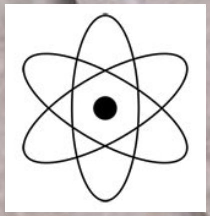
Models

Types of Models

- Atoms are so small that the number of them in a baseball is roughly equal to the number of **<u>Ping-Pong</u>** balls that could fit inside a hollow sphere as big as the **<u>Earth</u>**.



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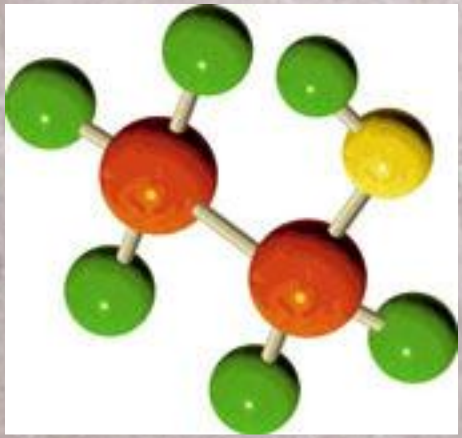
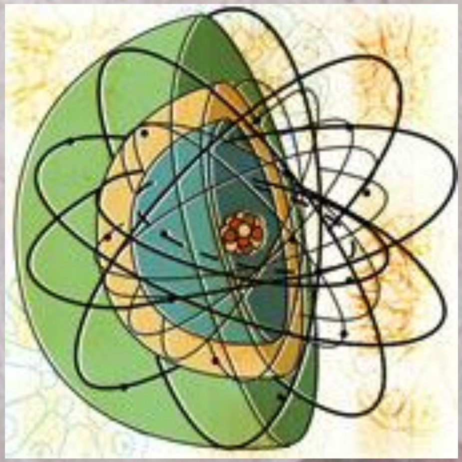
Types of Models

Because atoms are so small, it is difficult to create **physical models** of what atoms actually look like.

Types of Models

- Instead, scientists create **conceptual models** that are used to explain the ways atoms interact.



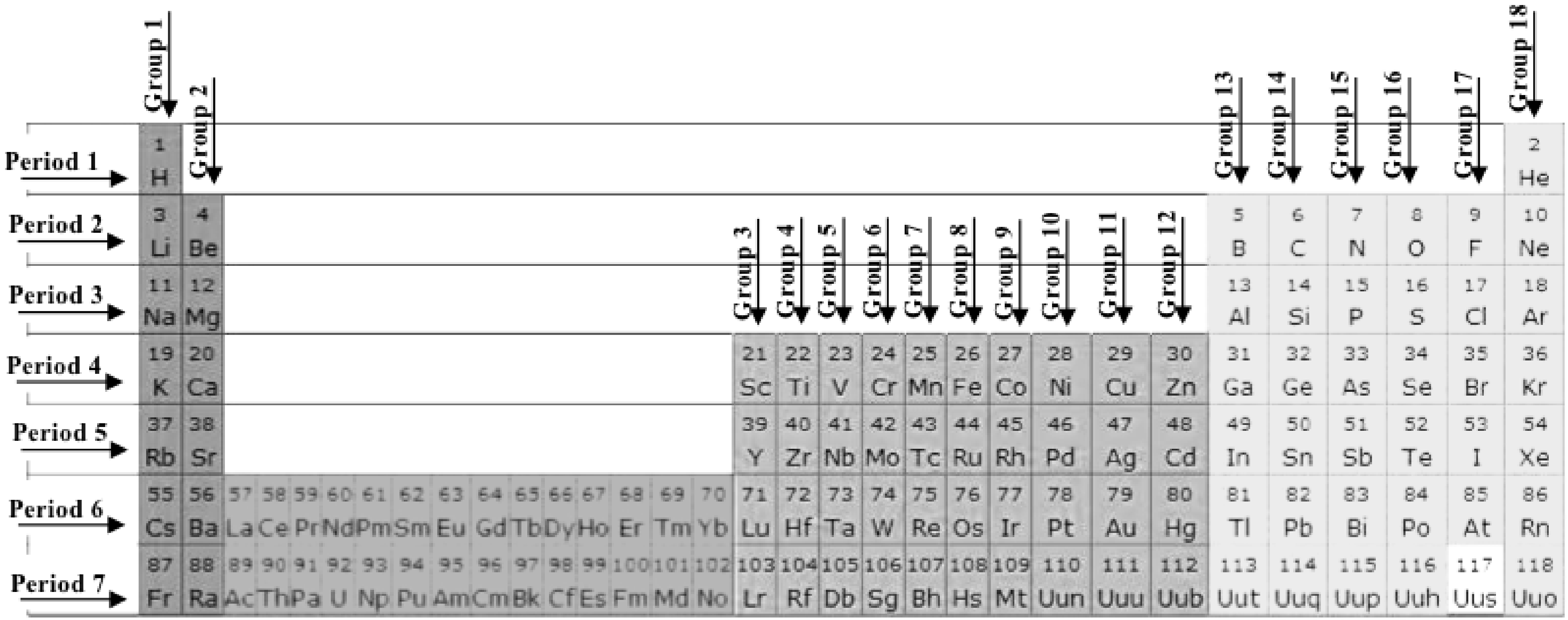


Types of Models

- One useful conceptual model of the atom is **Bohr's planetary** atomic model.
- This model consists of a central **nucleus** surrounded by electrons traveling in certain **energy levels**, much like the planets circling the sun.

Types of Models

- There are **seven** different energy levels, each represented by a **period** (horizontal row) on the periodic table.
- In the Bohr model, each ***energy level*** can only hold a ***maximum*** certain number of electrons, just like each period can only hold a certain number of **elements**.



Group 1
Group 2
Group 3
Group 4
Group 5
Group 6
Group 7
Group 8
Group 9
Group 10
Group 11
Group 12
Group 13
Group 14
Group 15
Group 16
Group 17
Group 18
Period 1
Period 2
Period 3
Period 4
Period 5
Period 6
Period 7
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 Ca
21 Sc
22 Ti
23 V
24 Cr
25 Mn
26 Fe
27 Co
28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
33 As
34 Se
35 Br
36 Kr
37 Rb
38 Sr
39 Y
40 Zr
41 Nb
42 Mo
43 Tc
44 Ru
45 Rh
46 Pd
47 Ag
48 Cd
49 In
50 Sn
51 Sb
52 Te
53 I
54 Xe
55 Cs
56 Ba
57 La
58 Ce
59 Pr
60 Nd
61 Pm
62 Sm
63 Eu
64 Gd
65 Tb
66 Dy
67 Ho
68 Er
69 Tm
70 Yb
71 Lu
72 Hf
73 Ta
74 W
75 Re
76 Os
77 Ir
78 Pt
79 Au
80 Hg
81 Tl
82 Pb
83 Bi
84 Po
85 At
86 Rn
87 Fr
88 Ra
89 Ac
90 Th
91 Pa
92 U
93 Np
94 Pu
95 Am
96 Cm
97 Bk
98 Cf
99 Es
100 Fm
101 Md
102 No
103 Lr
104 Rf
105 Db
106 Sg
107 Bh
108 Hs
109 Mt
110 Uun
111 Uuu
112 Uub
113 Uut
114 Uuq
115 Uup
116 Uuh
117 Uus
118 Uuo

Bohr Model

Period	Number of Elements	Energy Level	Maximum Number of Electrons
1			
2			
3			
4			
5			
6			
7			

Types of Models

Period	Number of Elements	Energy Level	Maximum Number of Electrons
1	2		
2	8		
3	8		
4	18		
5	18		
6	32		
7	32		

Types of Models

Period	Number of Elements	Energy Level	Maximum Number of Electrons
1	2	1	
2	8	2	
3	8	3	
4	18	4	
5	18	5	
6	32	6	
7	32	7	

Types of Models

Period	Number of Elements	Energy Level	Maximum Number of Electrons
1	2	1	2
2	8	2	8
3	8	3	8
4	18	4	18
5	18	5	18
6	32	6	32
7	32	7	32

Types of Models

- Draw Bohr Models for the following atoms:
  - Lithium
  - Boron
  - Nitrogen
  - Neon
  - Sodium
  - Carbon
- Remember to include the correct number of electrons in each energy level!

Lithium

Boron

Nitrogen

Neon

Sodium

Carbon

Types of Models

- The **number** of and **arrangement** of the electrons significantly affect chemical properties.
- Specifically, it is the **valance** (outermost) electrons that affect how an atom will interact with other atoms.

Types of Models

- Atoms are most stable when they have **<u>full</u>** valance shells.
- The elements that naturally have full valence shells are the **<u>noble gases</u>**
- Other elements will gain, lose, or share electrons during chemical reactions in order to get this **<u>noble gas configuration</u>**.

Lithium

Boron

Nitrogen

Neon

Sodium

Carbon

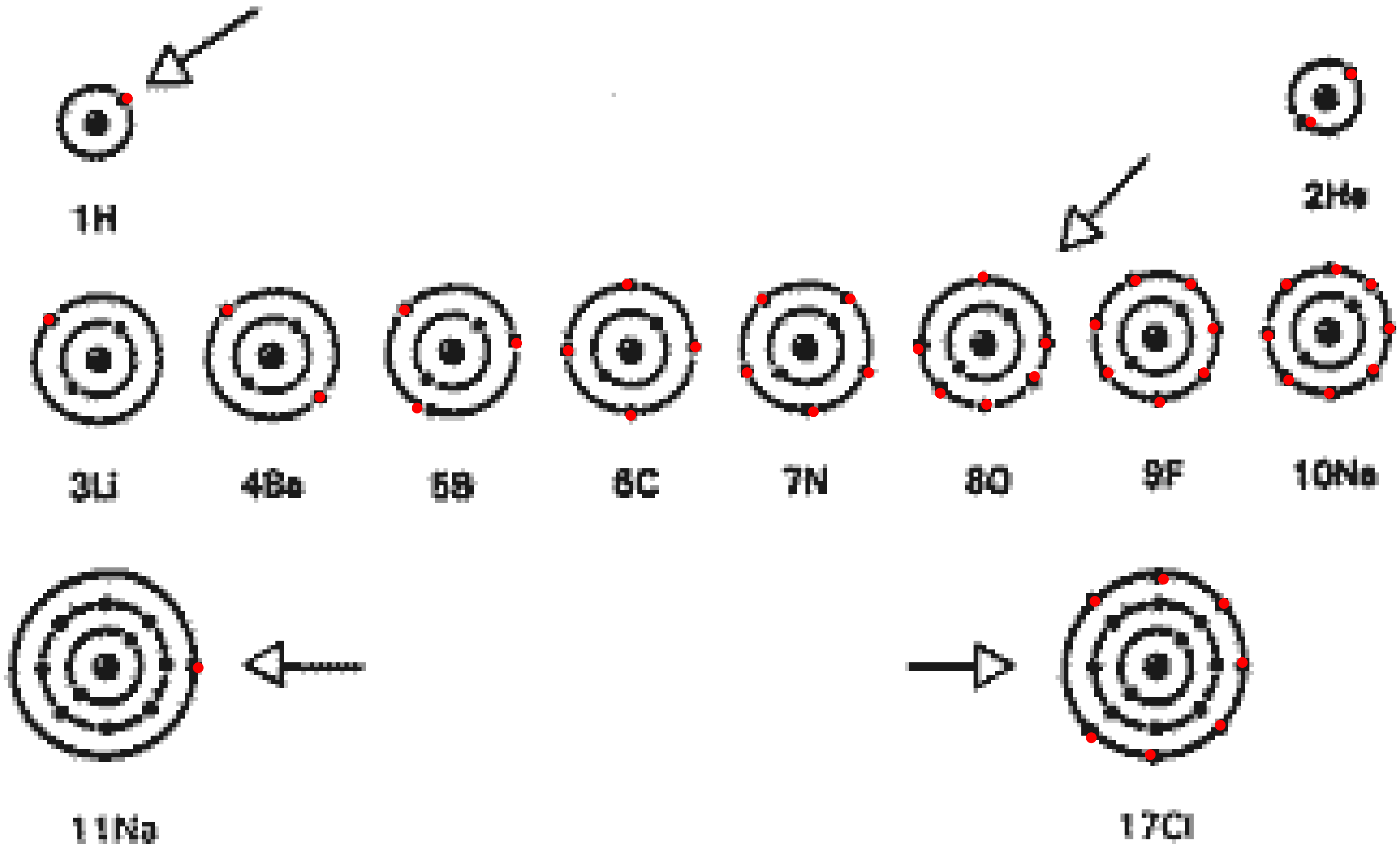


Fig.3.5 Iconic Models of Elements in the Periodic Table

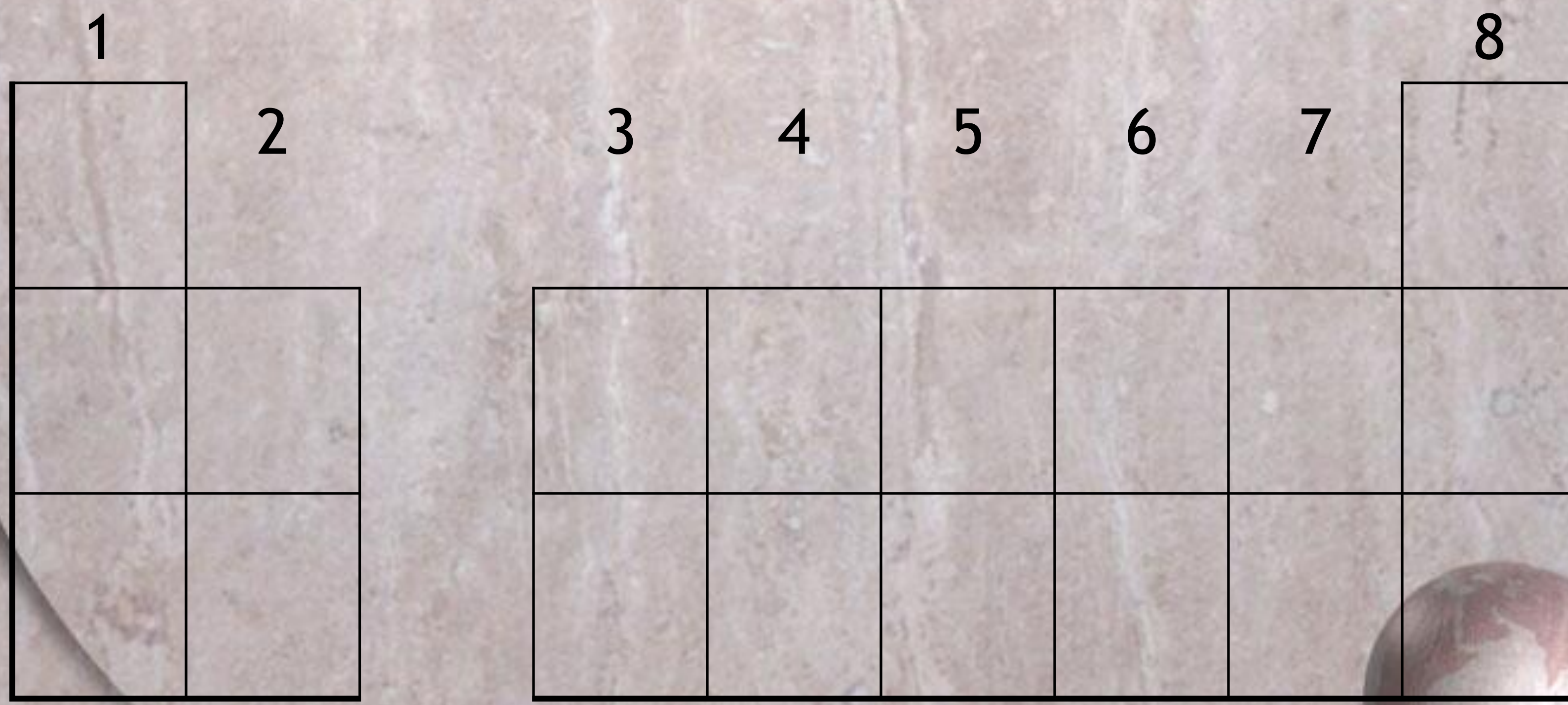
Types of Models

- Notice, elements in the same **group** (vertical column) on the periodic table will have the same number of **valance electrons.**

- The group the element is found in on the periodic table can also help us **predict** how many electrons the element will gain, lose, or share during a chemical **reaction**.
- To determine usual charges, we decide if it is easier for an atom to gain the required electrons **(negative charge)** or lose the required **ELECTRONS** **(positive charge).**

Group Number

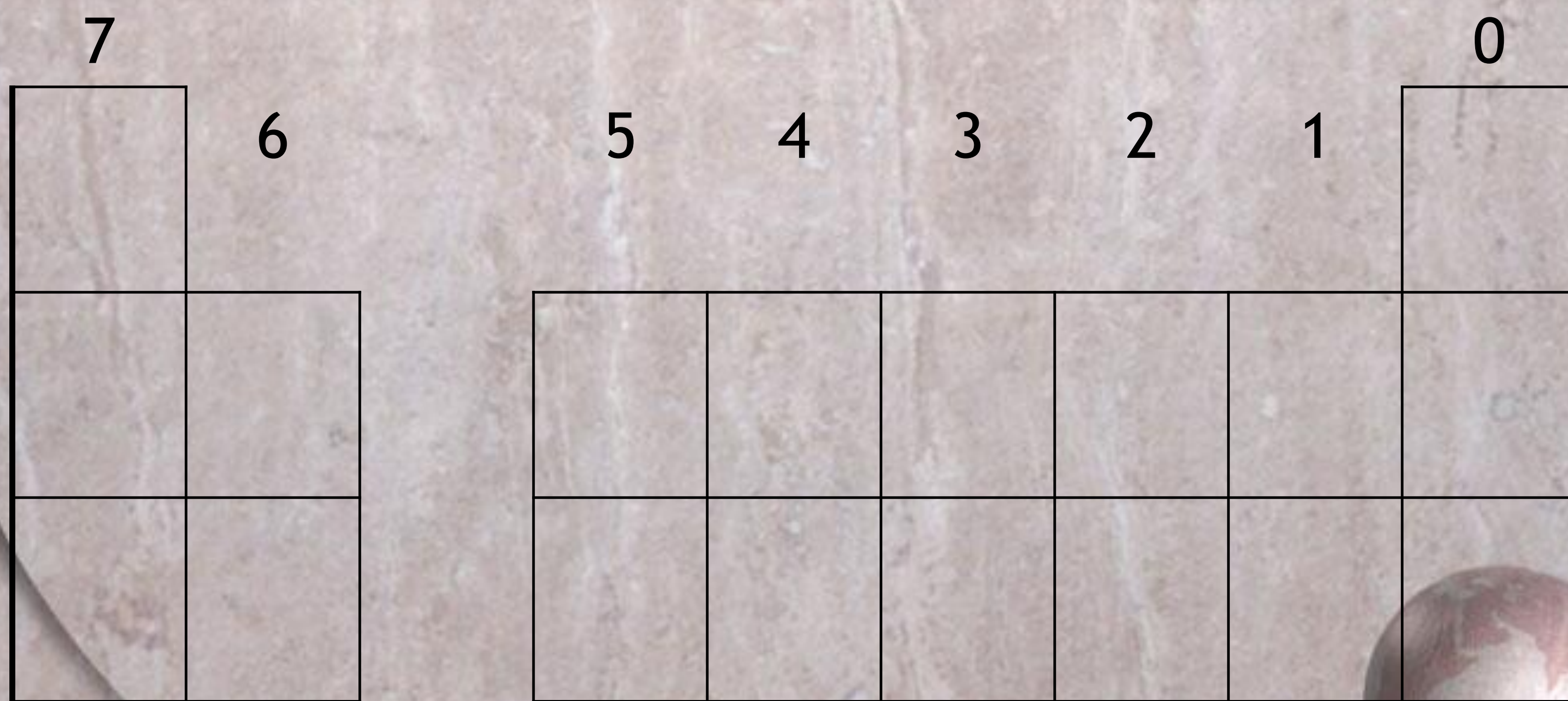
Valence Electrons



Group	1	2	13	14	15	16	17	18
Valence Electrons	1	2	3	4	5	6	7	8
Add __ Electrons								
Lose __ Electrons								
Usual Charge								

Electrons Gained to Achieve Nobel Gas Configuration

(Add __ Electrons to be stable)



Group	1	2	13	14	15	16	17	18
Valence Electrons	1	2	3	4	5	6	7	8
Add __ Electrons	X	X	X	4	3	2	1	0
Lose __ Electrons								
Usual Charge								

Electrons Lost to Achieve Nobel Gas Configuration

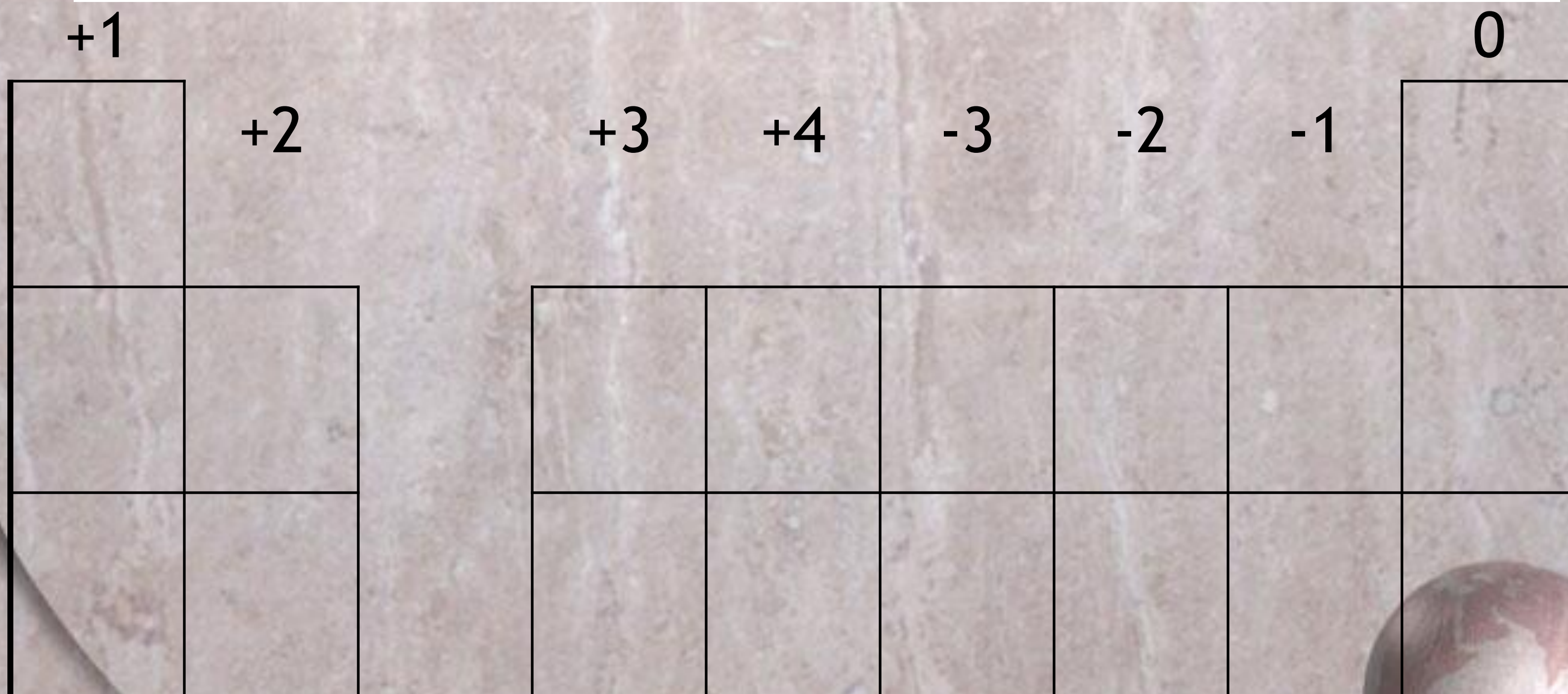
(Lose __ Electrons to be stable)

1	2	3	4	5	6	7	0

Group	1	2	13	14	15	16	17	18
Valence Electrons	1	2	3	4	5	6	7	8
Add __ Electrons	X	X	X	4	3	2	1	0
Lose __ Electrons	1	2	3	4	X	X	X	0
Usual Charge								

Which would be easier?
(Usual Charge)

Add 7	Add 6	Add 5	Add 4	Add 3	Add 2	Add 1	Add 0
Lose 1	Lose 2	Lose 3	Lose 4	Lose 5	Lose 6	Lose 7	Lose 0



Group	1	2	13	14	15	16	17	18
Valence Electrons	1	2	3	4	5	6	7	8
Add __ Electrons	X	X	X	4	3	2	1	0
Lose __ Electrons	1	2	3	4	X	X	X	0
Usual Charge	+1	+2	+3	-4 +4	-3	-2	-1	0

- The valence electrons are the only electrons that affect the **chemical properties** of an atom.

- A more simple model, the **Lewis Dot Structure**, includes only these electrons.

Lithium

Boron

Nitrogen

Neon

Sodium

Carbon