Review Notes 6.1 – 6.2

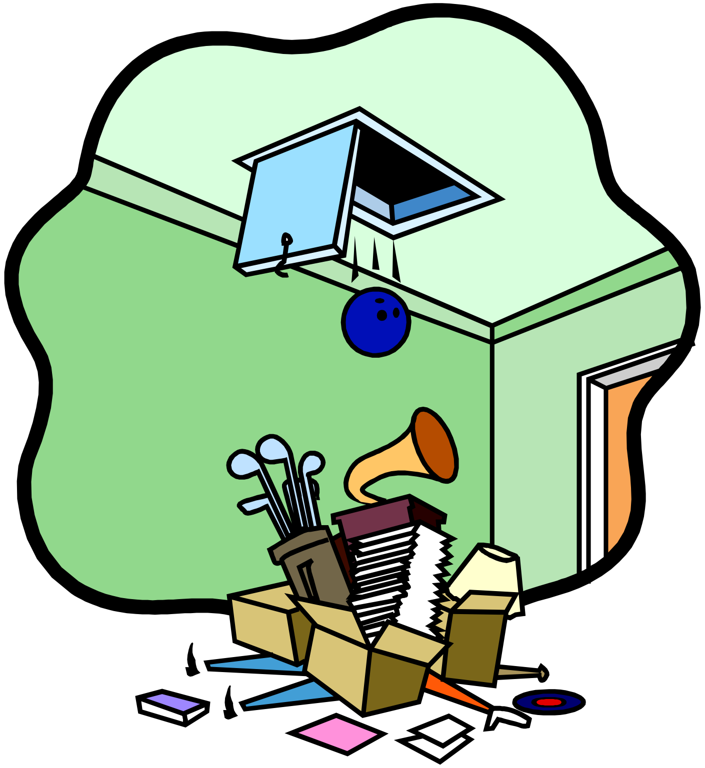
Periodic Table of the Elements

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	0
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	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
5	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
6	55 Cs	56 Ba	57 * La	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
7	87 Fr	88 Ra	89 + Ac	104 Rf	105 Ha	106 106	107 107	108 108	109 109	110 110								

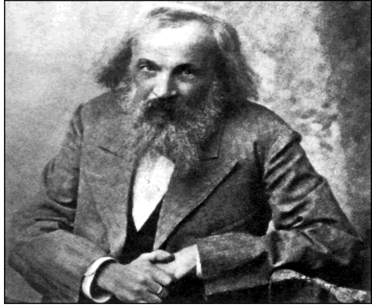
* Lanthanide Series	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
+ Actinide Series	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Pre-periodic table chemistry …

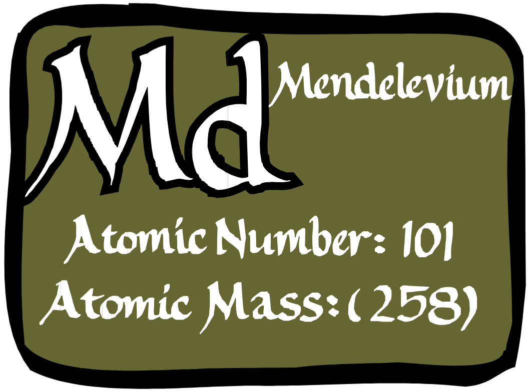
- …was a mess!!!
- No organization of elements.
- Imagine going to a grocery store with no organization!!
- Difficult to find information.
- Chemistry didn’t make sense.



Dmitri Mendeleev:
Father of the Periodic Table



In 1869 he published a table of the elements



<u>HOW THIS WORKED…</u>

- 70 known elements.
- Put elements in **rows** by increasing **atomic mass**.
- Put elements in **columns** by the way they **reacted**.

<u>SOME PROBLEMS…</u>

- He left **blank spaces** for undiscovered elements.
- Some elements didn't fit, he said their weight must be wrong.

He ***predicted*** *the physical properties of three elements that were yet unknown.*

The **discovery of these elements** *between 1874 and 1885…*

plus

the fact that his predictions for ***Sc****,* ***Ga****, and* ***Ge*** *were close to the actual values…*

his ***table was generally accepted****.*

Henry Moseley

In 1913, using X-rays,
determined the actual nuclear charge
*= **atomic number**.*

Rearranged the elements in order of **increasing *atomic number***

The Current Periodic Table

Elements are put in rows by increasing **ATOMIC NUMBER!!**

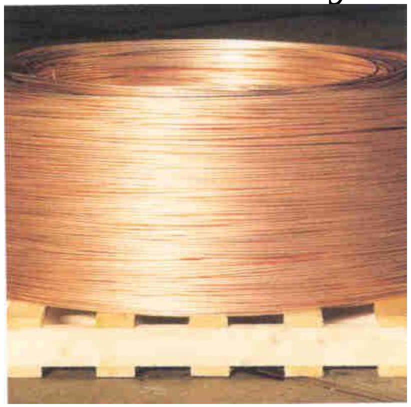
Elements in the same **group** have **similar** chemical & physical **properties**!!

3 classes of elements

1. Metals: located to the __left__ of the zig-zag line

Properties of Metals

- **All Solids!!!** Except one – which is it??
- shiny surface
- __malleable__ (can be pounded it into a flat sheet)
- __ductile__ (can be drawn it into a thin wire)
- good __conductors__ (heat/electricity travels through it easily)



3 classes of elements

2. Nonmetals: located to the __right__ of the zig-zag line.

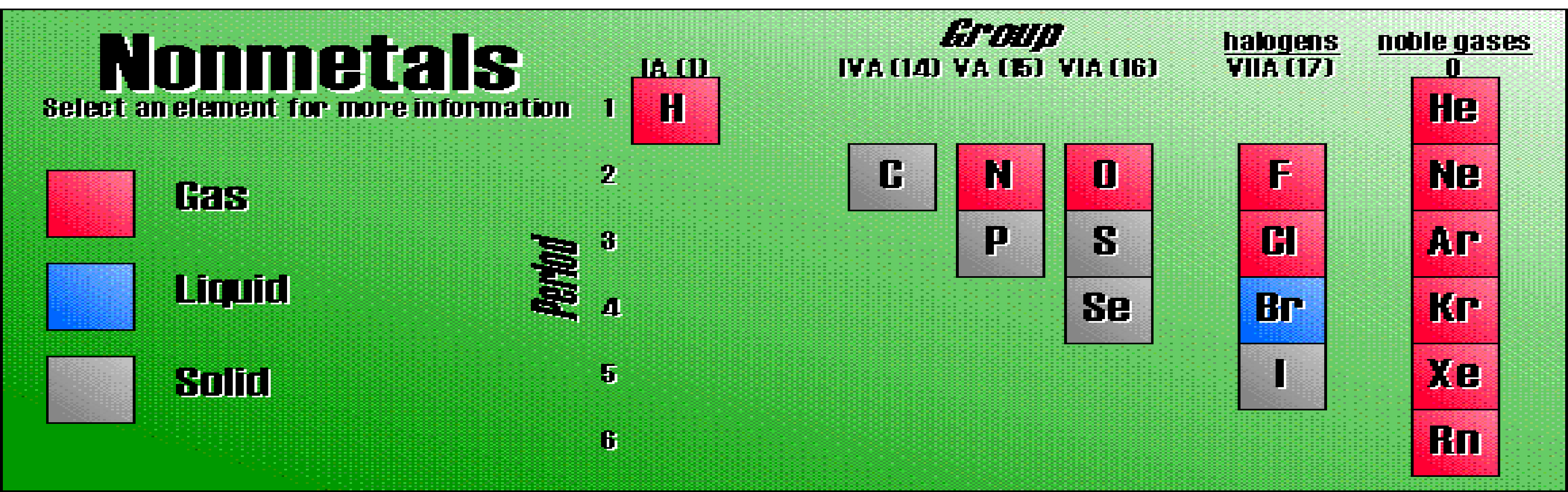
Properties of Nonmetals

– __dull__ surface

– __brittle__

– good __insulators__ (*or poor conductors*)

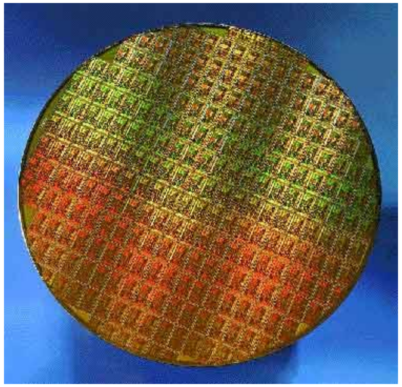
sulfur



3 classes of elements

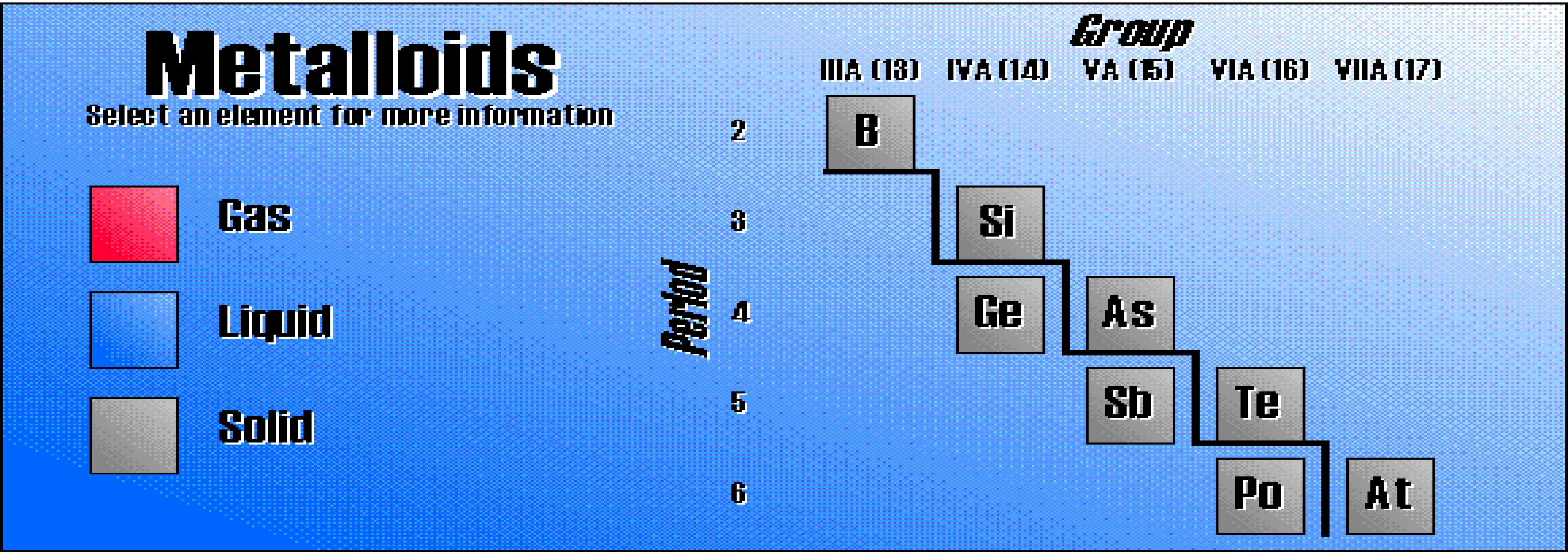
3. Metalloids (8): along the zig-zag line.

- Divide metals and nonmetals.
- Similar properties to nonmetals.
- *EXCEPT* good electrical conductors.



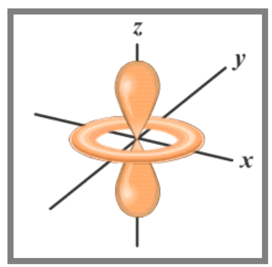
Example: silicon
(Used in computer chips)

semiconductors



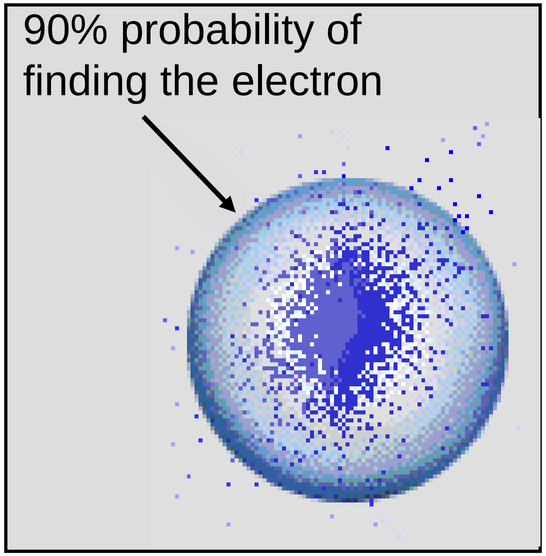
Review Notes 5.3 & 6.2
Electron Configuration & Orbitals

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6$…

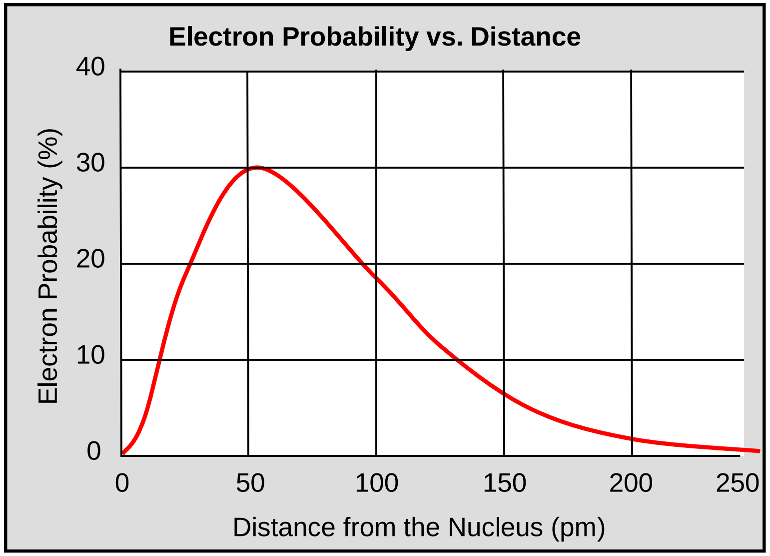


Quantum Mechanical Model of the Atom

- **Orbital** ("electron cloud")
  - Region where there is 90% probability of finding an electron



Orbital

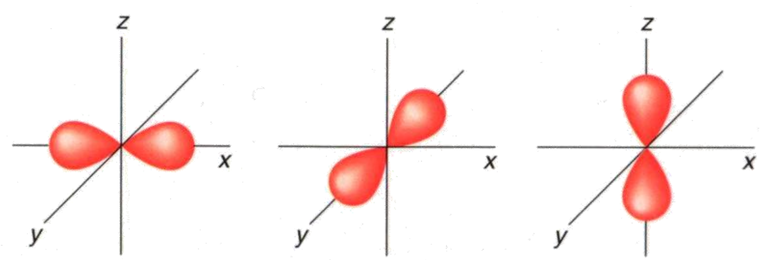


Courtesy Christy Johannesson www.nisd.net/communicationsarts/pages/chem

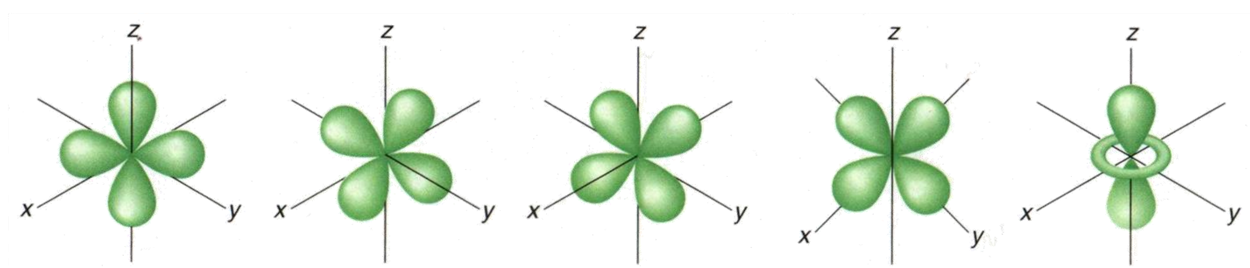
Shapes of s, p, and d-Orbitals

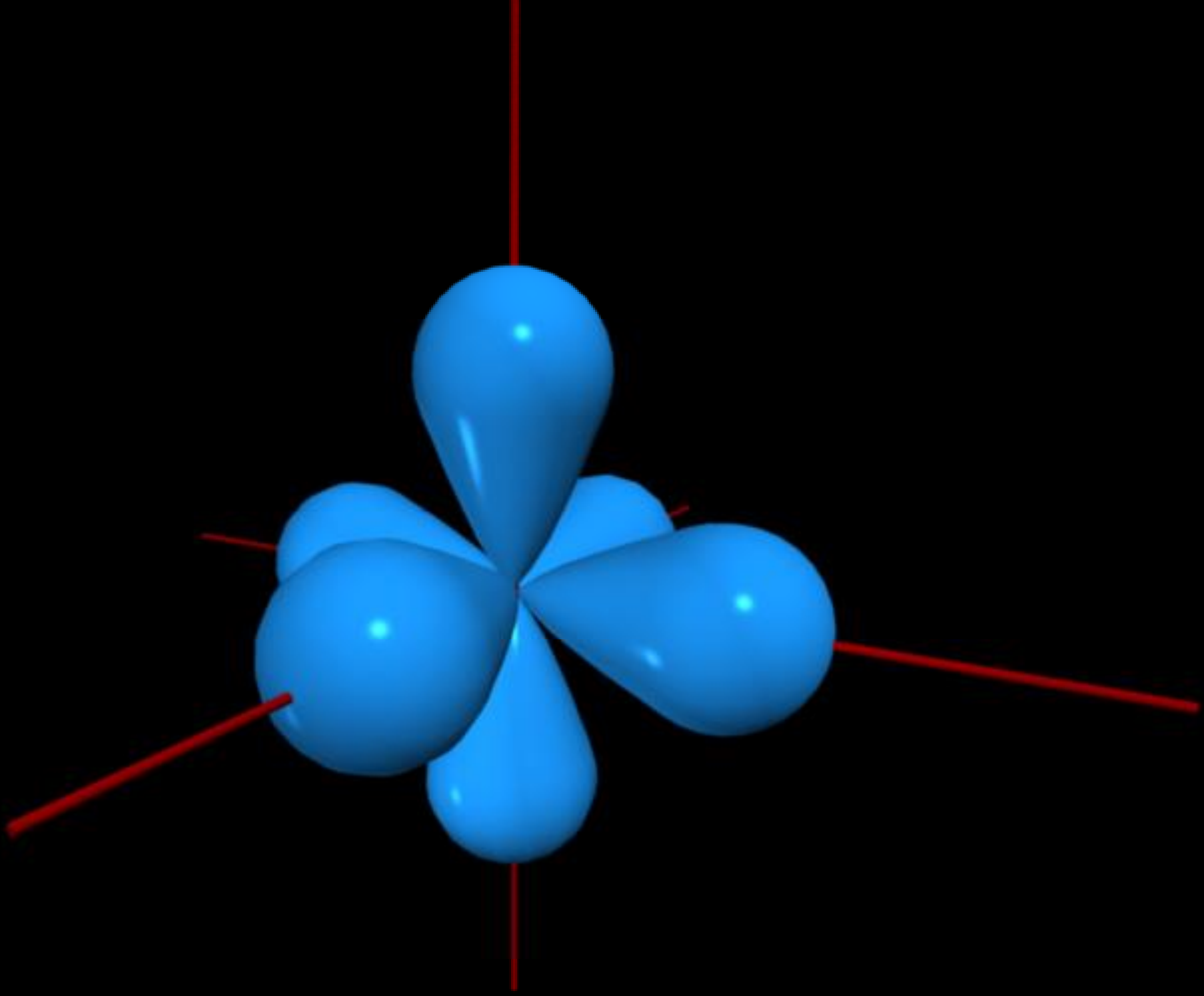
***s* orbital**

***p* orbitals**

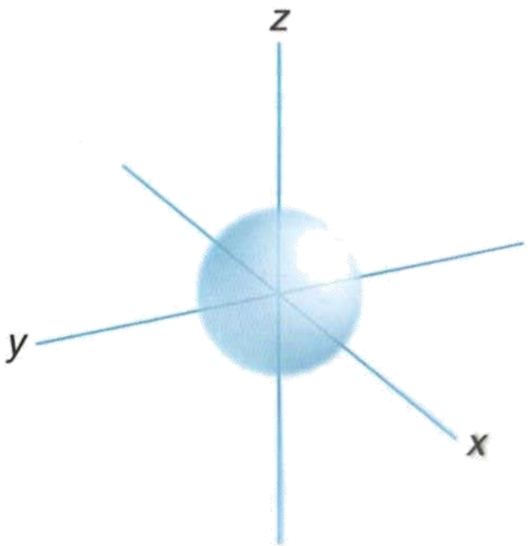


***d* orbitals**

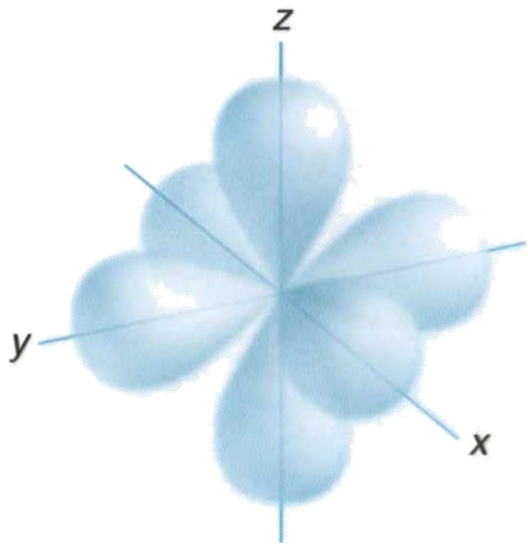




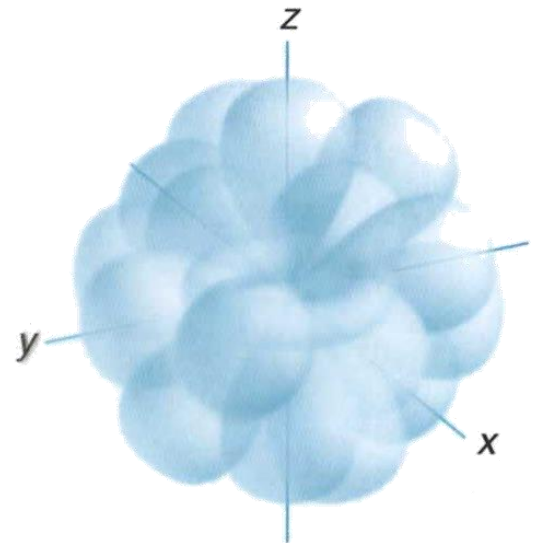
s, p, and d-orbitals



A
s orbitals:
Hold 2 electrons

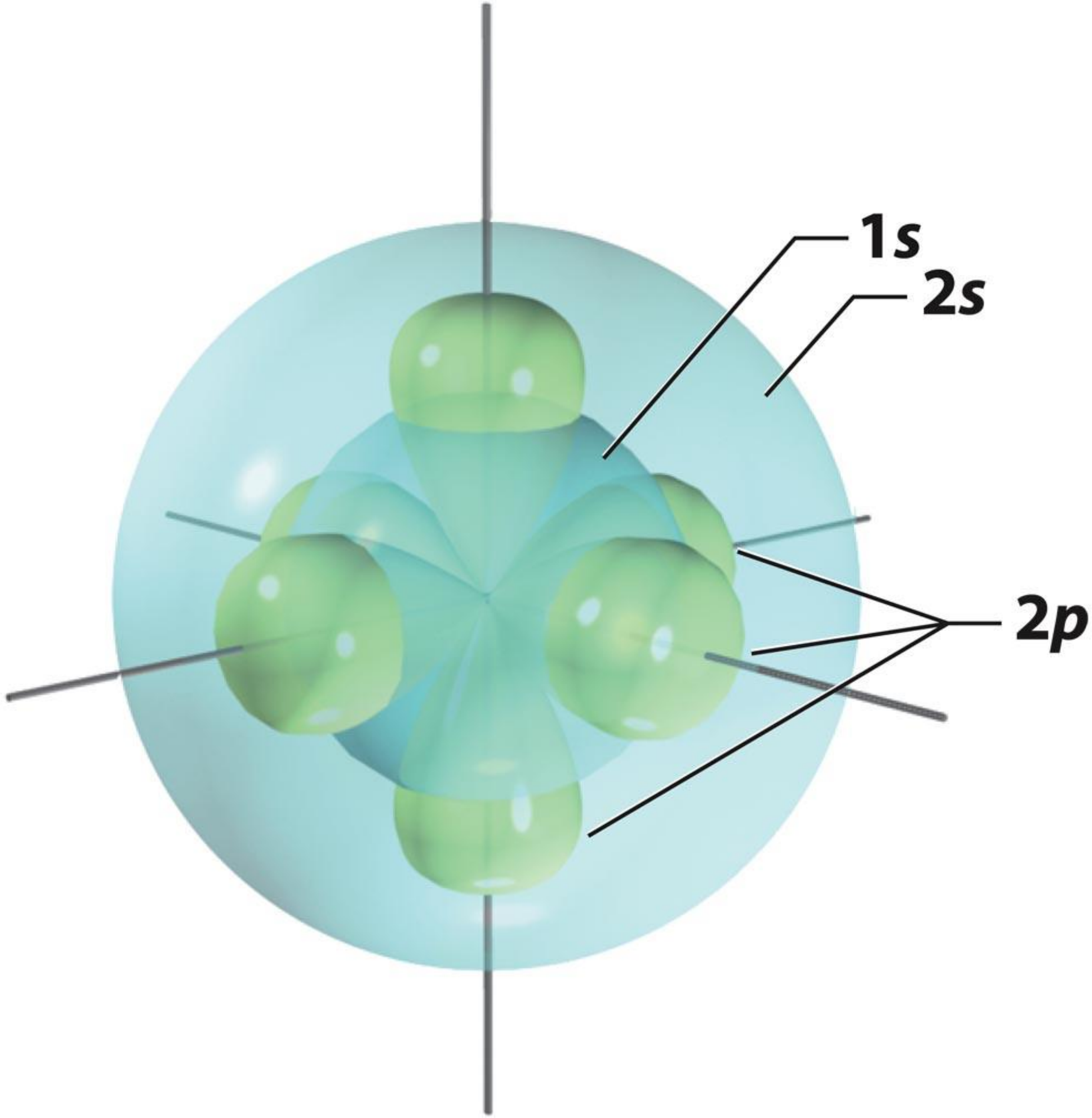


B
p orbitals:
Each of 3 pairs of
lobes holds 2 electrons
= 6 electrons



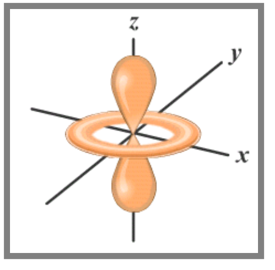
C
d orbitals:
Each of 5 sets of
lobes holds 2 electrons
= 10 electrons

Kelter, Carr, Scott, , Chemistry: A World of Choices 1999, page 82


1s
2s
2p

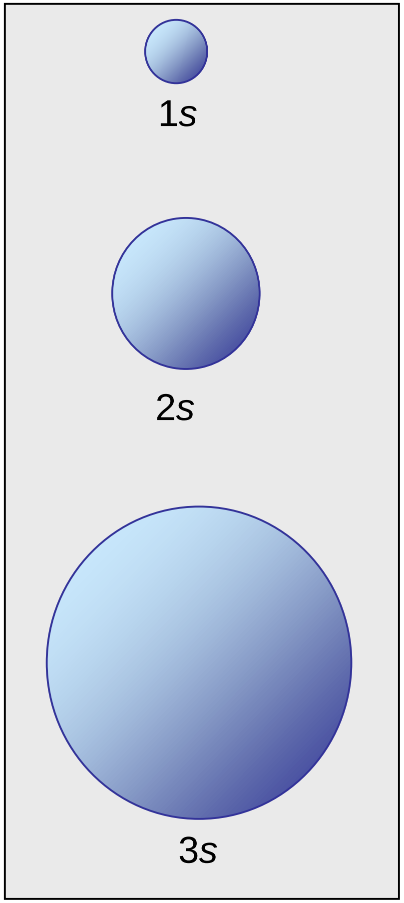
Review Notes 5.3 & 6.2 pt.2
Electron Configuration & Orbitals

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6$…



Principal Quantum Number (n)

- Energy level (n)
  - Size of the orbital
- n = # of sub levels
- n^2 = # of orbitals



Courtesy Christy Johannesson www.nisd.net/communicationsarts/pages/chem

s | s | p | d | f

1	H 1																H 1	He 2
2	Li 3	Be 4											B 5	C 6	N 7	O 8	F 9	Ne 10
3	Na 11	Mg 12											Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
4	K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
5	Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
6	Cs 55	Ba 56	*	Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
7	Fr 87	Ra 88	Ω	Rf 104	Db 105	Sg 106	Bh 107	Hs 108	Mt 109									
			*	La 57	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71
			Ω	Ac 89	Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103

Electron Filling in Periodic Table

	s	
	H $1s^1$	He $1s^2$

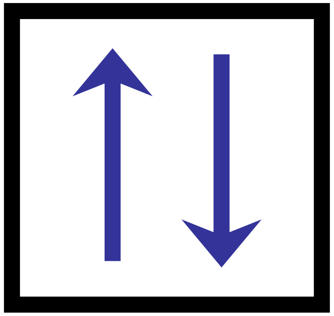
	s		*d*										*p*					
1	H $1s^1$																	
2	Li $2s^1$	Be $2s^2$											B $2p^1$	C $2p^2$	N $2p^3$	O $2p^4$	F $2p^5$	Ne $2p^6$
3	Na $3s^1$	Mg $3s^2$											Al $3p^1$	Si $3p^2$	P $3p^3$	S $3p^4$	Cl $3p^5$	Ar $3p^6$
4	K $4s^1$	Ca $4s^2$	Sc $3d^1$	Ti $3d^2$	V $3d^3$	Cr $3d^5$	Mn $3d^5$	Fe $3d^6$	Co $3d^7$	Ni $3d^8$	Cu $3d^{10}$	Zn $3d^{10}$	Ga $4p^1$	Ge $4p^2$	As $4p^3$	Se $4p^4$	Br $4p^5$	Kr $4p^6$
5	Rb $5s^1$	Sr $5s^2$	Y $4d^1$	Zr $4d^2$	Nb $4d^4$	Mo $4d^5$	Tc $4d^6$	Ru $4d^7$	Rh $4d^8$	Pd $4d^{10}$	Ag $4d^{10}$	Cd $4p^1$	In $5p^1$	Sn $5p^2$	Sb $5p^3$	Te $5p^4$	I $5p^5$	Xe $5p^6$
6	Cs $6s^1$	Ba $6s^2$	*	Hf $5d^2$	Ta $5d^3$	W $5d^4$	Re $5d^5$	Os $5d^6$	Ir $5d^7$	Pt $5d^9$	Au $5d^{10}$	Hg $5d^{10}$	Tl $6p^1$	Pb $6p^2$	Bi $6p^3$	Po $6p^4$	At $6p^5$	Rn $6p^6$
7	Fr $7s^1$	Ra $7s^2$	Ω	Rf $6d^2$	Db $6d^3$	Sg $6d^4$	Bh $6d^5$	Hs $6d^6$	Mt $6d^7$									

		f													
*	La $5d^1$	Ce $4f^1$	Pr $4f^2$	Nd $4f^3$	Pm $4f^4$	Sm $4f^5$	Eu $4f^6$	Gd $4f^7$	Tb $4f^8$	Dy $4f^9$	Ho $4f^{10}$	Er $4f^{11}$	Tm $4f^{12}$	Yb $4f^{14}$	Lu $4f^{14}$
Ω	Ac $6d^1$	Th $5f^1$	Pa $5f^2$	U $5f^3$	Np $5f^4$	Pu $5f^5$	Am $5f^6$	Cm $5f^7$	Bk $5f^8$	Cf $5f^9$	Es $5f^{10}$	Fm $5f^{11}$	Md $5f^{12}$	No $5f^{13}$	Lr $5f^{14}$

General Rules

Wolfgang Pauli

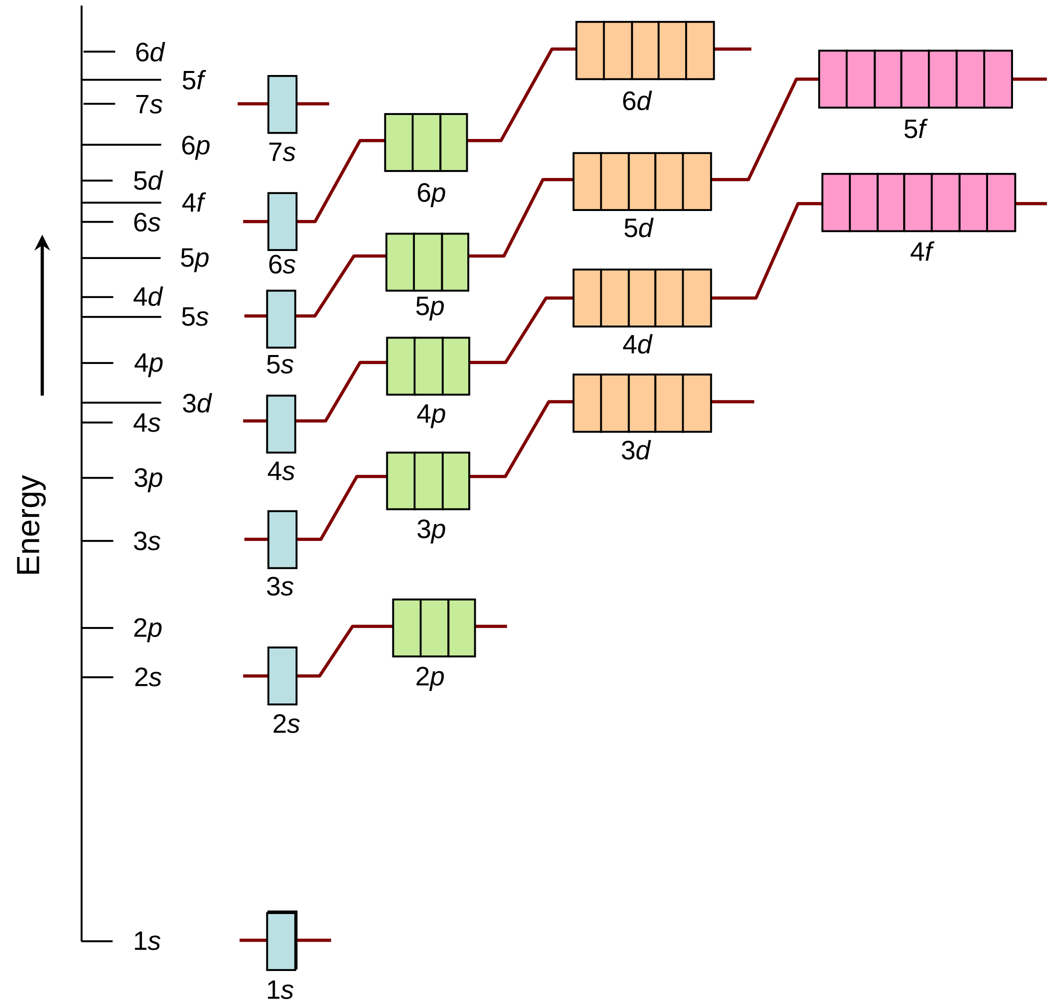
- Pauli Exclusion Principle
  - Each orbital can hold TWO electrons with opposite spins.



General Rules

Aufbau Principle

- Electrons fill the lowest energy orbitals first.
- "Lazy Tenant Rule"



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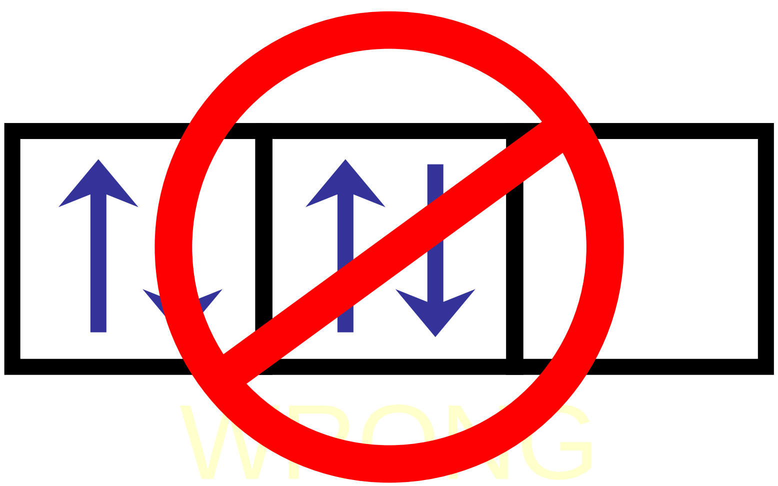
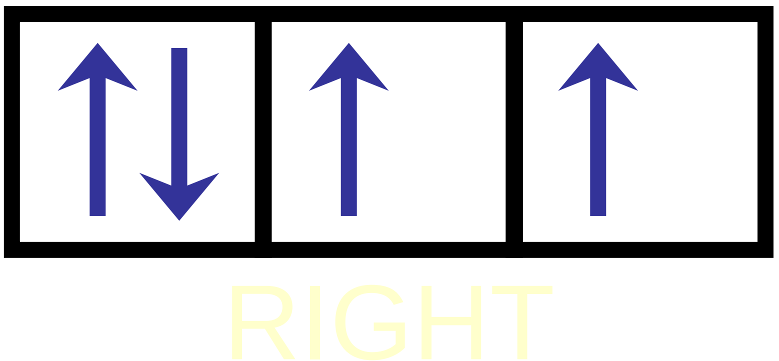
General Rules

- Hund's Rule
  - In a sublevel: one electron per orbital before doubling up.
  - "Empty Bus Seat Rule"





Courtesy Christy Johannesson www.nisd.net/communicationsarts/pages/chem

Electron Configurations

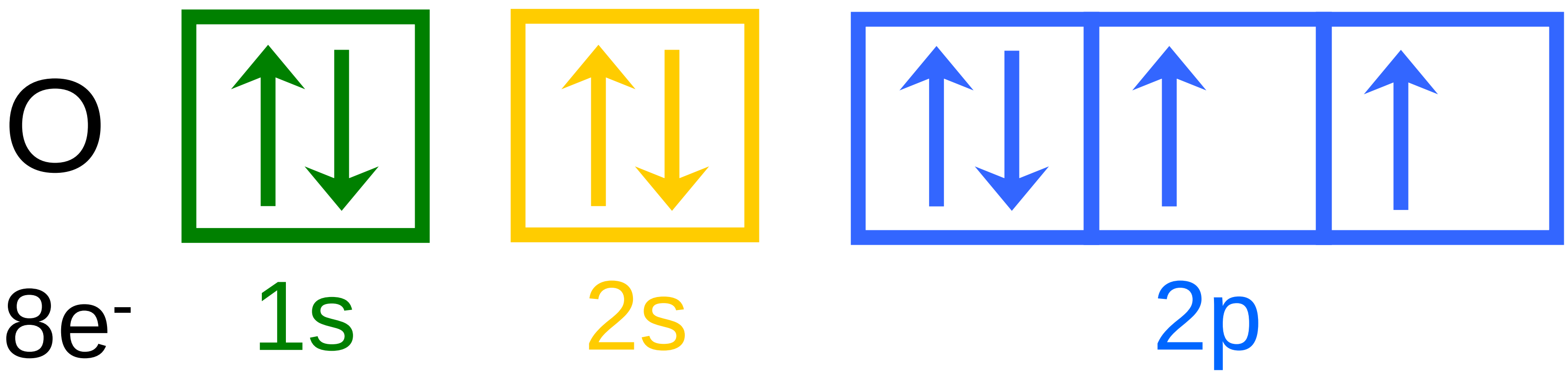
Element	Orbital Filling: 1s	2s	$2p_x$	$2p_y$	$2p_z$	3s	Electron Configuration
H	↑						$1s^1$
He	↑↓						$1s^2$
Li	↑↓	↑					$1s^2 2s^1$
C	↑↓	↑↓	↑	↑			$1s^2 2s^2 2p^2$
N	↑↓	↑↓	↑	↑	↑		$1s^2 2s^2 2p^3$
O	↑↓	↑↓	↑↓	↑	↑		$1s^2 2s^2 2p^4$
F	↑↓	↑↓	↑↓	↑↓	↑		$1s^2 2s^2 2p^5$
Ne	↑↓	↑↓	↑↓	↑↓	↑↓		$1s^2 2s^2 2p^6$
Na	↑↓	↑↓	↑↓	↑↓	↑↓	↑	$1s^2 2s^2 2p^6 3s^1$

NOT CORRECT
Violates Hund's Rule

8
O
15.9994

Notation

- Orbital Diagram

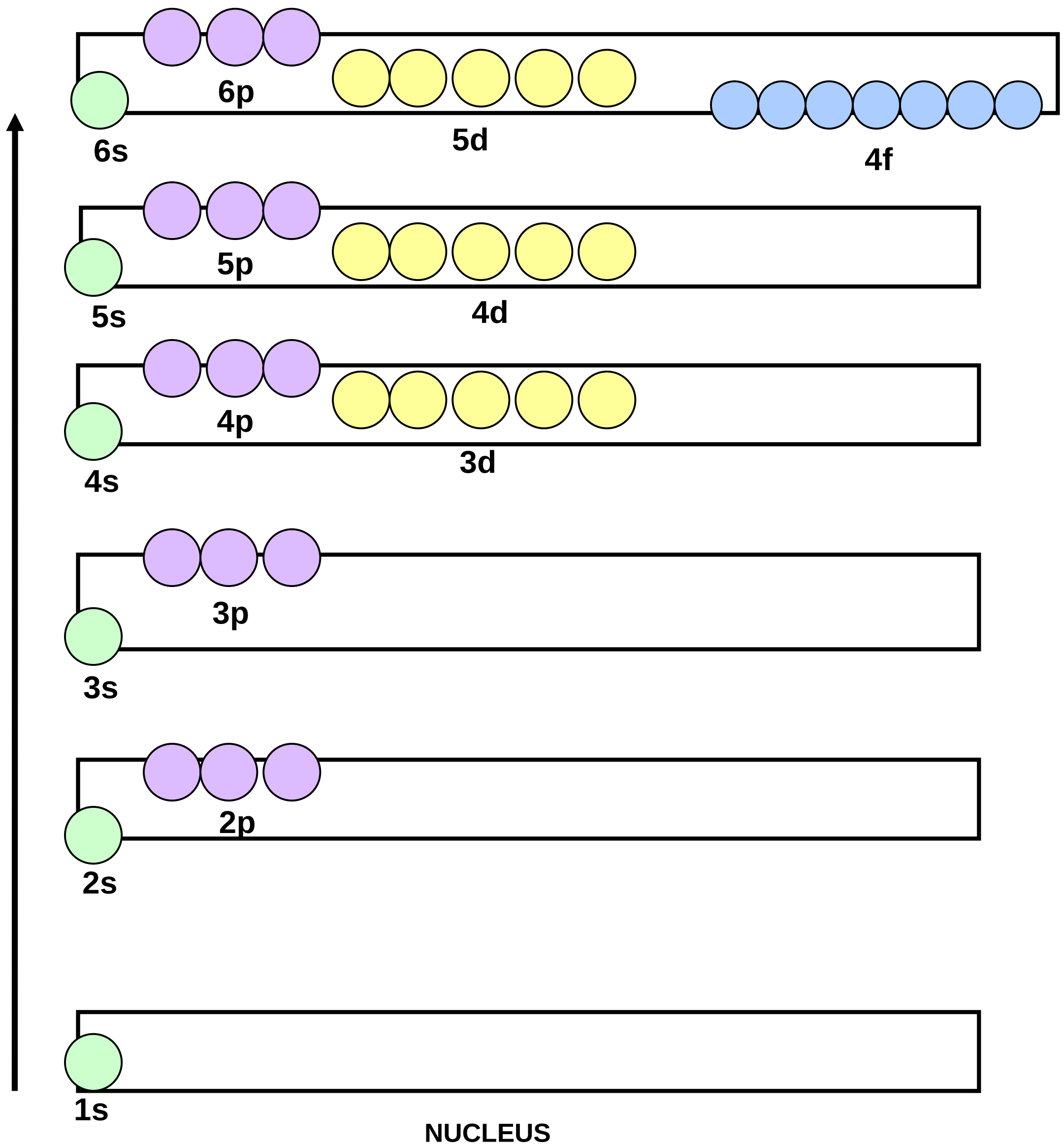


- **Electron Configuration**

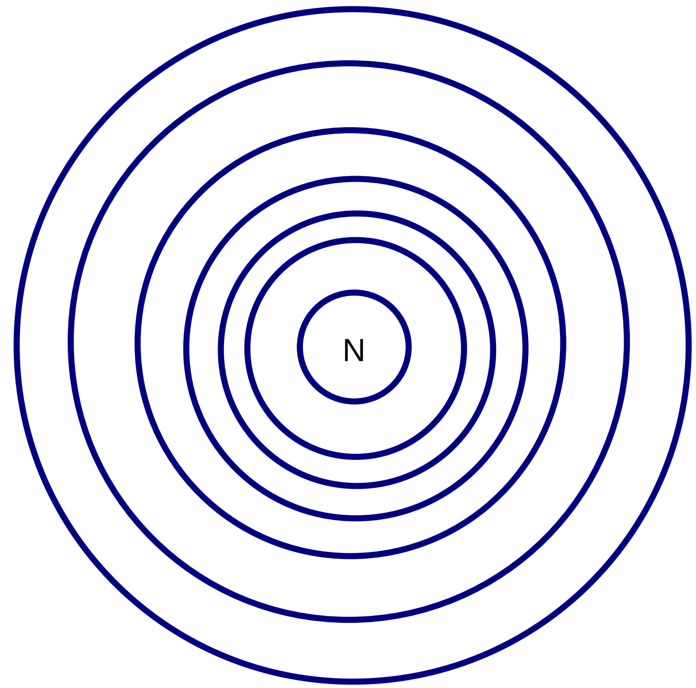
$1s^2\ 2s^2\ 2p^4$

Courtesy Christy Johannesson www.nisd.net/communicationsarts/pages/chem

Energy Level Diagram



Bohr Model



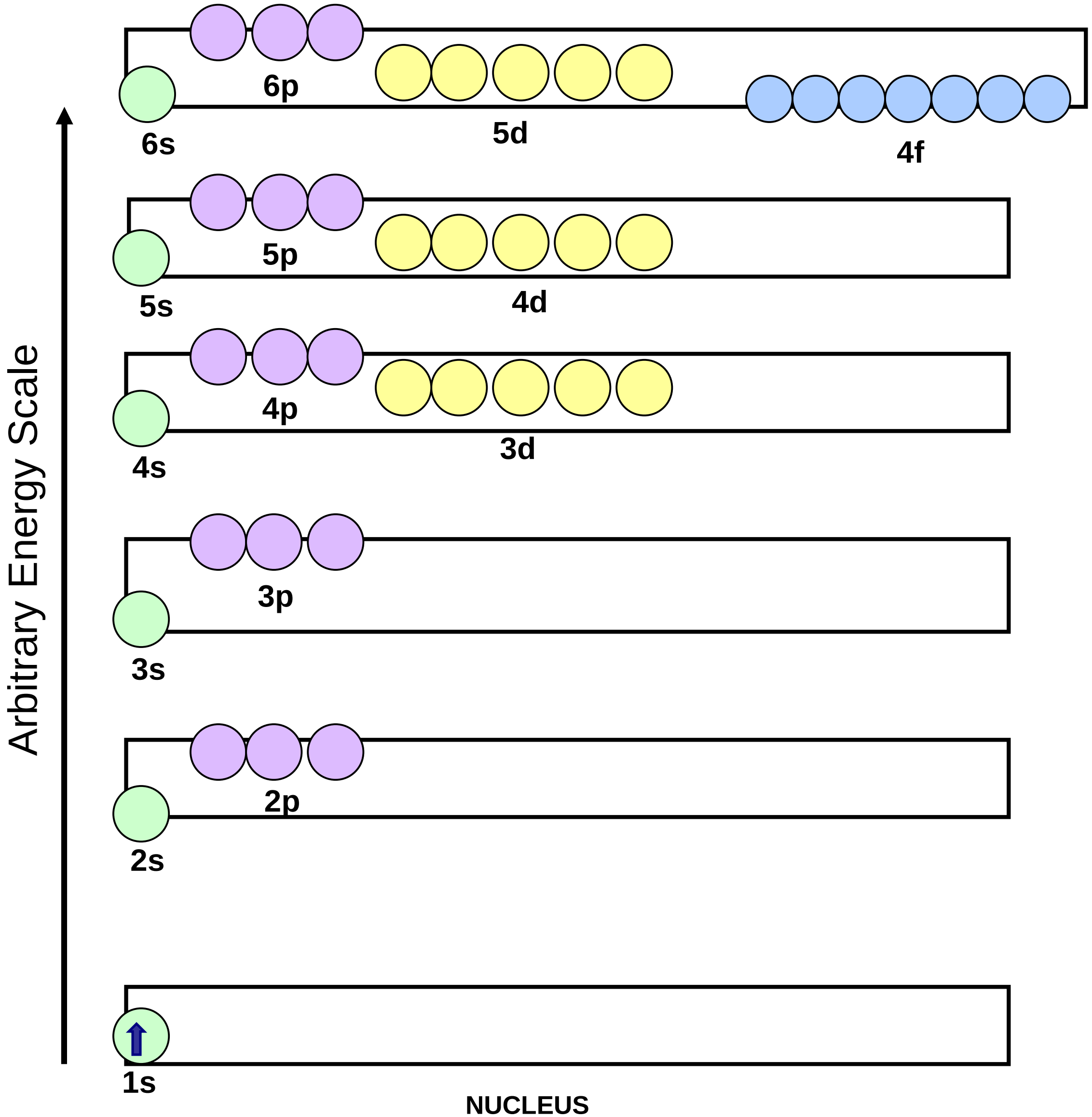
“ground state”

Electron Configuration

H He Li C N Al Ar F Fe La

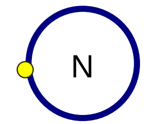
CLICK ON ELEMENT TO FILL IN CHARTS

Energy Level Diagram



Hydrogen

Bohr Model



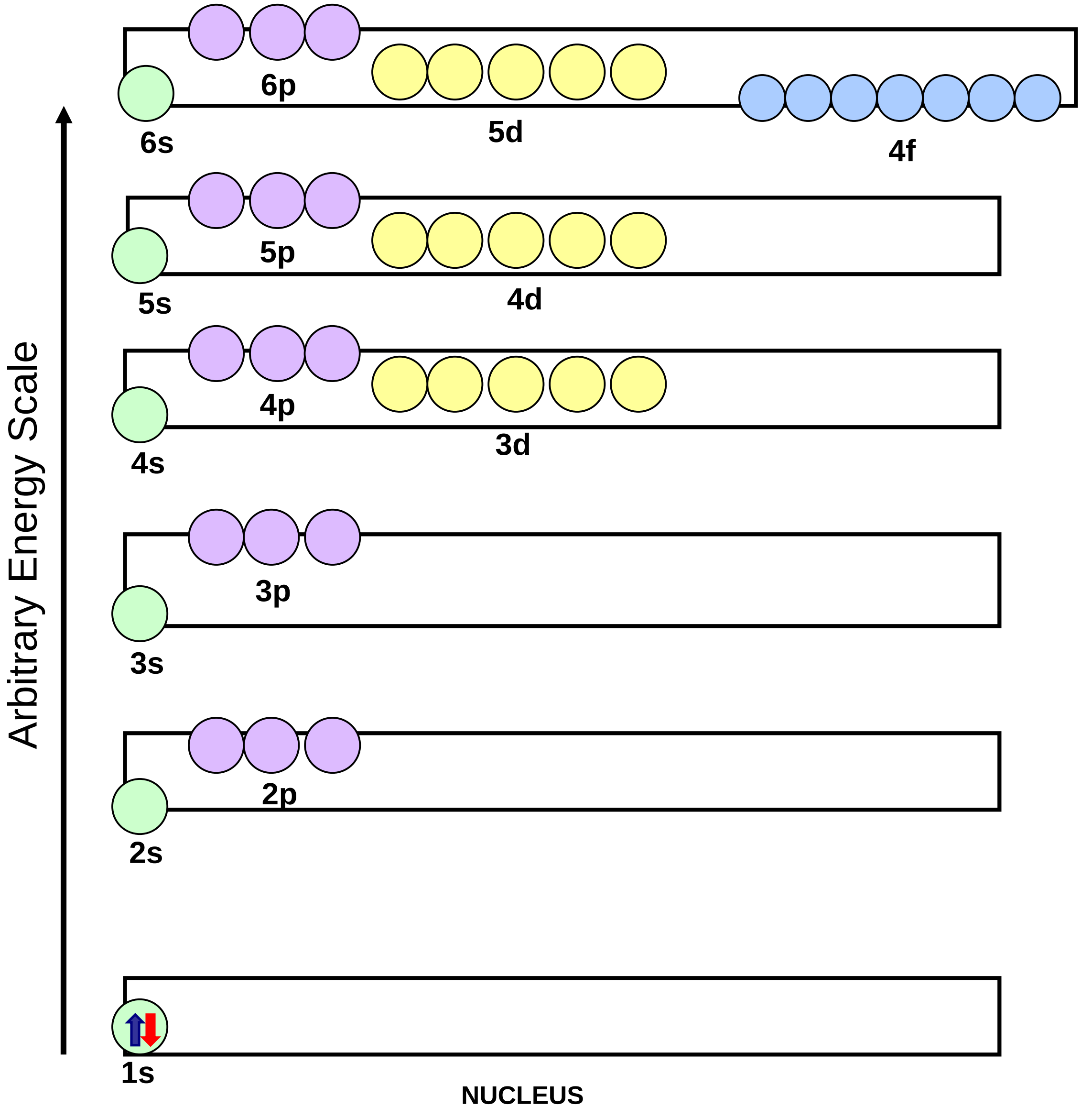
Electron Configuration

$1s^1$

H He Li C N Al Ar F Fe La

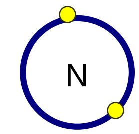
CLICK ON ELEMENT TO FILL IN CHARTS

Energy Level Diagram



Helium

Bohr Model



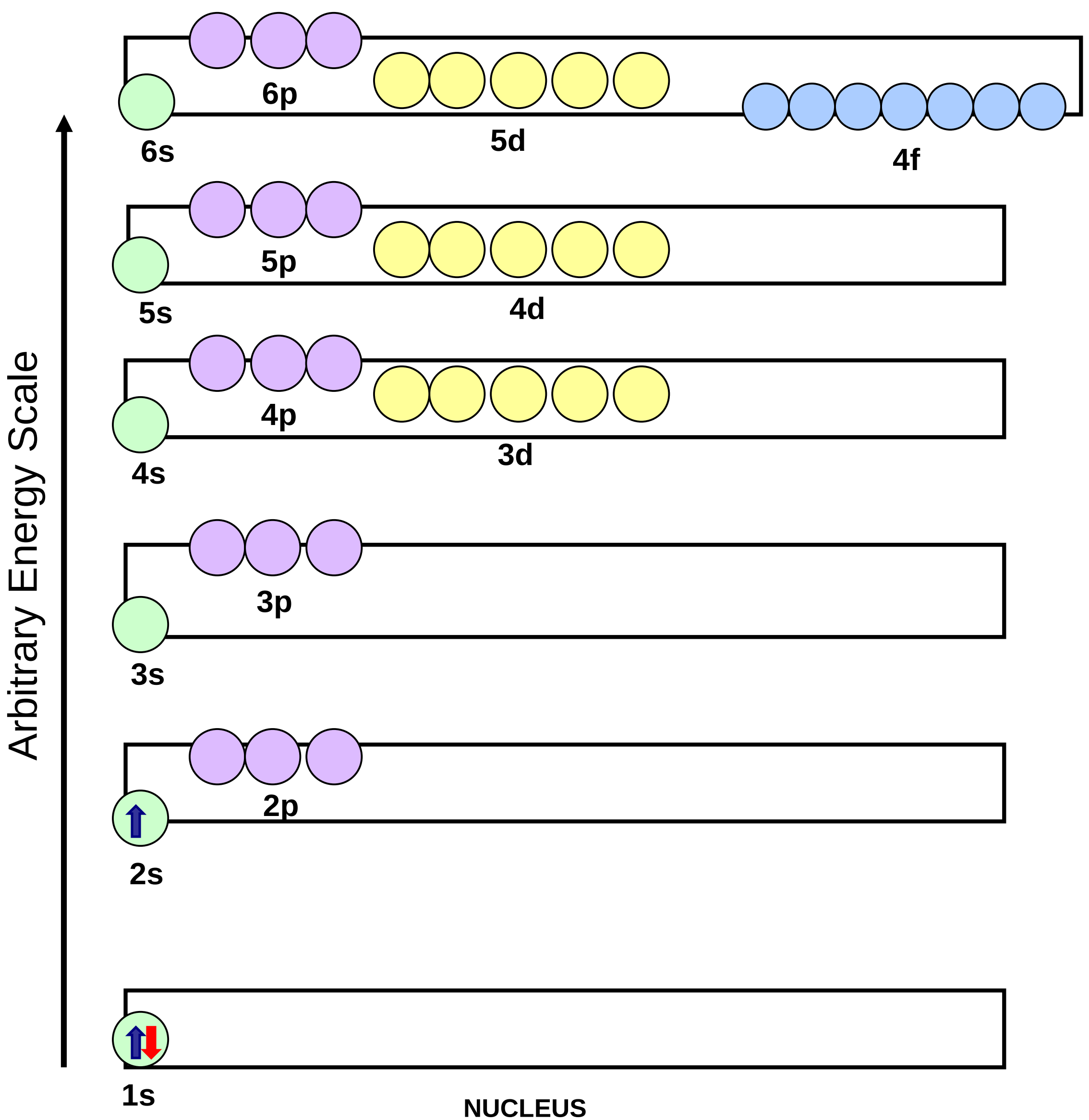
Electron Configuration

$1s^2$

H He Li C N Al Ar F Fe La

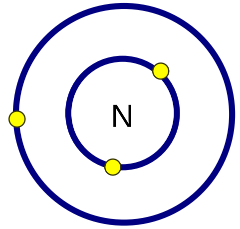
CLICK ON ELEMENT TO FILL IN CHARTS

Energy Level Diagram



Lithium

Bohr Model



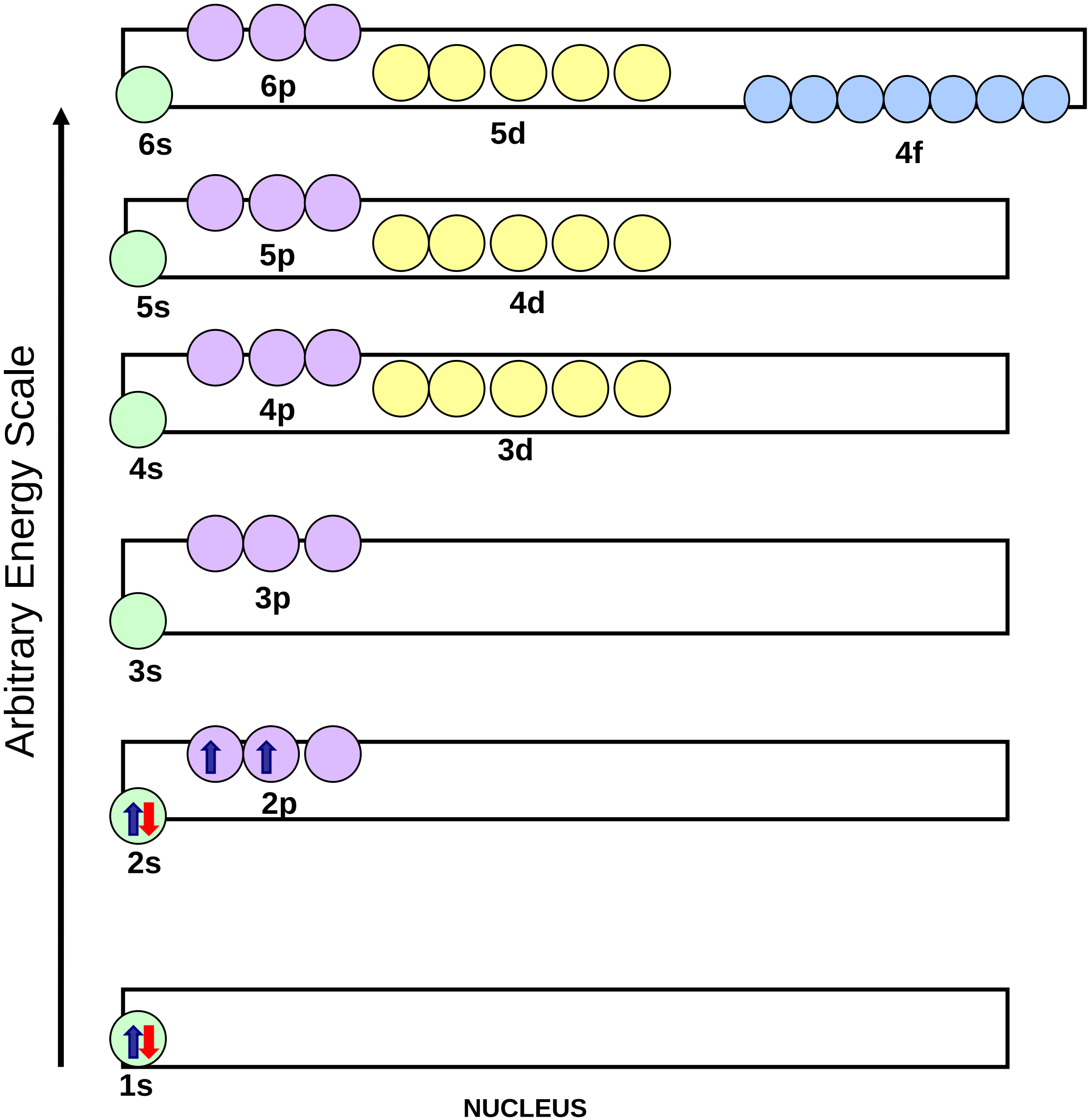
Electron Configuration

$1s^2 2s^1$

H He Li C N Al Ar F Fe La

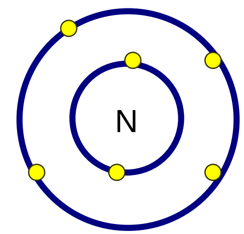
CLICK ON ELEMENT TO FILL IN CHARTS

Energy Level Diagram



Carbon

Bohr Model



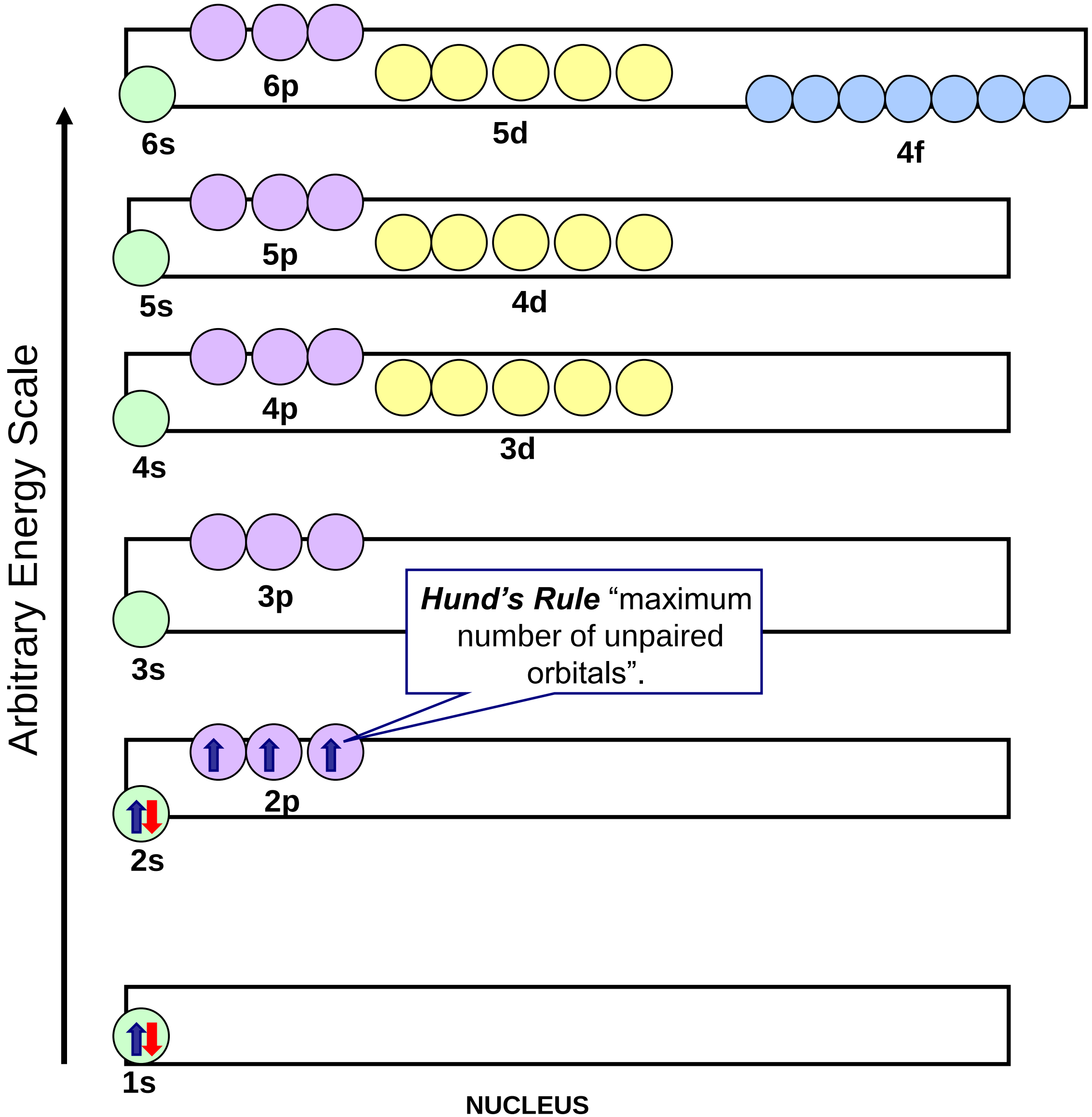
Electron Configuration

$1s^2 2s^2 2p^2$

H He Li C N Al Ar F Fe La

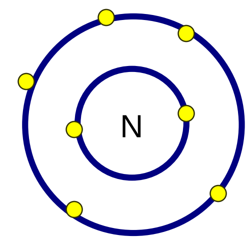
CLICK ON ELEMENT TO FILL IN CHARTS

Energy Level Diagram



Nitrogen

Bohr Model



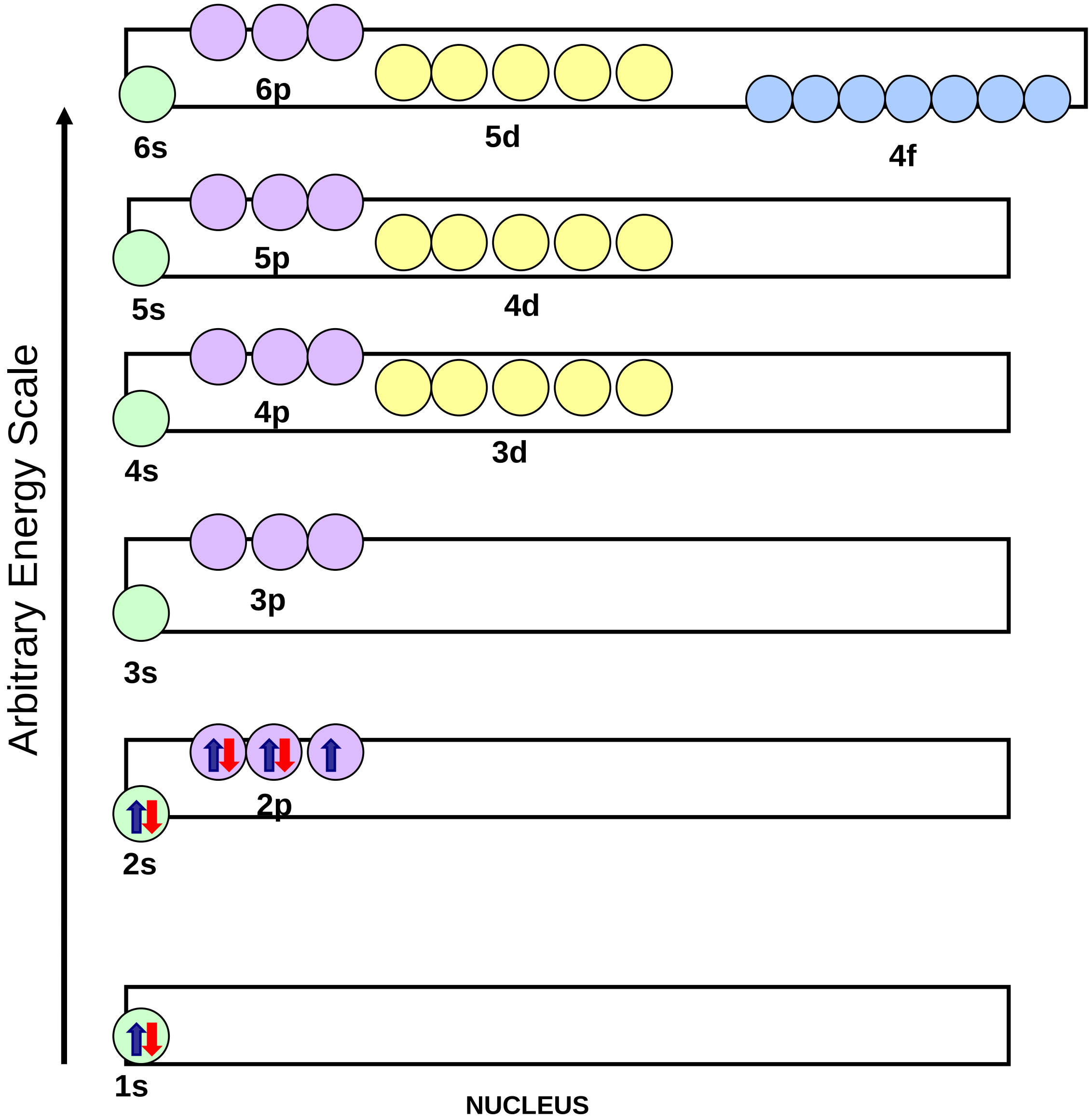
Electron Configuration

$1s^22s^22p^3$

H He Li C N Al Ar F Fe La

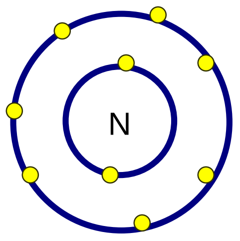
CLICK ON ELEMENT TO FILL IN CHARTS

Energy Level Diagram



Fluorine

Bohr Model



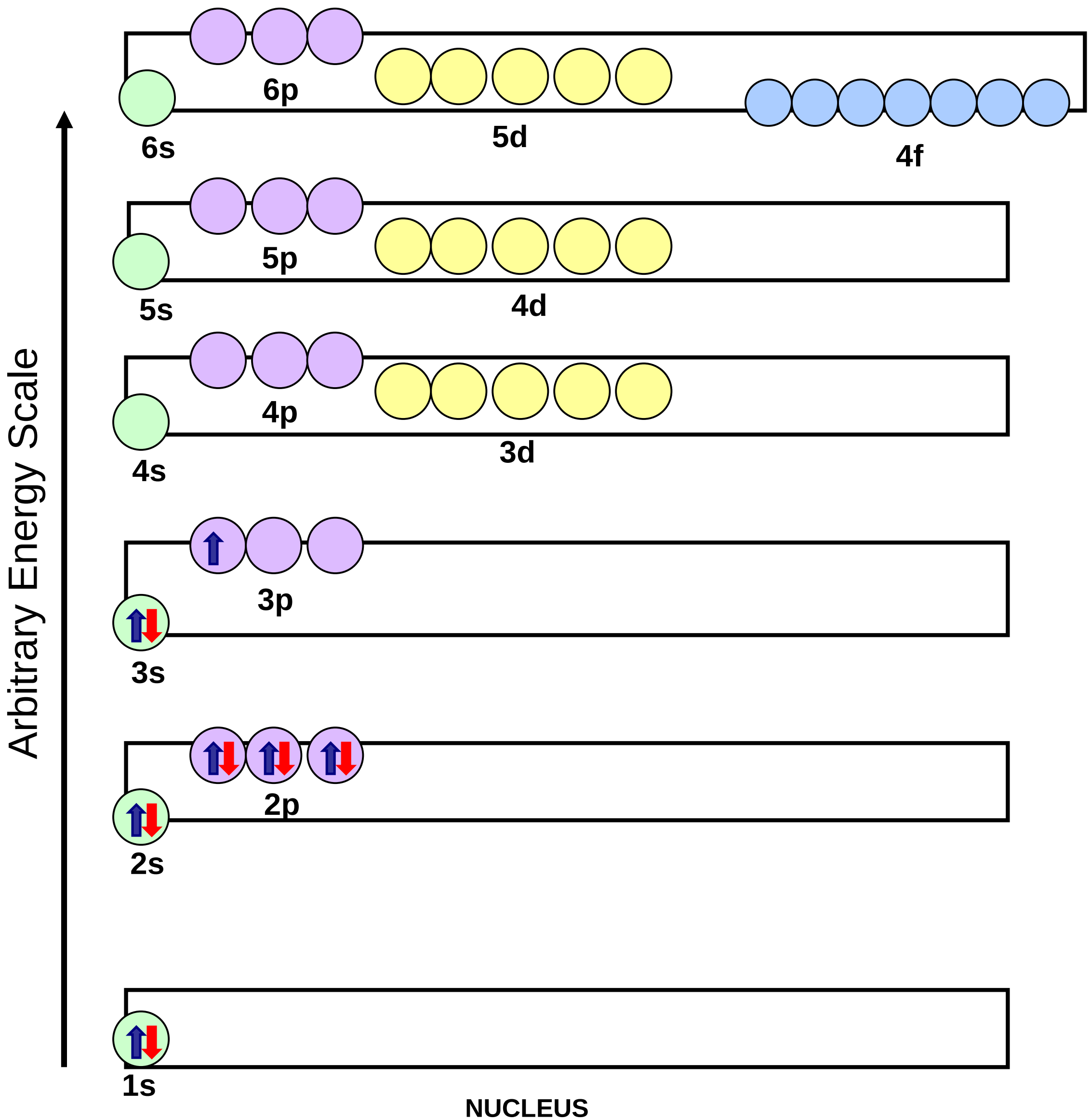
Electron Configuration

$1s^2 2s^2 2p^5$

H He Li C N Al Ar F Fe La

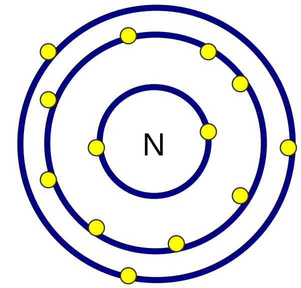
CLICK ON ELEMENT TO FILL IN CHARTS

Energy Level Diagram



Aluminum

Bohr Model



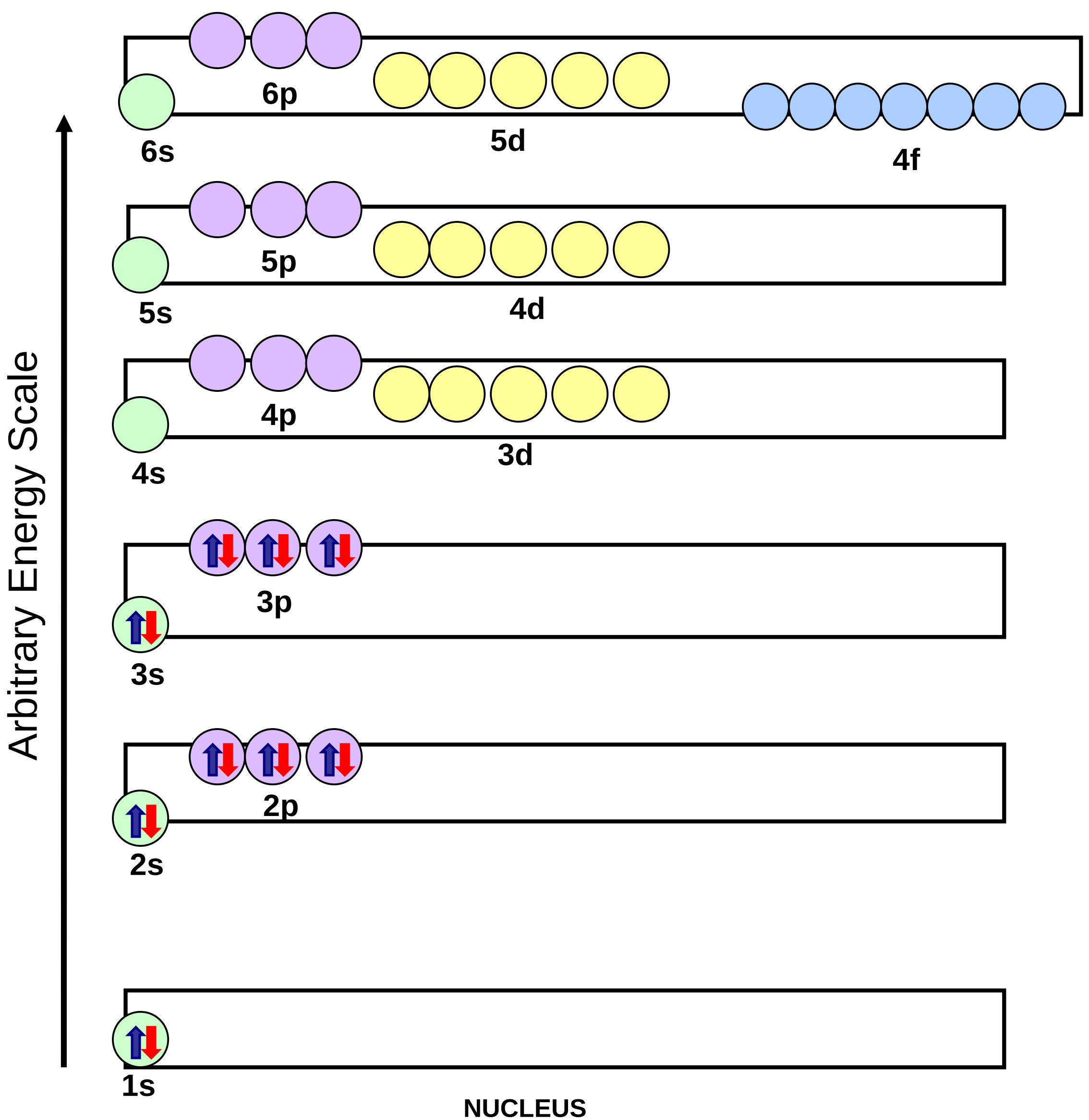
Electron Configuration

$1s^2 2s^2 2p^6 3s^2 3p^1$

H He Li C N Al Ar F Fe La

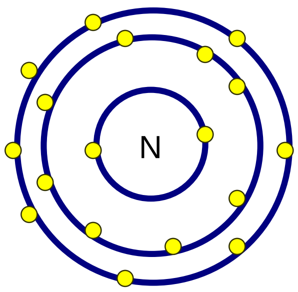
CLICK ON ELEMENT TO FILL IN CHARTS

Energy Level Diagram



Argon

Bohr Model



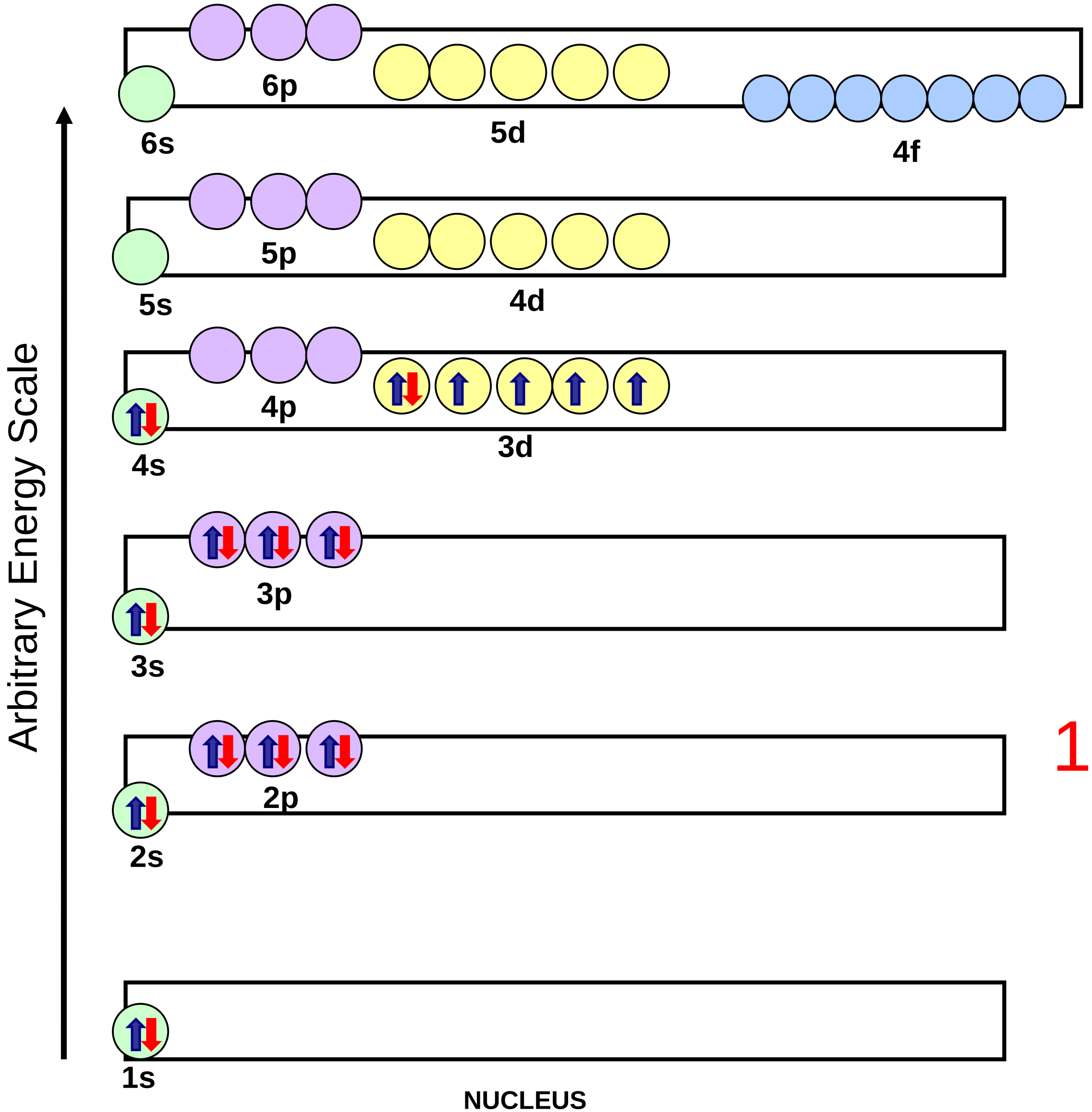
Electron Configuration

$1s^2 2s^2 2p^6 3s^2 3p^6$

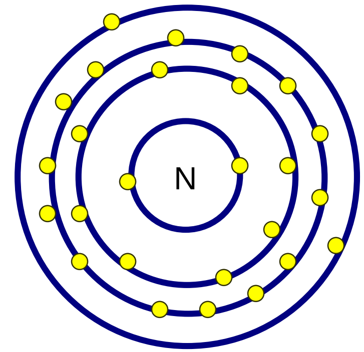
H He Li C N Al Ar F Fe La

CLICK ON ELEMENT TO FILL IN CHARTS

Energy Level Diagram



Iron
Bohr Model



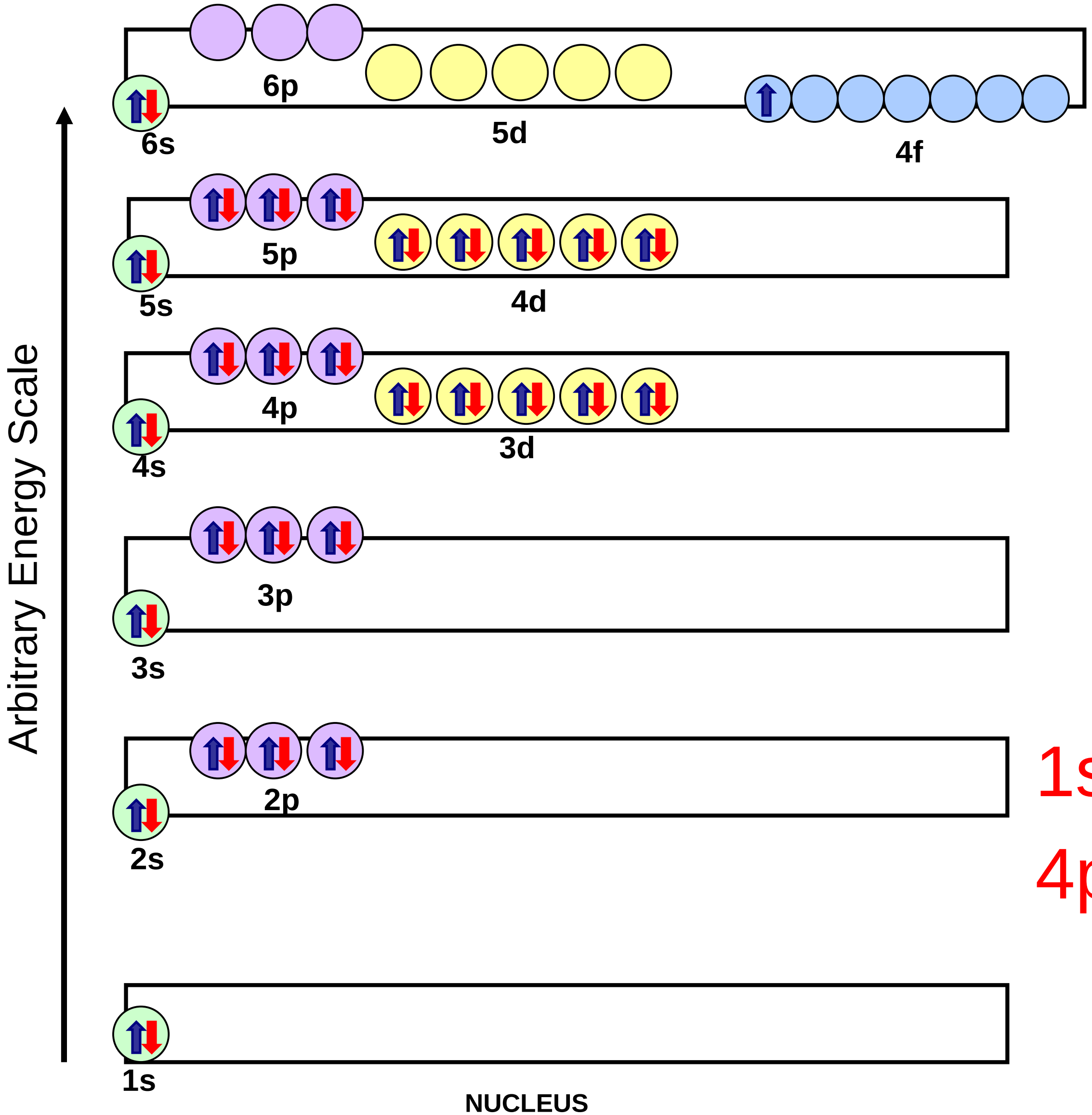
Electron Configuration

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

H He Li C N Al Ar F Fe La

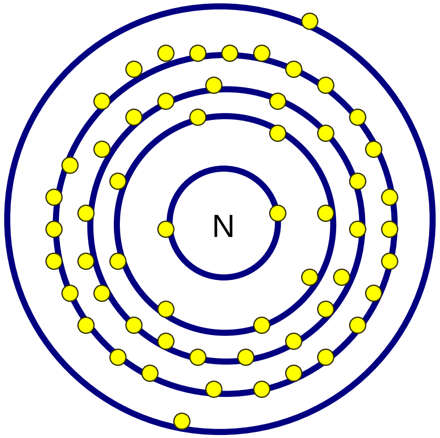
CLICK ON ELEMENT TO FILL IN CHARTS

Energy Level Diagram



Lanthanum

Bohr Model



Electron Configuration

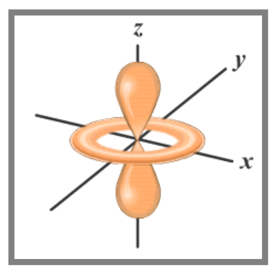
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$
$4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^1$

H He Li C N Al Ar F Fe La

CLICK ON ELEMENT TO FILL IN CHARTS

Review Notes 5.3 & 6.2 (pt.3)
Electron Configuration & Orbitals

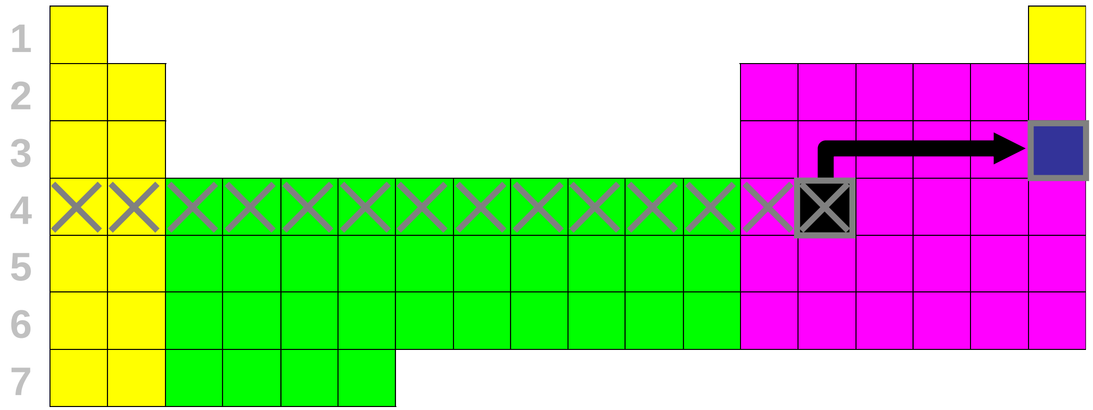
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6$…



32
Ge
72.61

Shorthand Configuration

- Example - Germanium



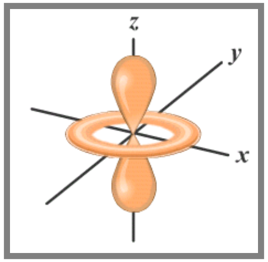
[Ar] $4s^2$ $3d^{10}$ $4p^2$

Shorthand Configuration

Element symbol	Electron configuration
Ca	[Ar] $4s^2$
V	[Ar] $4s^2\ 3d^3$
F	[He] $2s^2\ 2p^5$
Ag	[Kr] $5s^2\ 4d^9$
I	[Kr] $5s^2\ 4d^{10}\ 5p^5$
Xe	[Kr] $5s^2\ 4d^{10}\ 5p^6$
Fe	[He] $2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$ [Ar] $4s^2\ 3d^6$
Sg	[Rn] $7s^2\ 5f^{14}\ 6d^4$

Review Notes 5.3 & 6.2 (pt.4)
Electron Configuration & Orbitals

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6$…



Valence Electrons

What are "valence electrons"?

- Electrons in the _outer_ - _most_ energy level.
- "_s_" electrons and "_p_" electrons only.

Counting Valence Electrons

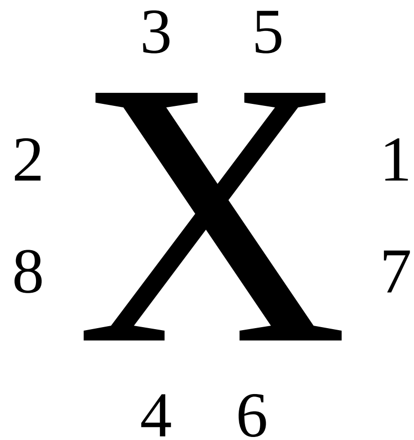
- Group A # = number of valence electrons

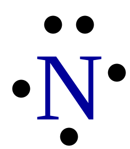
(exception Helium = _2_ e^-'s)

Examples: Ca = _2_ e^-'s Nitrogen = _5_ e^-'s Argon = _8_ e^-'s

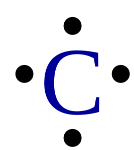
- ALL d-block and f-block = _2_ valence e^-'s

Drawing Valence Electrons

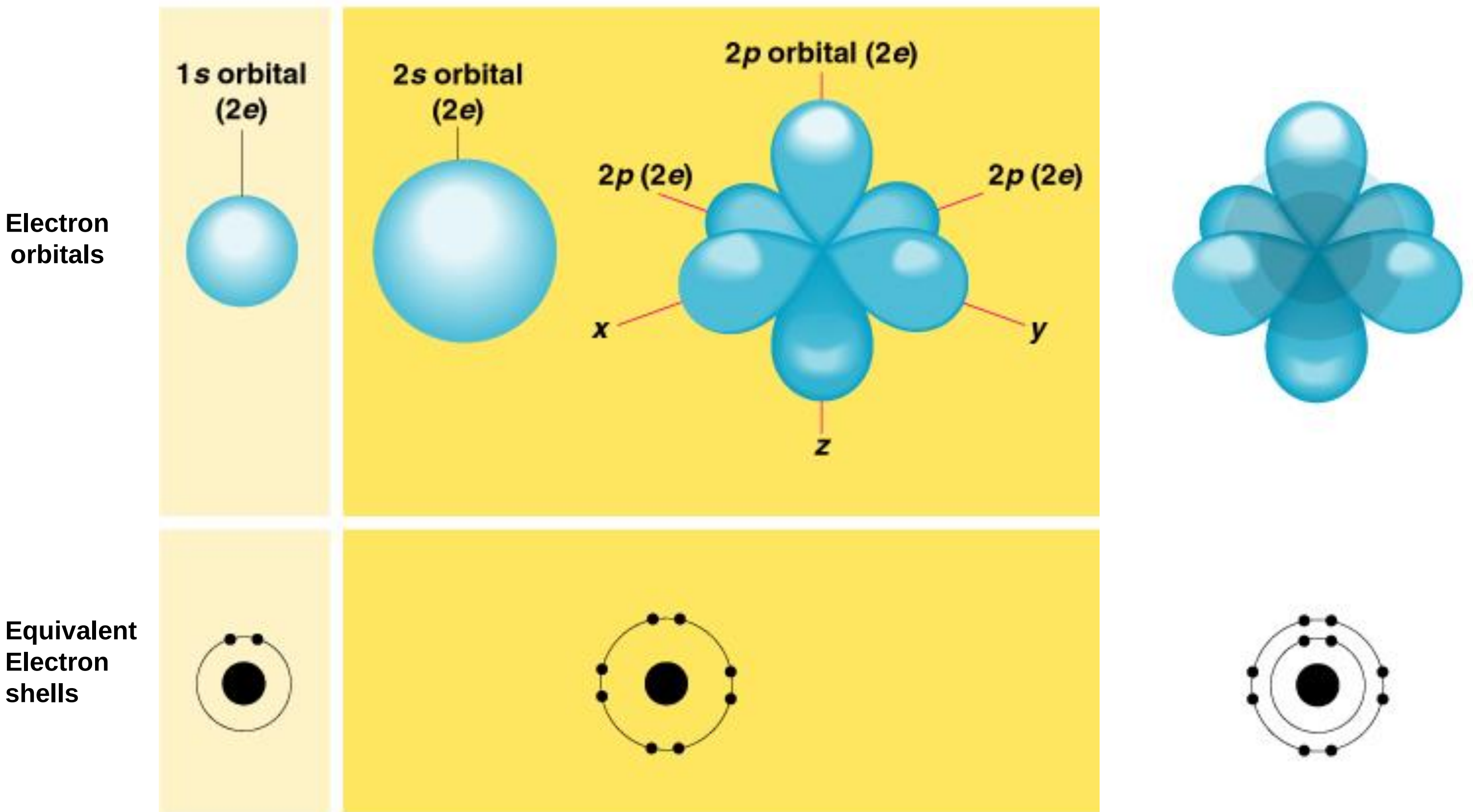


Examples: Nitrogen = 

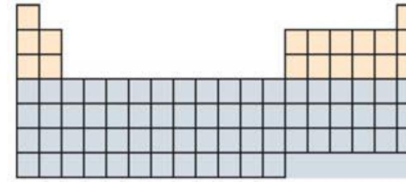
Hydrogen = 

Carbon = 

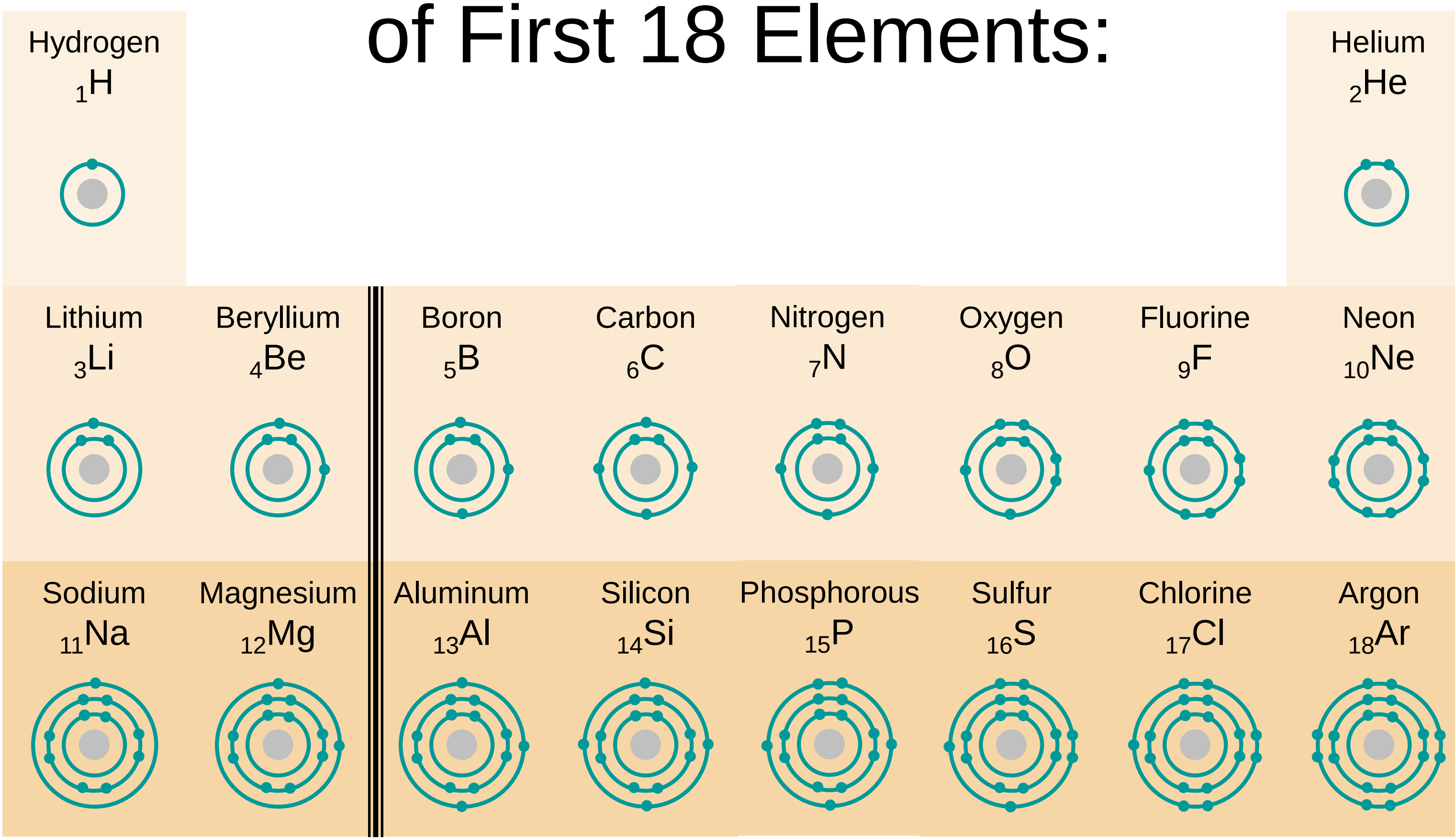
Electron Orbitals:



(a) 1*s* orbital **(b) 2*s* and 2*p* orbitals** **c) Neon Ne-10: 1*s*, 2*s* and 2*p***



Electron Configurations of First 18 Elements:

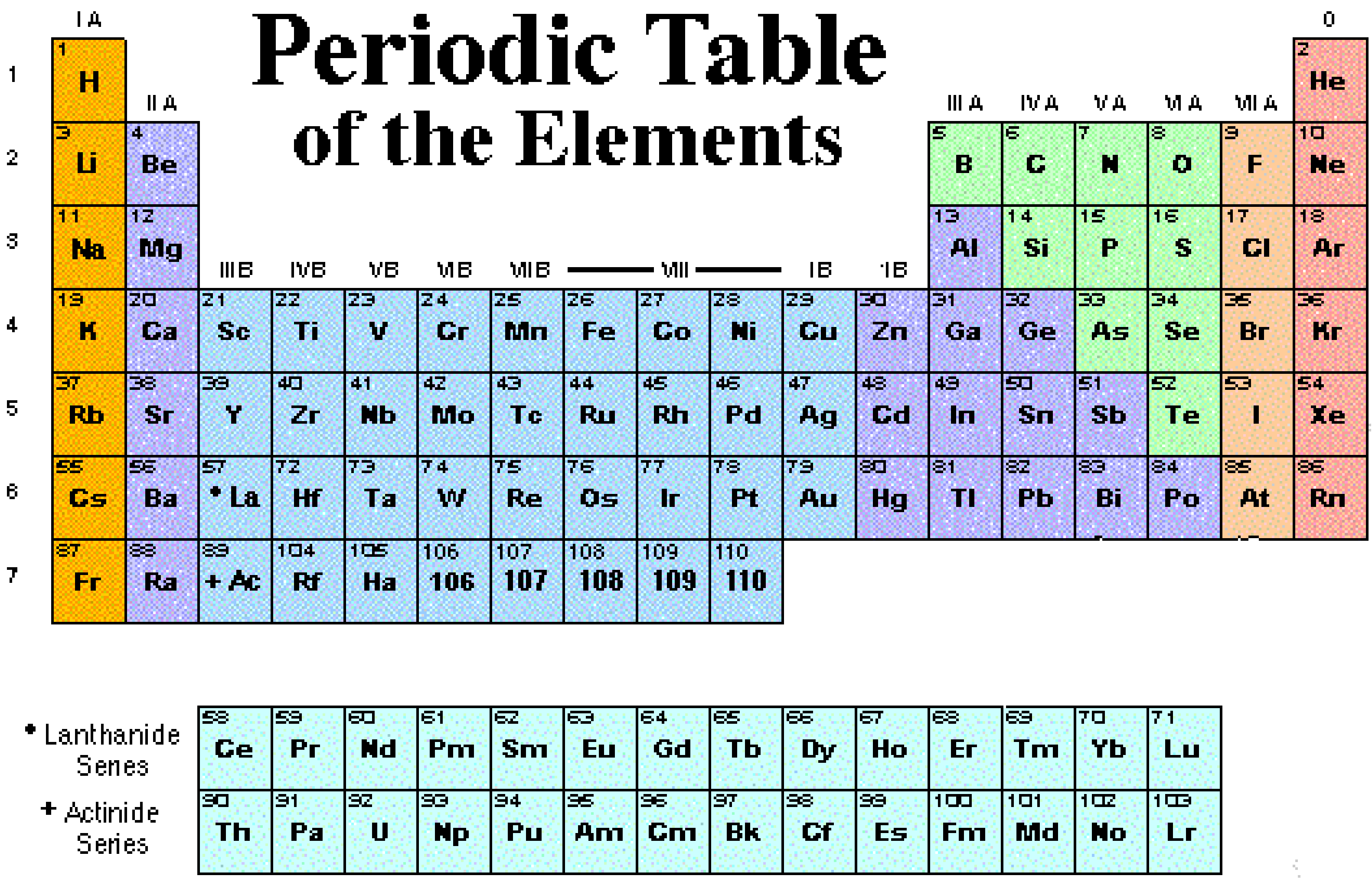


Electron Dot Diagrams

Group							
1A 1	2A 2	3A 13	4A 14	5A 15	6A 16	7A 17	8A 18
H							He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar
K	Ca	Ga	Ge	As	Se	Br	Kr
s^1	s^2	s^2p^1	s^2p^2	s^2p^3	s^2p^4	s^2p^5	s^2p^6

= valence electron

Review Notes 6.3



Trends in the Periodic Table

Atomic Size (Atomic Radius)

(See Fig. 14.10)

- Moving Down a Group= the size of the atoms ______increases______
  - Why? You are adding ___more___ of electrons to higher and higher energy levels (farther and farther out.)
- Moving Across a Period= the size generally _____decreases_____
  - Why? You are adding more e^- and p^+ to the same energy level. This causes more _____attraction_____ of opposite charges and it ____pulls____ the electron cloud inward.

Trends in the Periodic Table

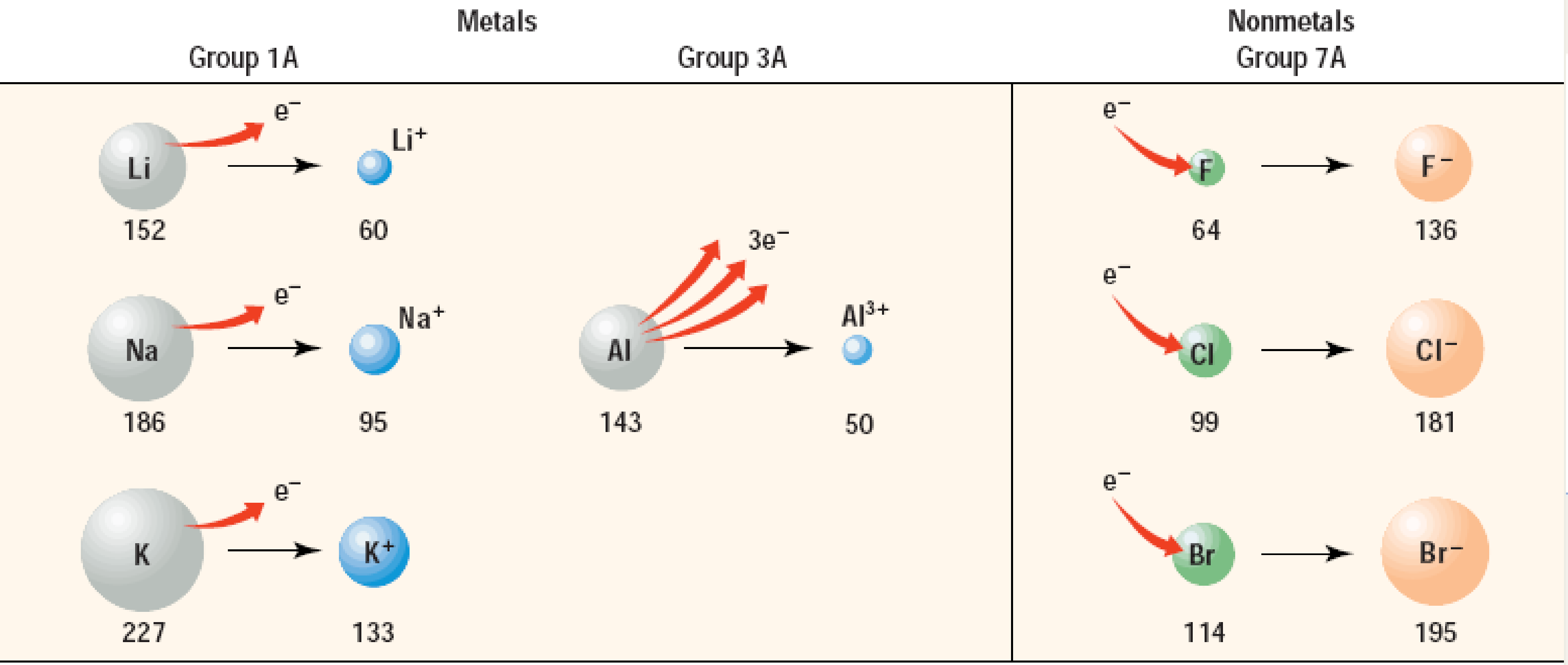
Atomic Size vs. Ion Size

(See Fig. 14.8)

- **Cation** = (__+__) charged atom created by __removing__ e-'s.
  - Cations are __smaller__ than the original atom.
  - __Metals__ generally form cations.
- **Anion** = (__–__) charged atom created by __adding__ e-'s.
  - Anions are __larger__ than the original atom.
  - __Nonmetals__ generally form anions.

Trends in the Periodic Table

Atomic Size vs. Ion Size



Determining the Ion Formed

- Atoms try to achieve a __noble__ __gas__ configuration when forming an ion. (This makes them more stable.)
  - Locate the nearest noble gas and count how many "places" it is away, but remember that you can skip over the d-block!!
  - This amount will be the same as the # of e^-'s either gained or lost by the atom when forming an ion.

Practice Problem: How many electrons are gained or lost when forming an ion from the following elements?

a) Magnesium: __2__ (gained or lost) b) Iodine: __1__ (gained or lost)

c) Gallium: __3__ (gained or lost) d) Boron: __3__ (gained or lost)

Review Notes 6.3 pt.2

Periodic Table of the Elements

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IB	IIIA	IVA	VA	VIA	VIIA	0
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	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
5	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
6	55 Cs	56 Ba	57 * La	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
7	87 Fr	88 Ra	89 + Ac	104 Rf	105 Ha	106 106	107 107	108 108	109 109	110 110								

* Lanthanide Series	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
+ Actinide Series	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

Trends in the Periodic Table

Ionization Energy

(See Fig. 6.16 & 6.17)

- Ionization energy is the energy required to ______remove______ the outer most electron in an atom.
- Moving Down a Group= ___decreases_______ (less energy is needed)
  - Why? You are trying to remove an electron that is farther and farther out (for larger and larger atoms). These e^-'s are not as ______attracted______to the nucleus.
  - In general, the larger the atom, the _less_ attracted it is to its e^-'s.

Trends in the Periodic Table

Ionization Energy

- Moving Across a Period= generally ____increases______
  - Why? Moving across a period takes us from metals to nonmetals. More ionization energy is needed for ___nonmetals____ compared to ___metals____.
  - Also, since metals generally form __cations___, it won't take as much energy to remove it's outer most electron.
  - Remember that as you move across the period, the atoms get __smaller__ and therefore _more_ attracted to the electrons.

Trends in the Periodic Table

"Successive Ionization Energies"

(See Table 6.2)

- "Successive Ionization Energies" means the energy required to remove a __2nd__ or a __3rd__ electron from an atom.
  - Removing more and more e^-'s requires __more__ and __more__ energy.
  - Why? The remaining e^-'s are more __tightly__ __bound__ to the nucleus.

Trends in the Periodic Table

Electronegativity

(See Fig 6.18)

- Electronegativity is a relative value (from___0 – 4.0__) which compares how much an atom is attracted to the e^-'s in a ___chemical___ bond.
- Moving Down a Group= generally ____decreases____ (less attraction)
  - Why? The bonded electron is farther and farther out. These e^-'s will not be as attracted to the larger and larger atoms.

Trends in the Periodic Table

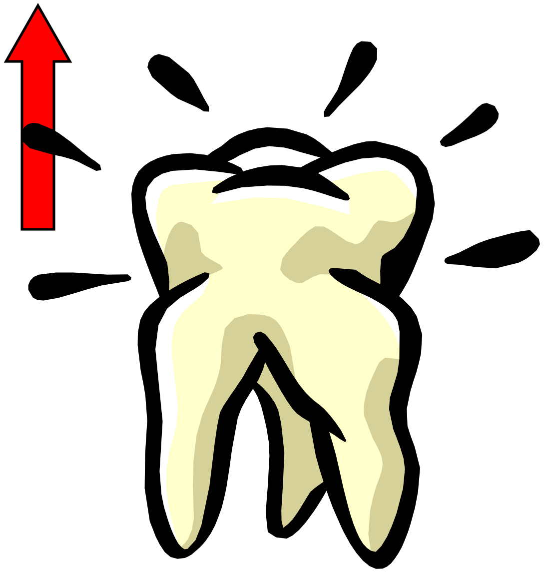
Electronegativity

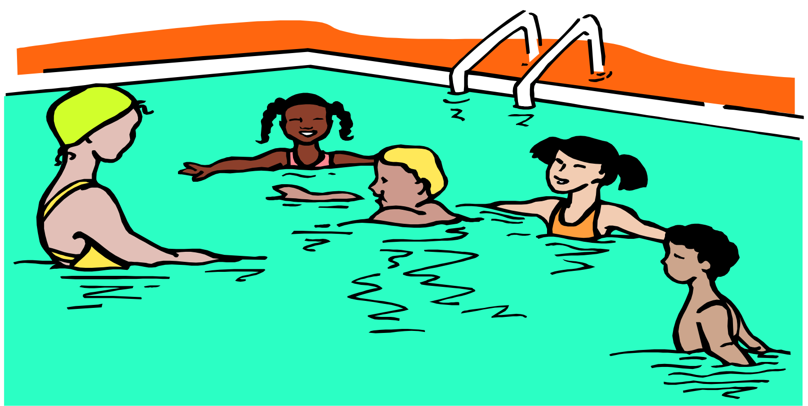
- Moving Across a Period= generally ______increases______
  - Why? Again, the atoms are getting _smaller_ so they are _more_ attracted to the bonding electrons.
  - Also, moving across a period takes us from metals to nonmetals. Since nonmetals generally form _anions_, they tend to _gain_ e^-'s anyway, and this makes them _highly_ attracted to e^-'s when forming a chemical bond.
  - _Noble_ _gases_ are not listed in Fig 6-18 since they do not _form_ _compounds_.

Periodic Table Geography

Halogens

- Very **reactive**, volatile, **diatomic**, nonmetals
- Always **found combined** with other element in nature .





Noble Gases

- VERY **unreactive**, monatomic gases
- Have a **full valence** shell.

Alkali Metals

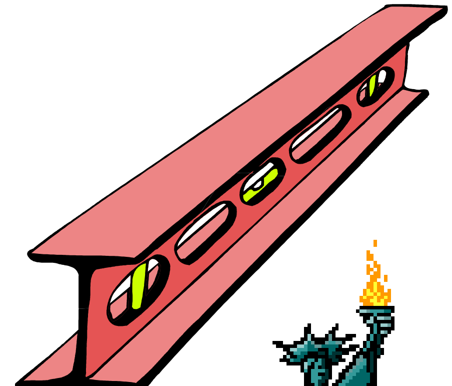
- **<u>Very reactive metals (solids) with air and water</u>**, always combined with something else in nature (like in salt).
- Soft enough to cut with a butter knife

Alkaline Earth Metals

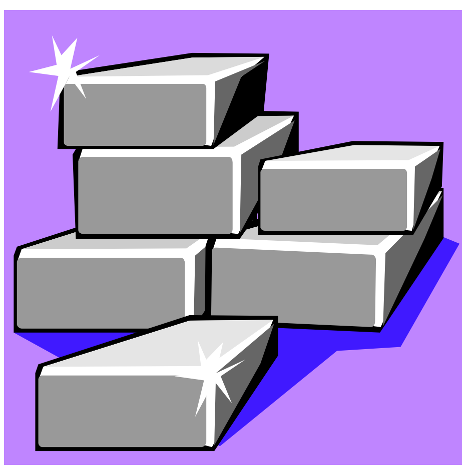
- Reactive metals (solids) that are always combined with nonmetals in nature.
- Several of these elements are important mineral nutrients (such as Mg and Ca
- Also, used used in batteries

Transition Metals

Transition Metals



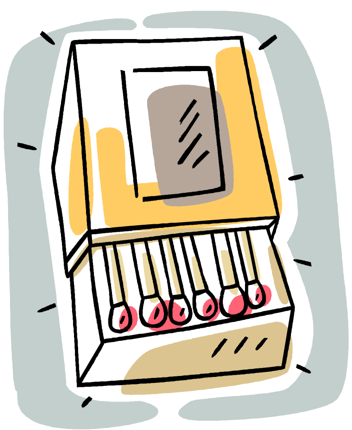
- Elements in groups 3-12
- All solids except Mercury
- Less reactive harder metals
- Includes metals used in jewelry and construction.
- Metals used “as metal.”

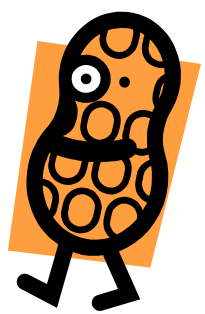


Carbon Family

- Elements in group 14
- Contains elements important to life and computers.
- Carbon is the basis for an **entire branch** of chemistry.
- Silicon and Germanium are important semiconductors.

Nitrogen Family

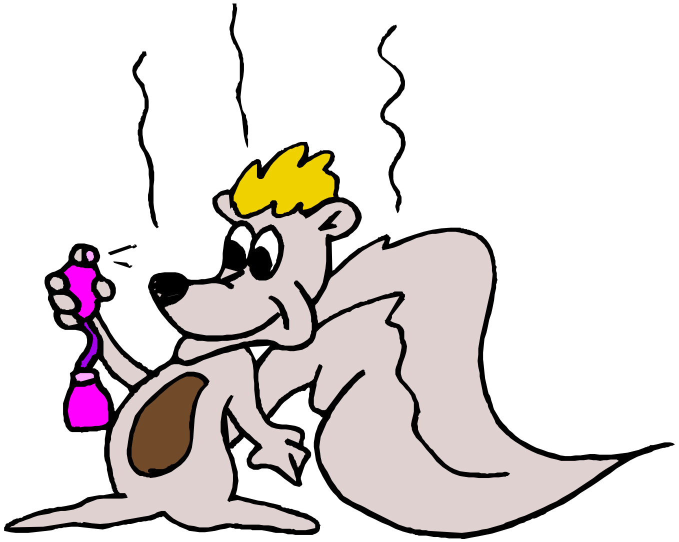




- Elements in group 15
- Nitrogen makes up over 80% of the atmosphere.
- Nitrogen and phosphorus are both important in living things.
- The red stuff on the tip of matches is phosphorus.

Oxygen Family or Chalcogens

- Elements in group 16
- Oxygen is necessary for respiration.
- Many things that stink, contain sulfur (rotten eggs, garlic, skunks,etc.)



QUESTIONS