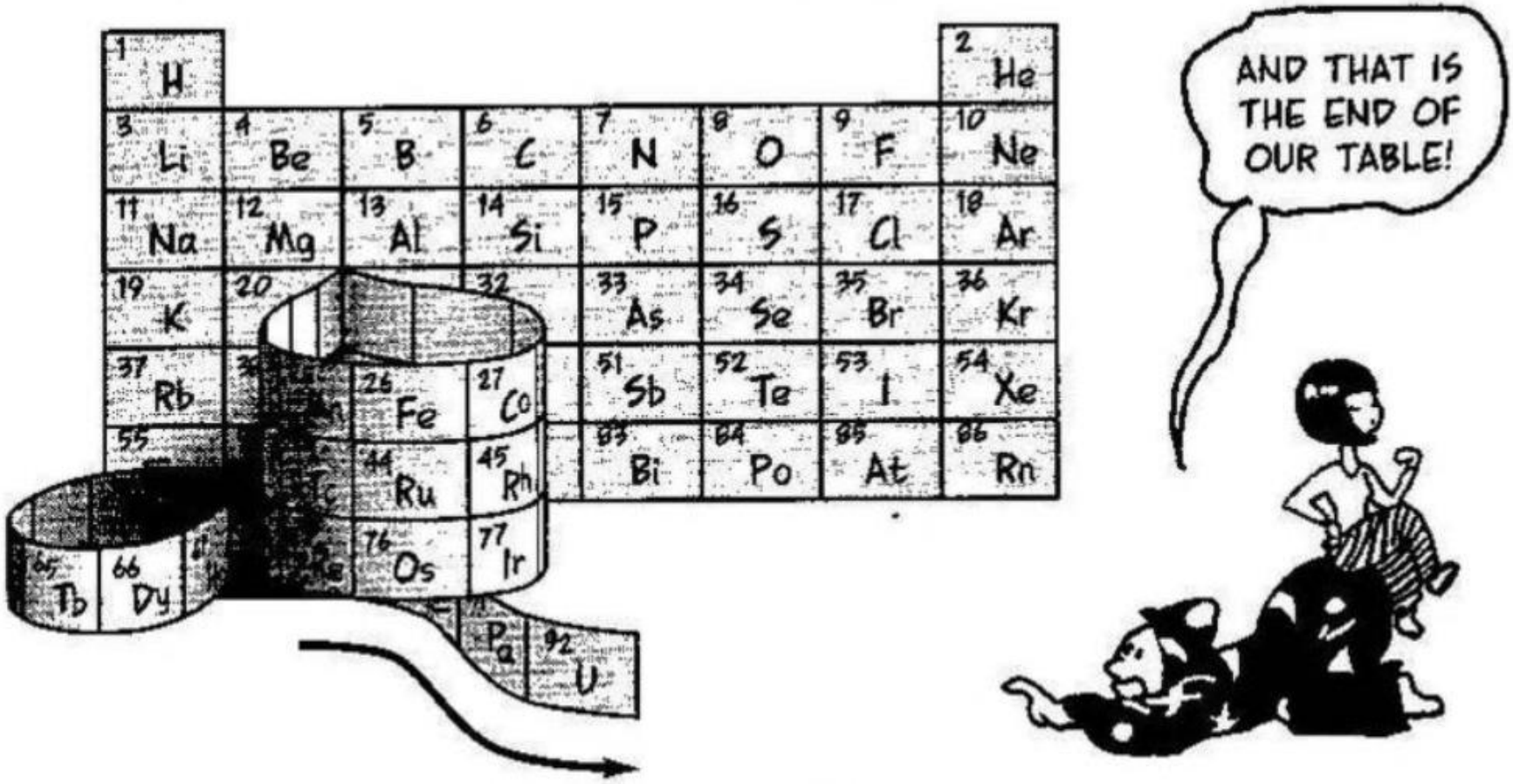


The elements that are "flat on the slide" are called **main-group elements**. Those in the loops are called **transition metals**.

The sixth row has a loop within a loop, as 4f orbitals will before 5d. As there are 7 4f orbitals, this look has 14 elements. It is called **lanthanide series**, after its first element, lanthanum.

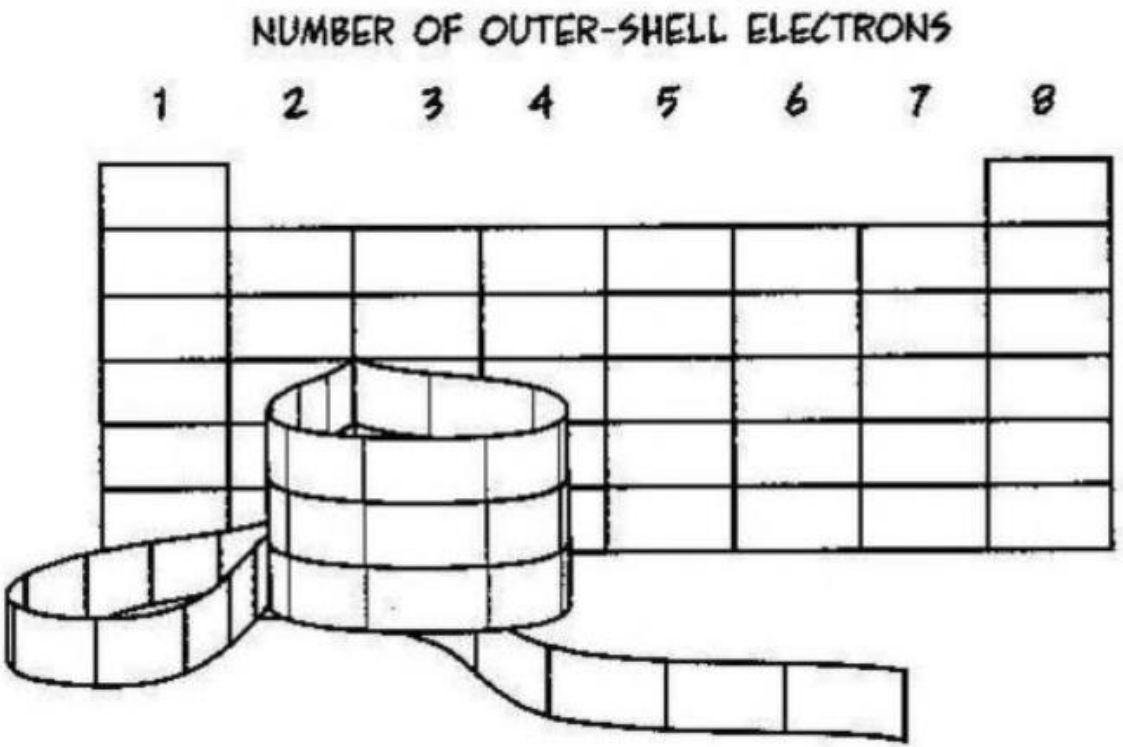
1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, ...

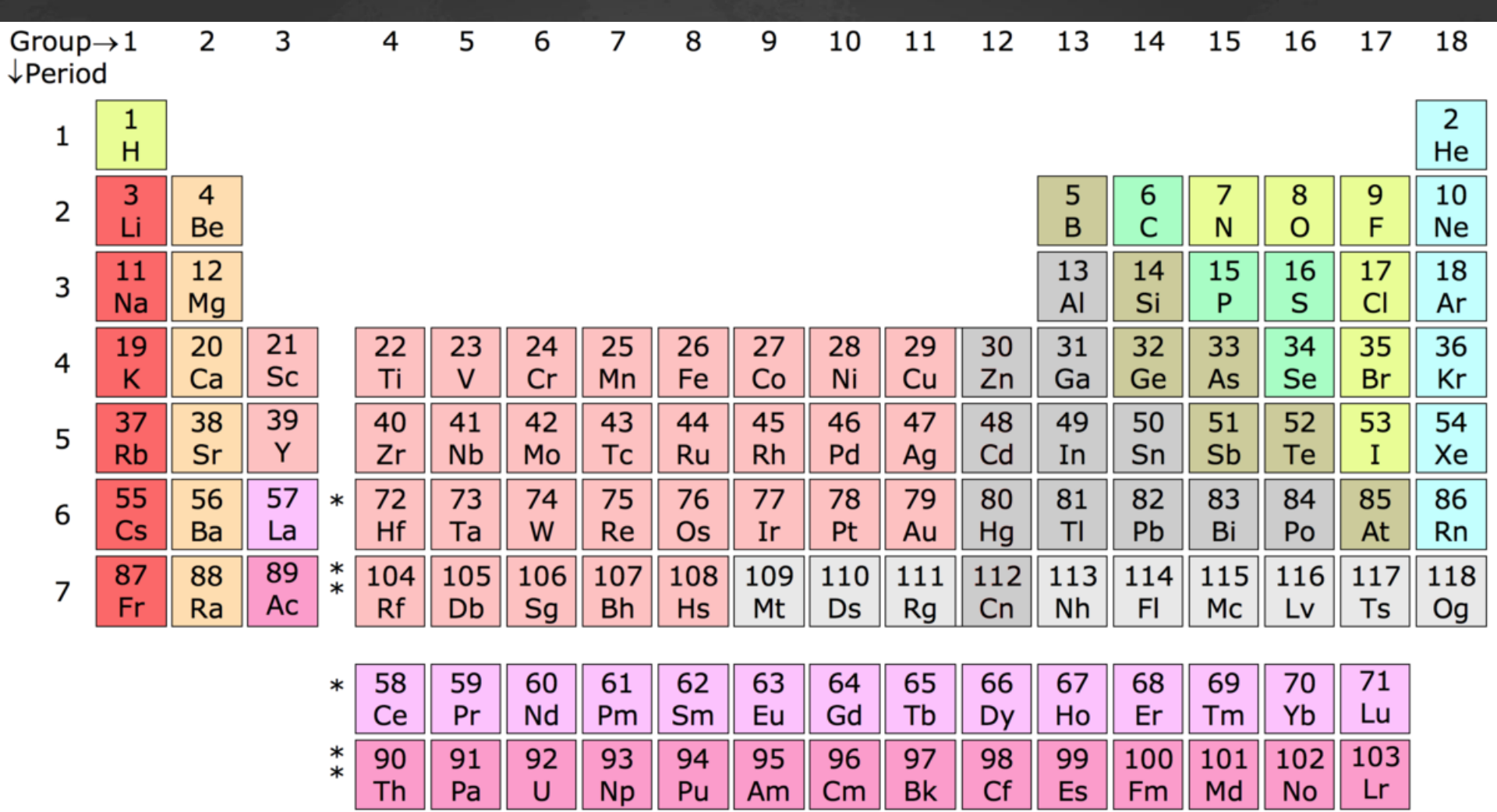



1 H
2 He
3 Li
4 Be
5 B
6 C
7 N
8 O
9 F
10 Ne
11 Na
12 Mg
13 Al
14 Si
15 P
16 S
17 Cl
18 Ar
19 K
20
32
33 As
34 Se
35 Br
36 Kr
37 Rb
51 Sb
52 Te
53 I
54 Xe
55
26 Fe
27 Co
44 Ru
45 Rh
83 Bi
84 Po
85 At
86 Rn
65 Tb
66 Dy
76 Os
77 Ir
91 Pa
92 U
AND THAT IS THE END OF OUR TABLE!

The Outermost Electrons

MOVING LEFT TO RIGHT ALONG A ROW OF MAIN-GROUP ELEMENTS, THE NUMBER OF OUTER ELECTRONS GOES UP STEADILY. GROUP 1 ELEMENTS ALL HAVE ONE OUTER ELECTRON, GROUP 2 ELEMENTS HAVE TWO, ETC., UNTIL THE LAST GROUP, WHICH ALL HAVE EIGHT. TRANSITION METALS HAVE EITHER ONE OR TWO OUTER ELECTRONS.*

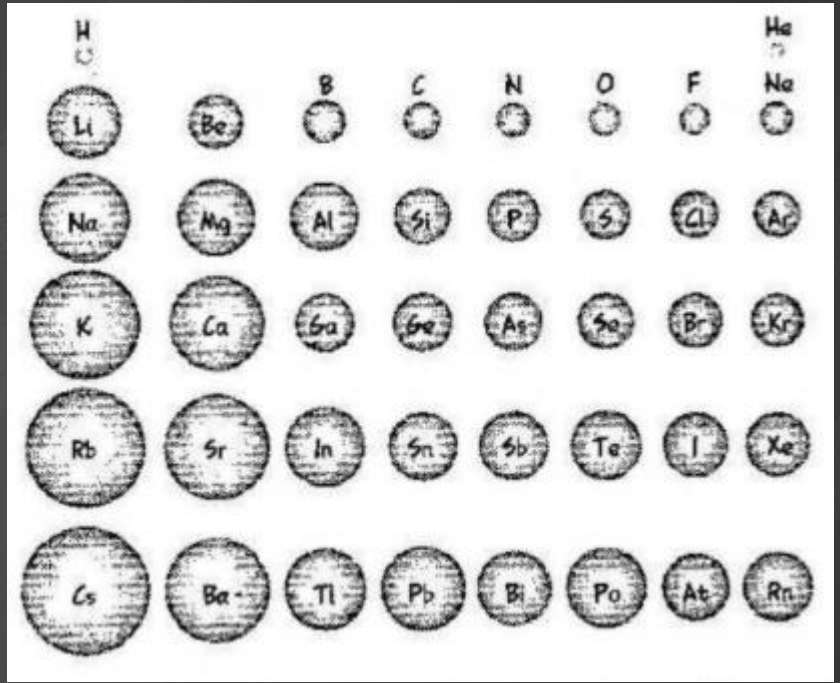


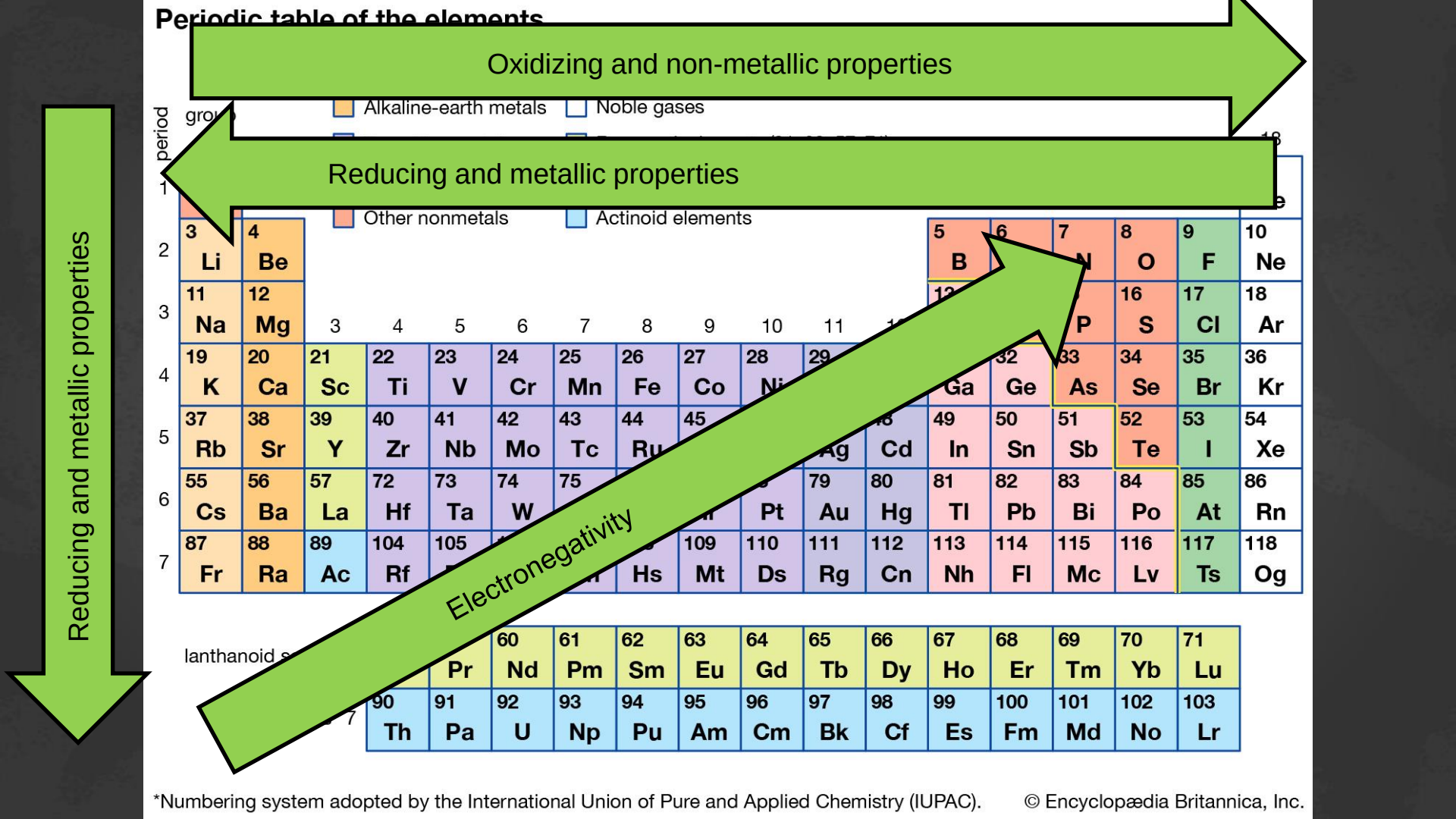


Going along a row from left to right, atoms get smaller, and moving down a column, they get bigger.

Moving to the right, the bigger charge of the nucleus pulls electrons closer in.

Going down a column, the outer electrons are in higher shells, hence farther away from the nucleus.





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

Metallic and non-metallic properties

Properties of metals

- High density
- High melting and boiling points
- Good electrical conductivity
- Shiny
- Malleable (easy to shape)
- Ductile (easy to stretch into wires)
- Reactive with nonmetals

Properties of nonmetals

- Often liquid or gaseous at room temperature
- Brittle when solid
- Dull-looking
- Poor electrical conductivity
- Reactive with metals (except for the last group)

This class uses the materials from the following books:
Larry Gonick and Graig Criddle “The cartoon guide to chemistry”
Manyuilov and Rodionov “Chemistry for children and adults”
Kuzmenko, Eremin, Popkov “Beginnings of chemistry”