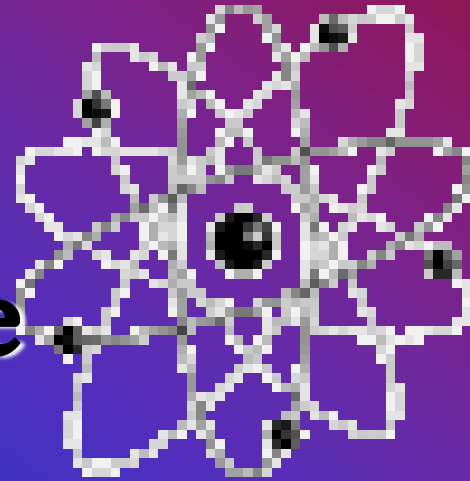
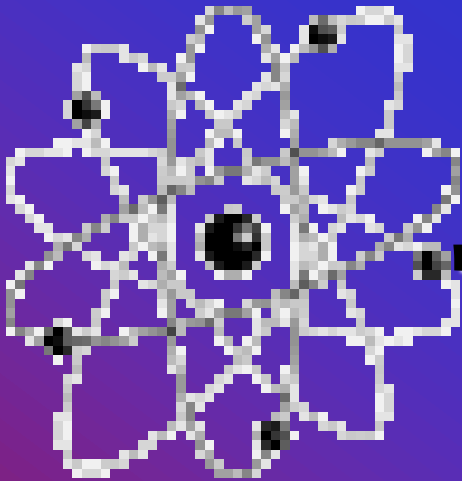


Properties of Atoms

&

The Periodic Table



Atomic Structure Goals

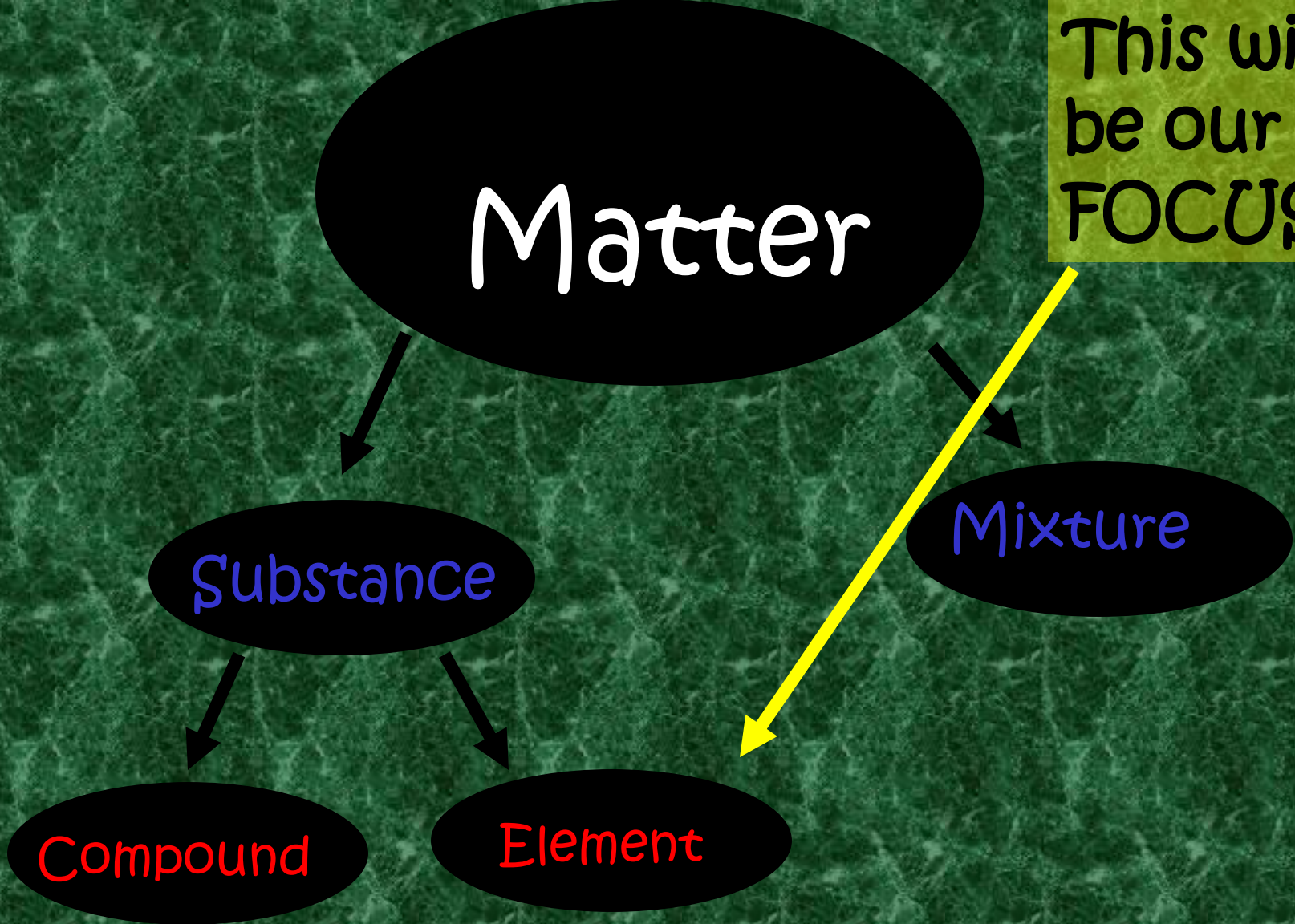
Examine the structure of the atom in terms of

1. proton, electron, and neutron locations.
2. atomic mass and atomic number.
3. atoms with different numbers of neutrons (isotopes).

Periodic Table Goals

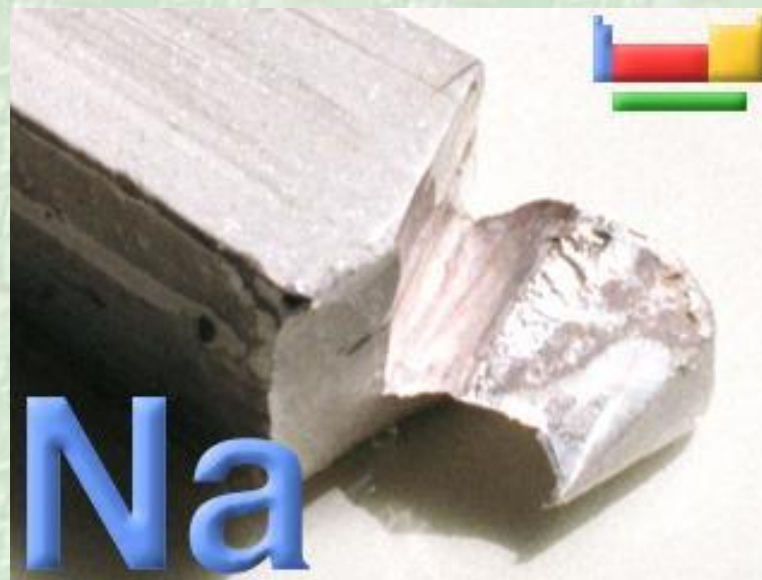
- Determine the trends of the following:
 - Number of valence electrons
 - Types of ions formed by representative elements
 - Location of metals, nonmetals, and metalloids
 - Phases at room temperature
- Use the Periodic Table to predict the above properties for representative elements.

This will be our FOCUS



What is an Element?

- One of the ~116 known “Pure”, un-cuttable substances.



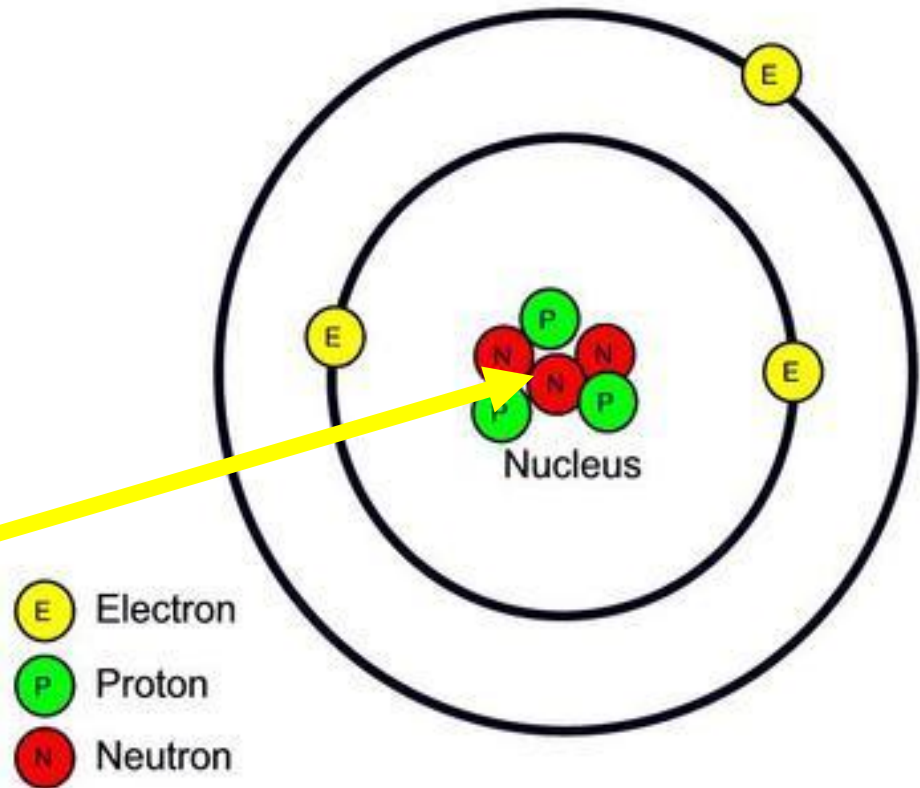
What is an Atom?

- Smallest piece of matter that still retains the properties of that matter.
- What are they composed of?

Subatomic Particles

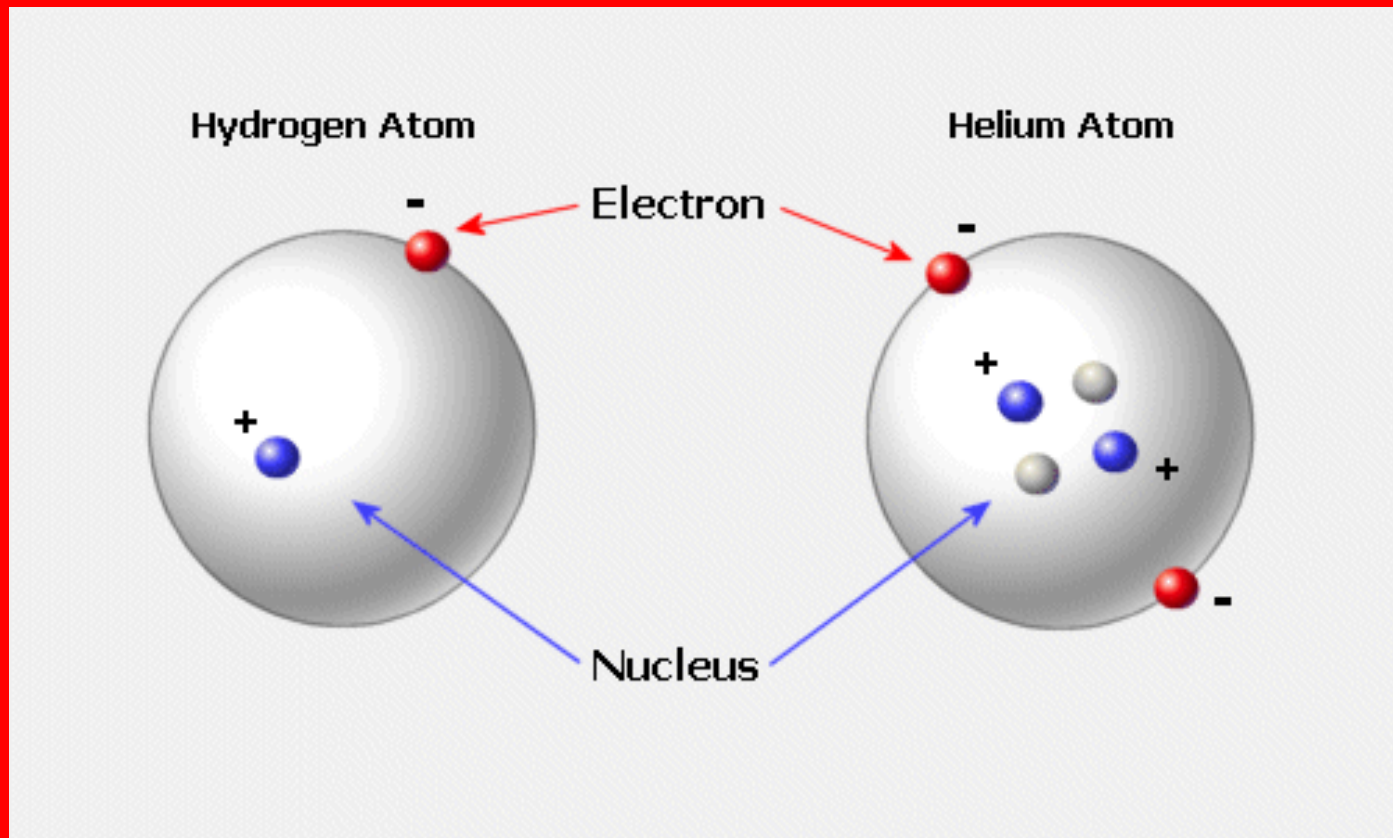
- Protons
- Neutrons
- Electrons

Nucleus



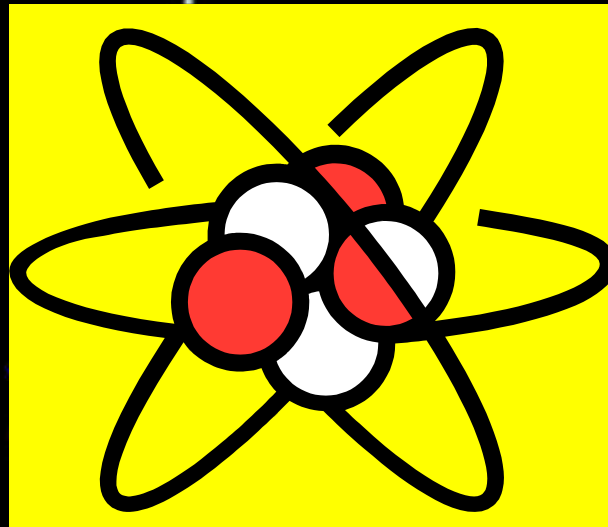
9 What makes one element different from another element?

Number of protons.



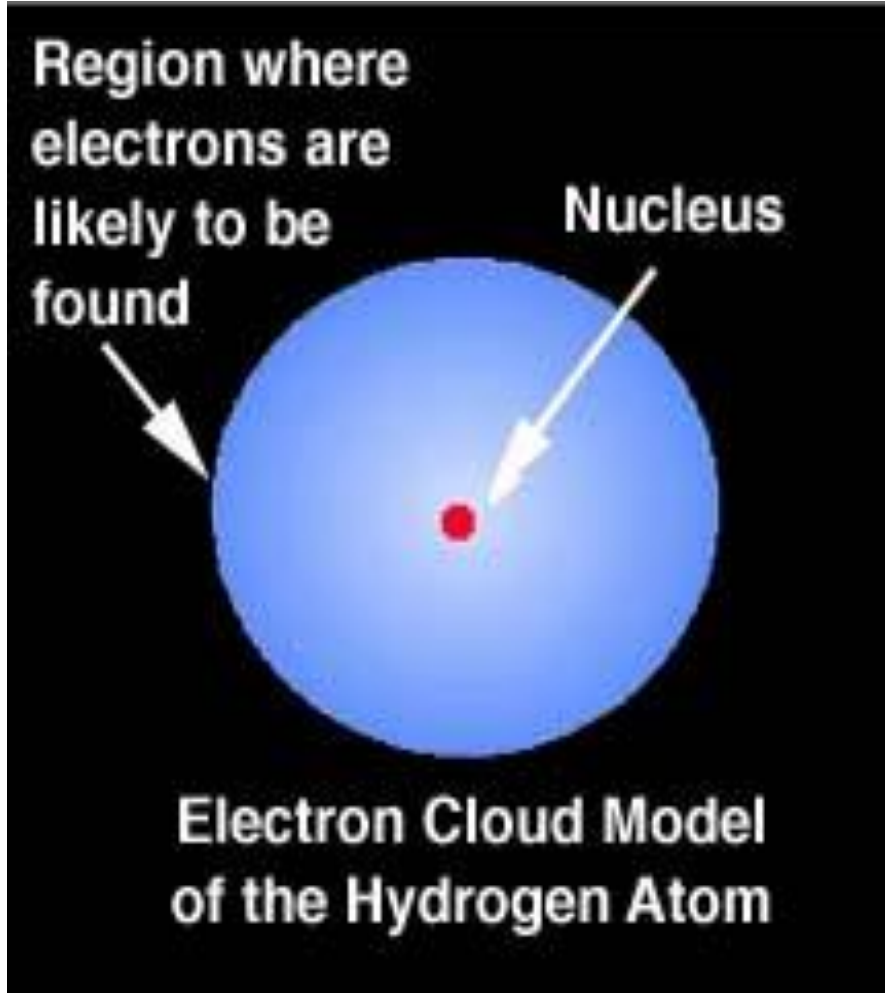
Protons

- Positive Charge
- The number of protons determines which element it is.
- All elements have different numbers of protons



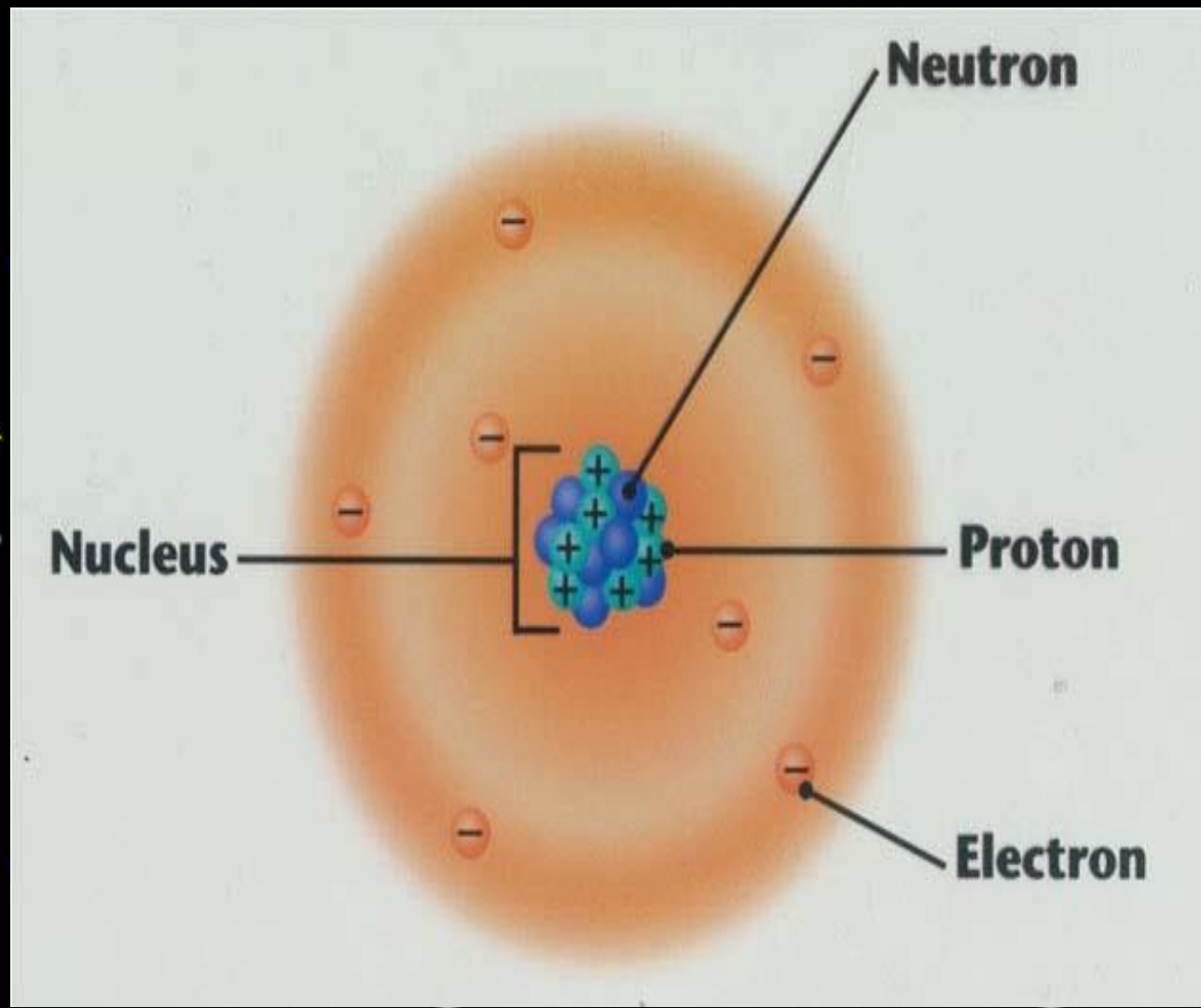
Electrons

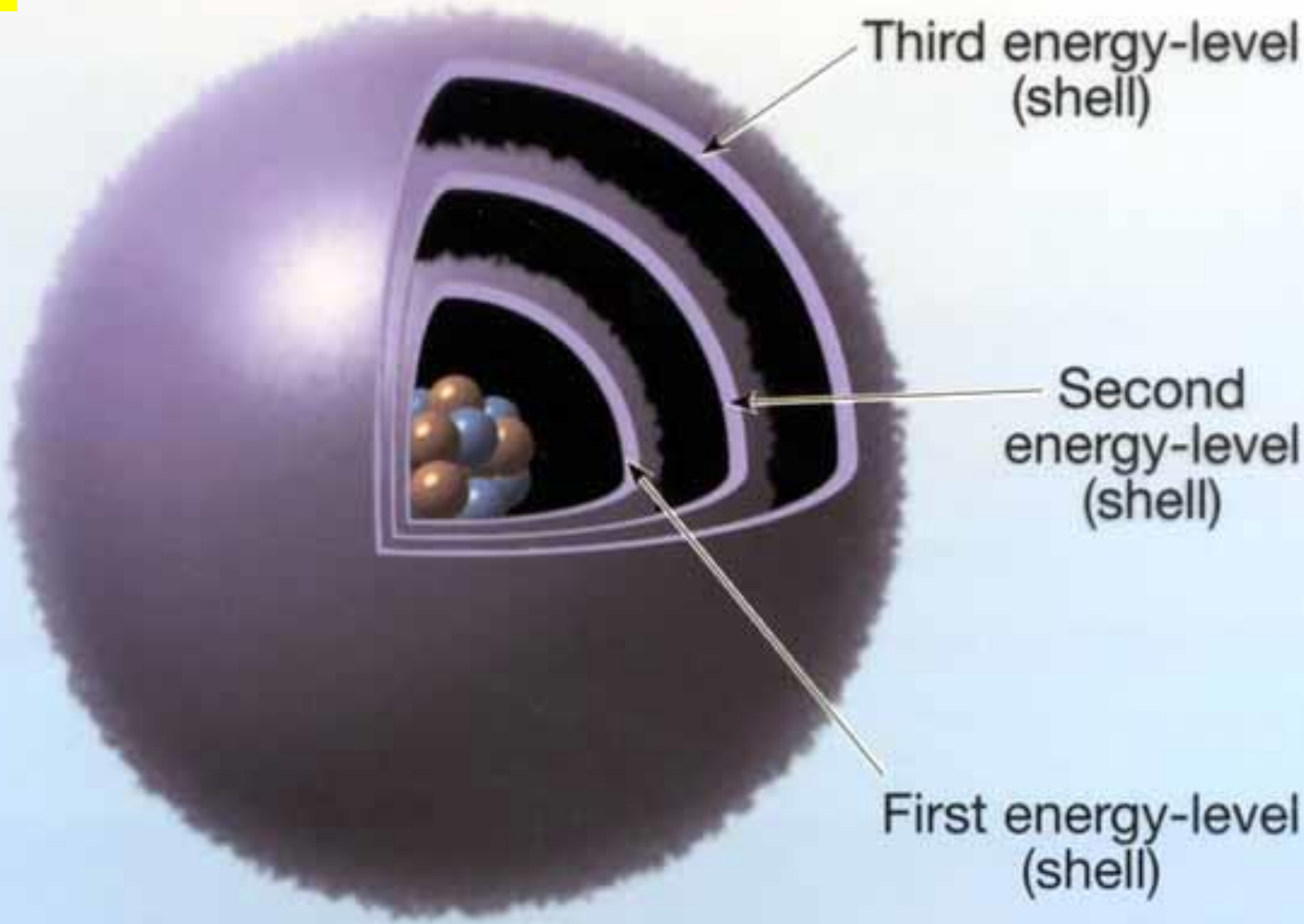
- Smallest subatomic particle.
- 1/1800 the mass of a proton (basically zero mass).
- Orbit nucleus.
- Negative Charge



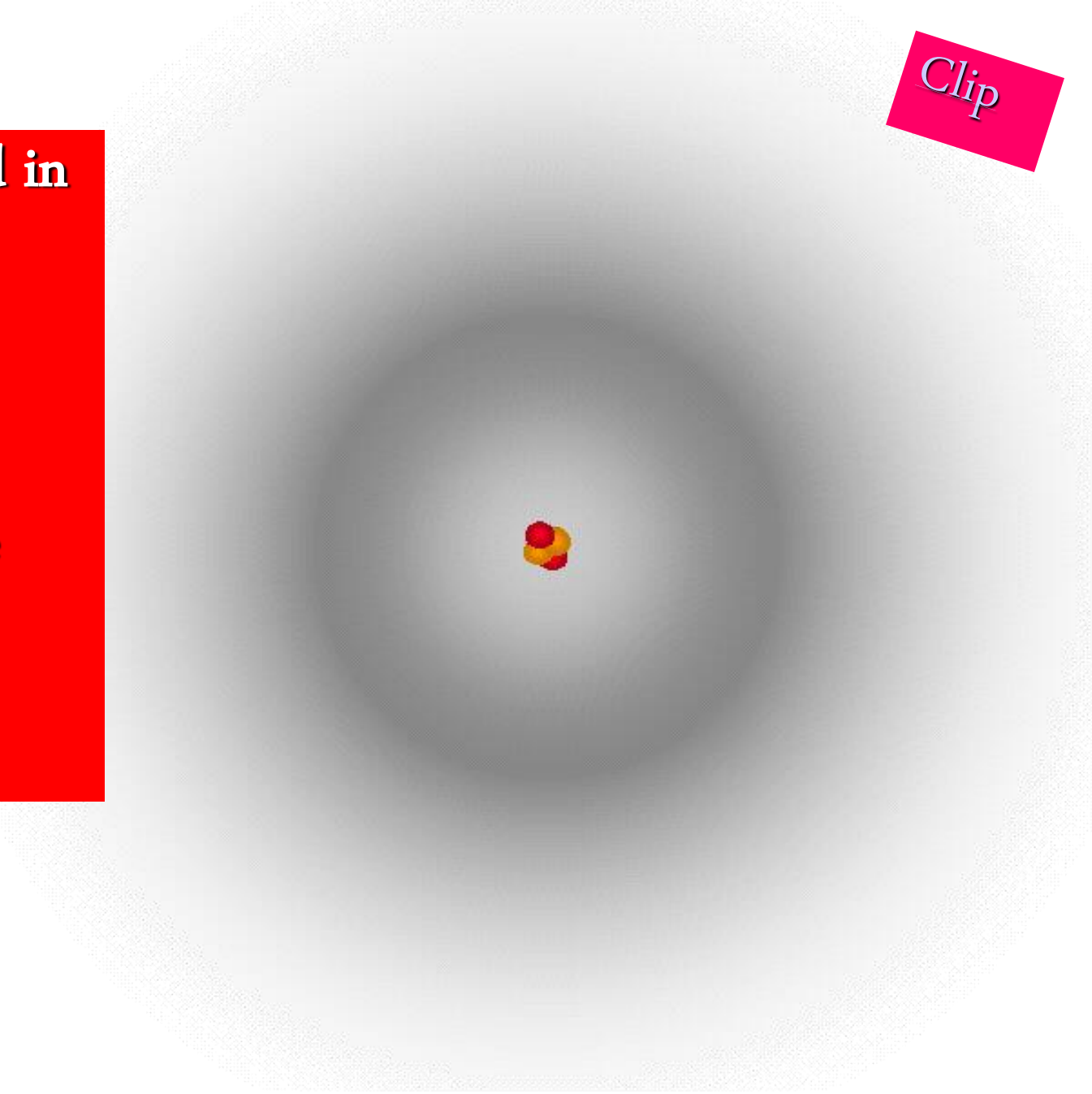
- **Electrons are found in different levels around the nucleus.**

- **These are called Energy Levels or shells.**

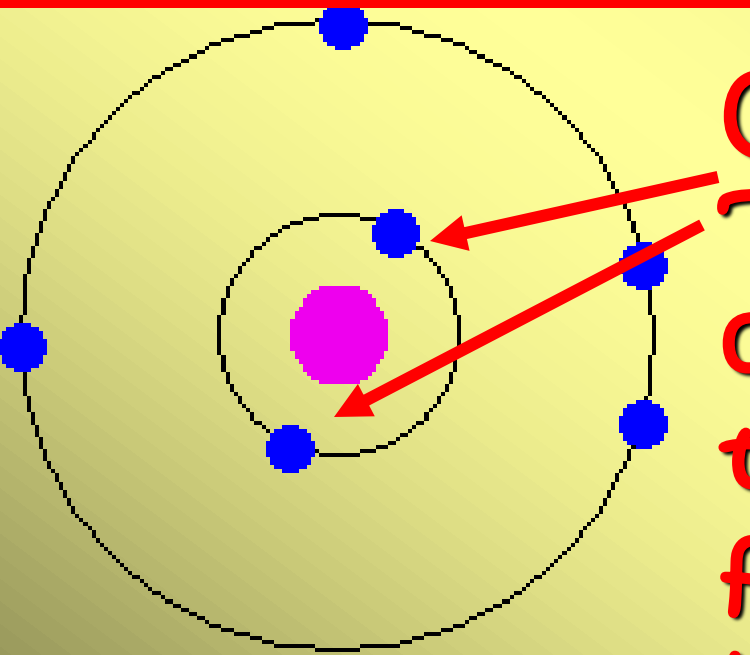




Electrons are found in
the
Electron Cloud
surrounding the
nucleus.

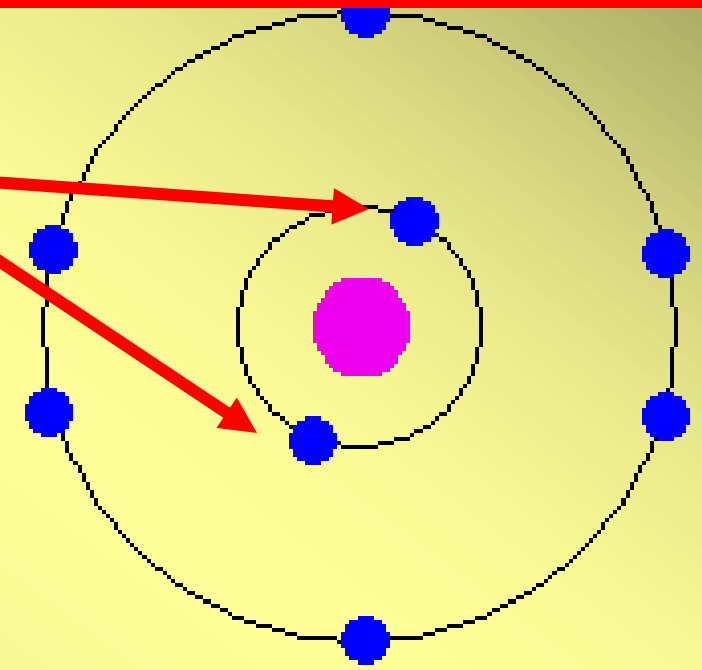


Each Energy Level Can Hold A Certain Number of Electrons!



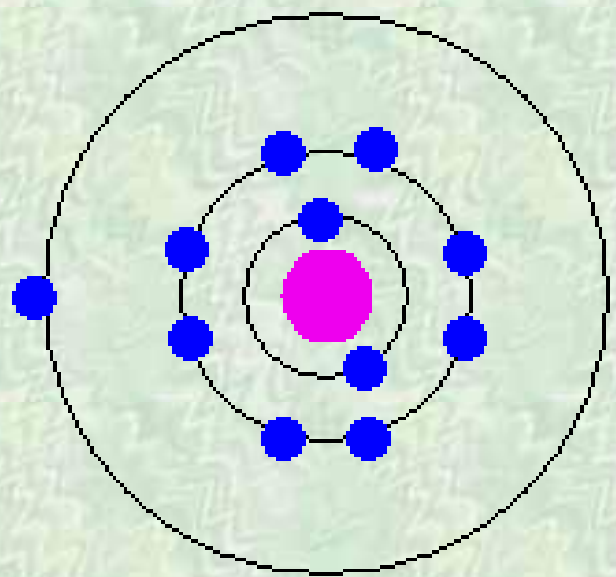
Carbon Atom ($Z = 6$)

Only
TWO
on
the
first
level!



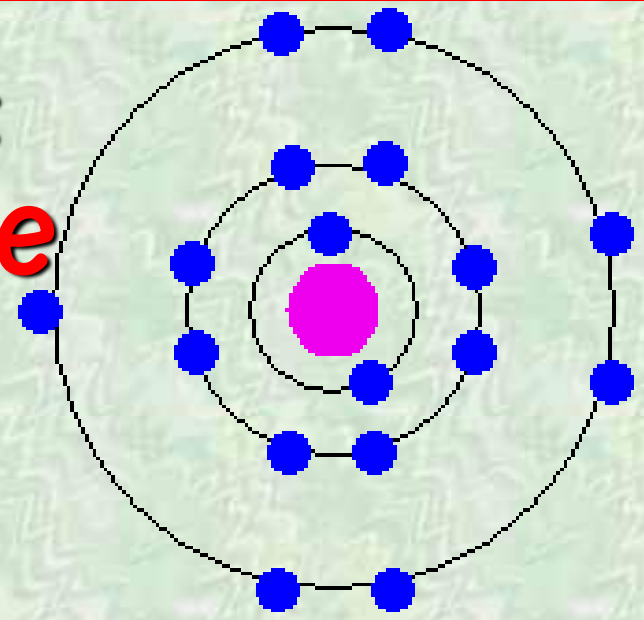
Oxygen Atom ($Z = 8$)

Each Energy Level Can Hold A Certain Number of Electrons!



Sodium Atom (Z = 11)

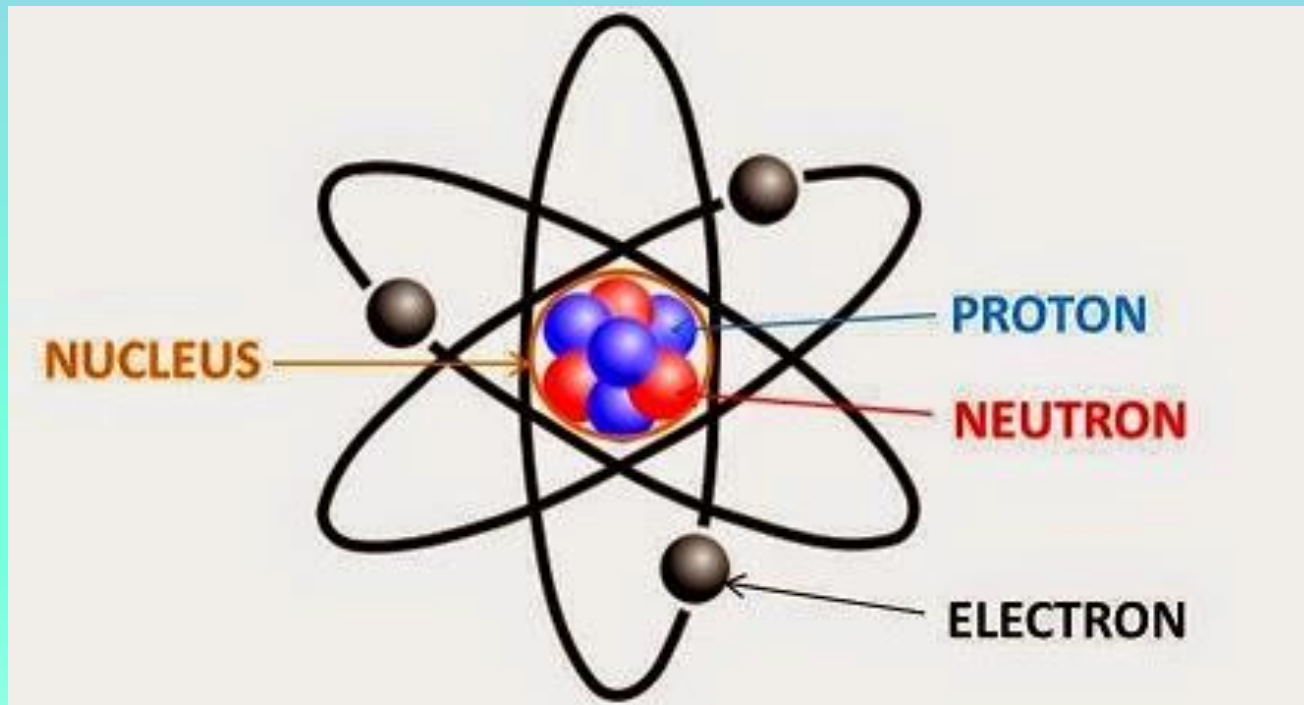
Eight
on the
2nd
and
3rd
levels!



Chlorine Atom (Z = 17)

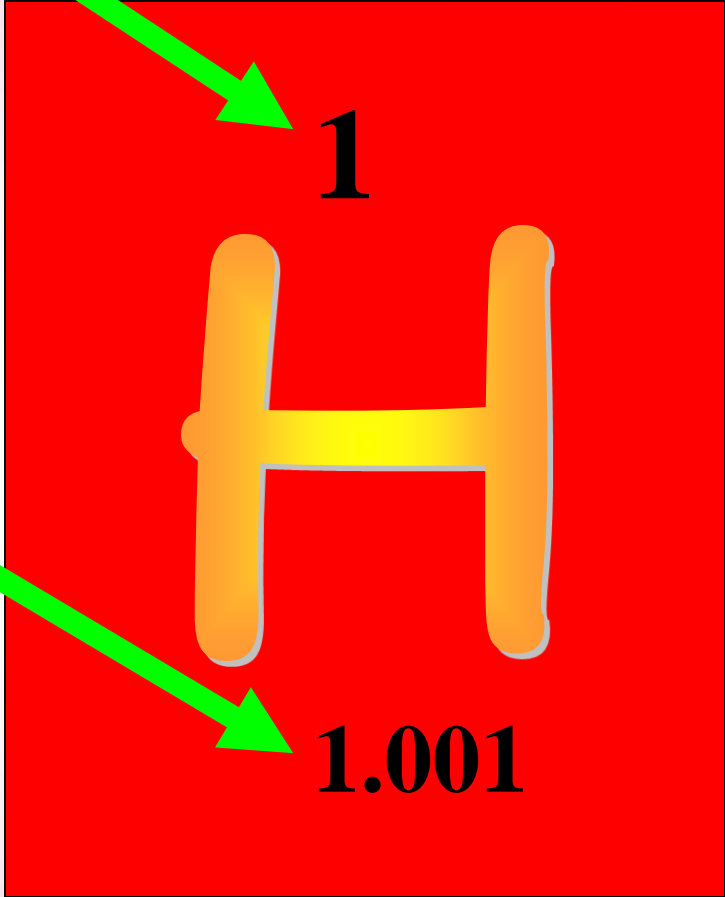
NEUTRONS

- Neutrons are located in the nucleus and have no charge.



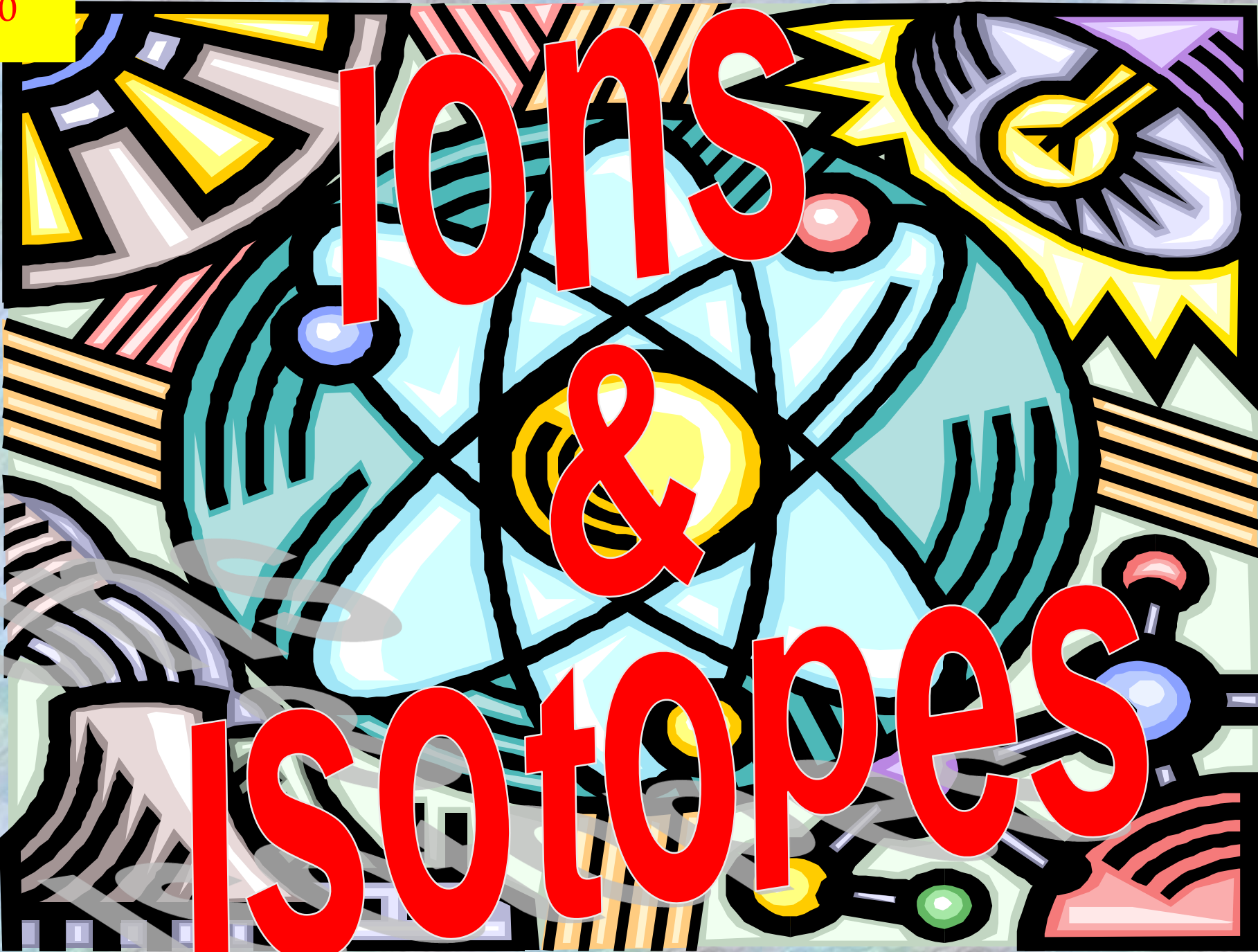
- **Atomic Number**
- **Number of Protons**

- **Atomic Mass**
- **Sum of Protons & Neutrons**



How can I find out how many electrons an atom has?

- Atom = neutral
- So, the number of protons = electrons.
- Atomic number tells you the number of protons.....
- So, it also tells you the number of **electrons!**



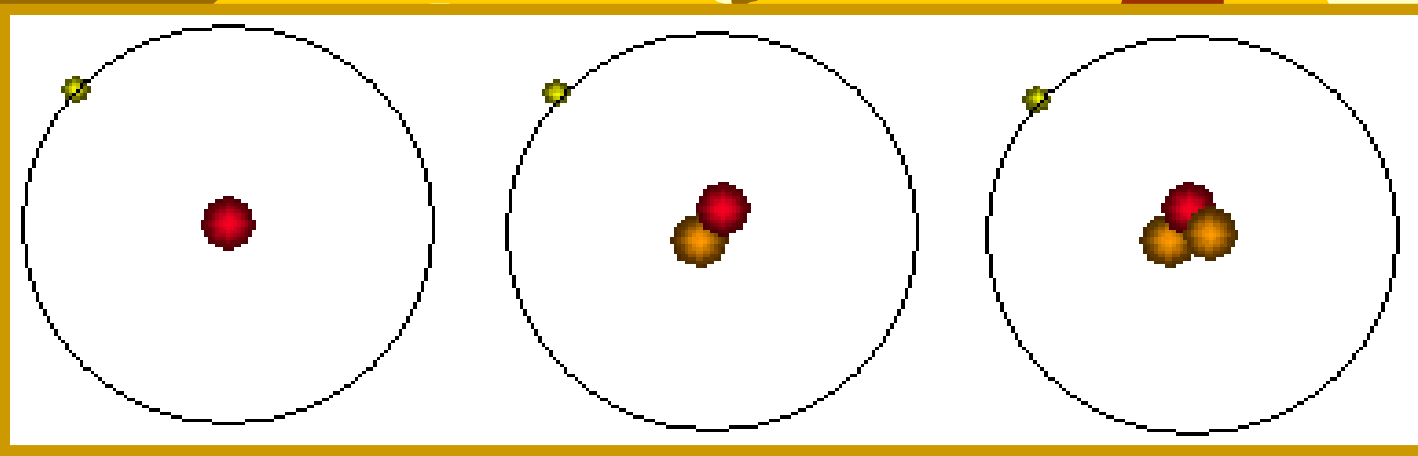
Ions

&

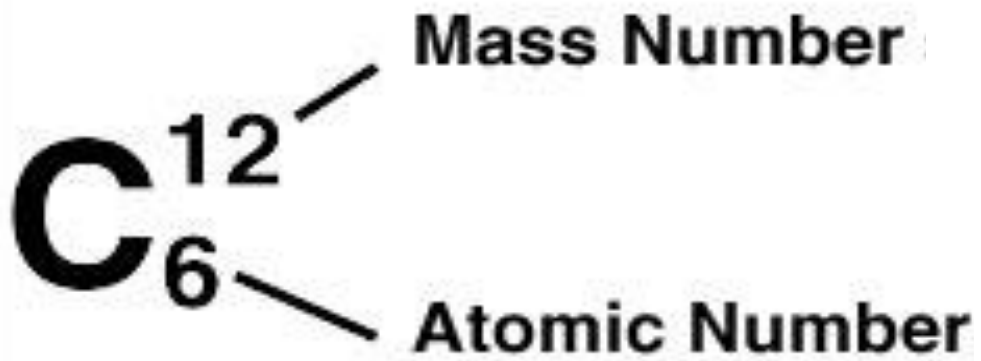
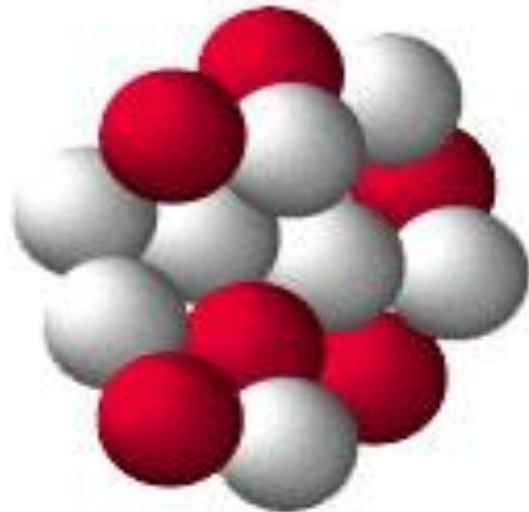
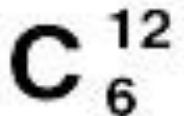
Isotopes

Isotopes

Isotopes are atoms that have the same number of protons and **differ** only in the number of **neutrons**.



Most isotopes are stable but radioactive isotopes are unstable and break down into more stable forms **by emitting** particles and **energy** (*radiation*). Radiation can be detected, so radioactive isotopes are **useful** as labels in scientific research and medical diagnostic procedures.



Hydrogen

1 proton





^1H



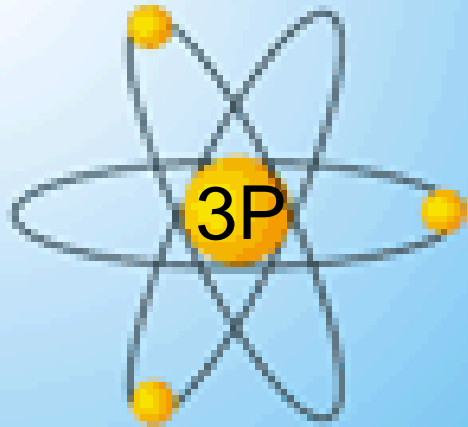
^2H



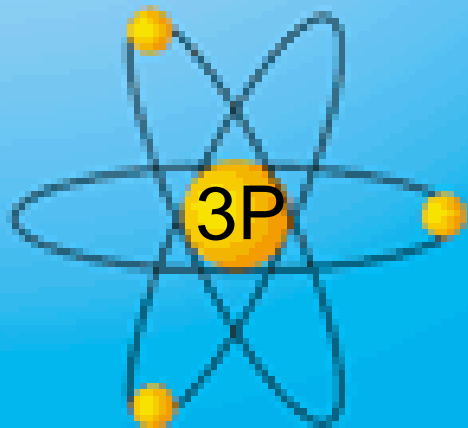
^3H

Proton:  Neutron: 

atoms can gain or lose electrons



Neutral Atoms



Atoms can gain or lose electrons

Ionization: requires energy

Why do atoms lose and gain electrons?

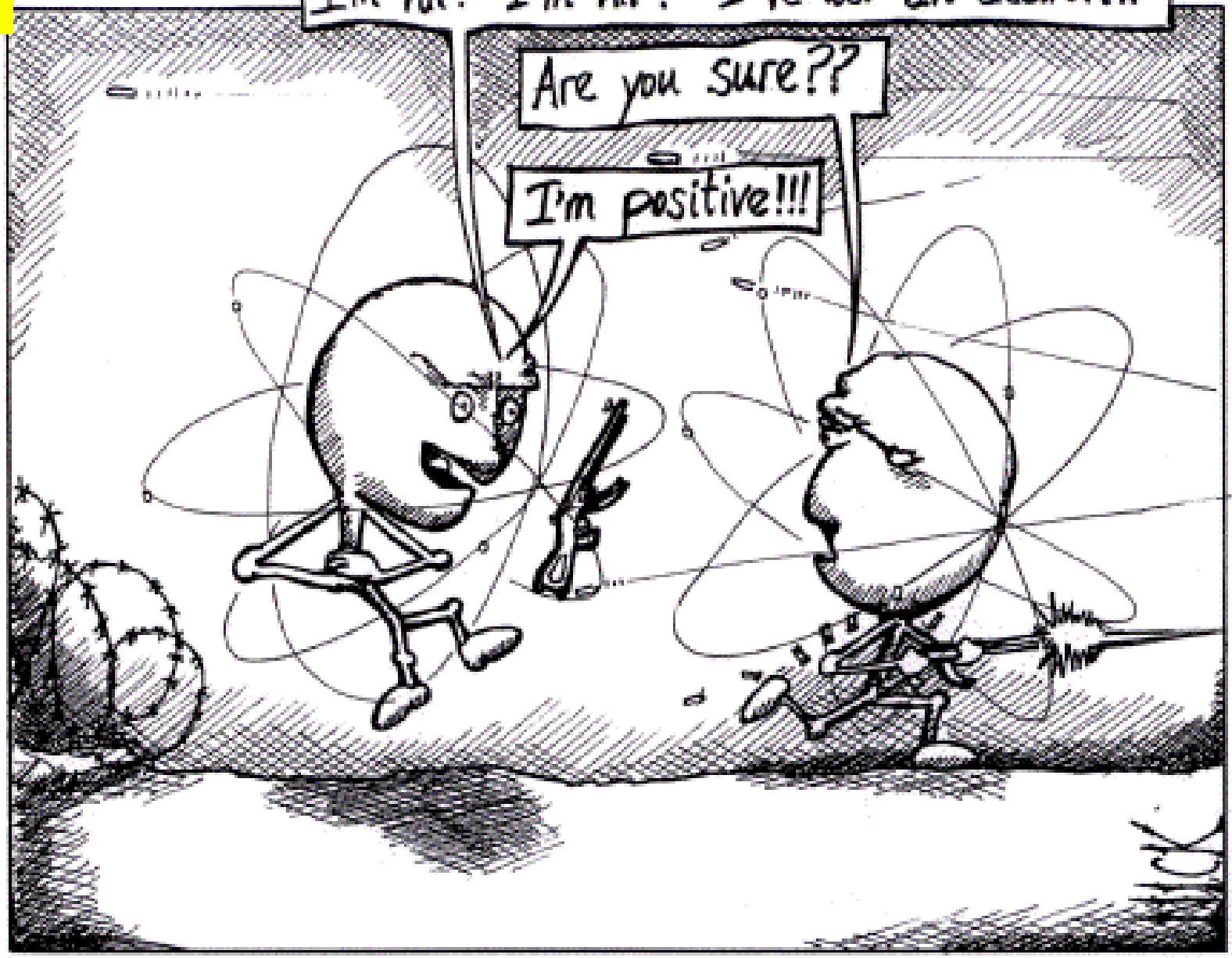
To become more stable.

Stability=full outer energy level

I'm hit! I'm hit! I've lost an electron!!

Are you sure??

I'm positive!!!



copyright Nick Kim
<http://strangematter.sci.waikato.ac.nz/>

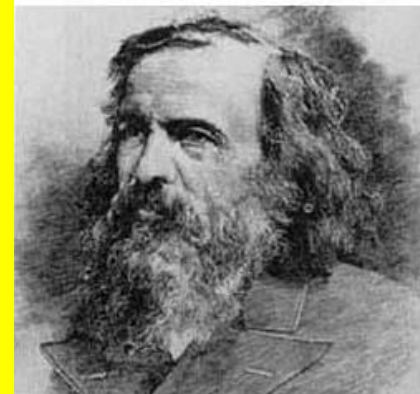
ANOTHER CASUALTY IN THE WAR OF THE SODIUM ATOMS

H																He	
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn

Periodic Table

Dmitri Ivanovitch Mendeléeev

- Grouped elements on the basis of similar chemical properties.
- Left blank spaces open to add new elements where he predicted they would occur.
- Accepted minor inversions when placing the elements in order of increasing atomic mass.
- Predicted properties for undiscovered elements.



Mendeléeev 1869

Reihen	Gruppe I. — R^2O	Gruppe II. — RO	Gruppe III. — R^2O^3	Gruppe IV. RH^4 RO^2	Gruppe V. RH^3 R^2O^5	Gruppe VI. RH^2 RO^3	Gruppe VII. RH R^2H^7	Gruppe VIII. — RO^4
1	H = 1							
2	Li = 7	Be = 9, 4	B = 11	C = 12	N = 14	O = 16	F = 19	
3	Na = 23	Mg = 24	Al = 27, 3	Si = 28	P = 31	S = 32	Cl = 35, 5	
4	K = 39	Ca = 40	— = 44	Ti = 48	V = 51	Cr = 52	Mn = 55	Fe = 56, Co = 59, Ni = 59, Cu = 63.
5	(Cu = 53)	Zn = 65	— = 68	— = 72	As = 75	Se = 78	Br = 80	
6	Rb = 85	S = 87	?Yt = 88	Zr = 90	Nb = 94	Mo = 96	— = 100	Ru = 104, Rh = 104, Pd = 106, Ag = 108
7	(Ag = 108)	Cd = 112	In = 113	Sn = 118	Sb = 122	Te = 125	J = 127	
8	Cs = 133	Ba = 137	?Di = 138	?Ce = 140	—	—	—	— — — —
9	(—)	—	—	—	—	—	—	
10	—	—	?Er = 178	?La = 180	Ta = 182	W = 184	—	Os = 195, Ir = 197, Pt = 198, Au = 199.
11	(Au = 198)	Hg = 200	Tl = 204	Pb = 207	Bi = 208	—	—	
12	—	—	—	Th = 231	—	U = 240	—	— — — —

Groups or Families

increasing atomic number

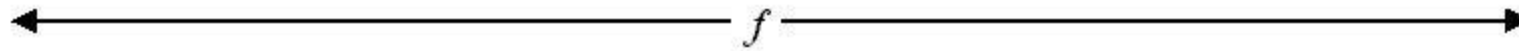
1998 Dr. Michael Blaber

1 1.008 H																	2 4.003 He														
3 6.941 Li	4 9.012 Be											5 10.81 B	6 12.01 C	7 14.01 N	8 16.00 O	9 19.00 F	10 20.18 Ne														
11 22.99 Na	12 24.31 Mg	← VIII →										13 26.98 Al	14 28.09 Si	15 30.97 P	16 32.07 S	17 35.05 Cl	18 39.95 Ar														
19 39.10 K	20 40.08 Ca	21 44.96 Sc	22 47.88 Ti	23 50.94 V	24 52.00 Cr	25 54.94 Mn	26 55.85 Fe	27 58.93 Co	28 58.69 Ni	29 63.55 Cu	30 65.39 Zn	31 69.72 Ga	32 72.61 Ge	33 74.92 As	34 78.96 Se	35 79.90 Br	36 83.80 Kr														
37 85.47 Rb	38 87.62 Sr	39 88.91 Y	40 91.22 Zr	41 92.91 Nb	42 95.94 Mo	43 98.91 Tc	44 101.1 Ru	45 102.9 Rh	46 106.4 Pd	47 107.9 Ag	48 112.4 Cd	49 114.8 In	50 118.7 Sn	51 121.8 Sb	52 127.6 Te	53 126.9 I	54 131.3 Xe														
55 123.9 Cs	56 137.3 Ba	57 138.9 La	58 140.1 Ce	59 140.9 Pr	60 144.2 Nd	61 146.9 Pm	62 150.4 Sm	63 152.0 Eu	64 157.2 Gd	65 158.9 Tb	66 162.5 Dy	67 164.9 Ho	68 167.3 Er	69 168.9 Tm	70 173.0 Yb	71 175.0 Lu	72 178.5 Hf	73 180.9 Ta	74 183.8 W	75 186.2 Re	76 190.2 Os	77 192.2 Ir	78 195.1 Pt	79 197.0 Au	80 200.6 Hg	81 204.4 Tl	82 207.2 Pb	83 209.0 Bi	84 210.0 Po	85 210.0 At	86 222.0 Rn
87 223.0 Fr	88 226.0 Ra	89 227.0 Ac	90 232.0 Th	91 231.0 Pa	92 238.0 U	93 237.0 Np	94 239.1 Pu	95 241.1 Am	96 244.1 Cm	97 249.1 Bk	98 252.1 Cf	99 252.1 Es	100 257.1 Fm	101 258.1 Md	102 259.1 No	103 262.1 Lr	104 262.1 Db	105 262.1 Jl	106 262.1 Rf	107 262.1 Bh	108 262.1 Hn	109 262.1 Mt	110 262.1 Uun	111 262.1 Uuu							

periods



Lanthanides	57 138.9 La	58 140.1 Ce	59 140.9 Pr	60 144.2 Nd	61 146.9 Pm	62 150.4 Sm	63 152.0 Eu	64 157.2 Gd	65 158.9 Tb	66 162.5 Dy	67 164.9 Ho	68 167.3 Er	69 168.9 Tm	70 173.0 Yb	71 175.0 Lu
Actinides	89 227.0 Ac	90 232.0 Th	91 231.0 Pa	92 238.0 U	93 237.0 Np	94 239.1 Pu	95 241.1 Am	96 244.1 Cm	97 249.1 Bk	98 252.1 Cf	99 252.1 Es	100 257.1 Fm	101 258.1 Md	102 259.1 No	103 262.1 Lr



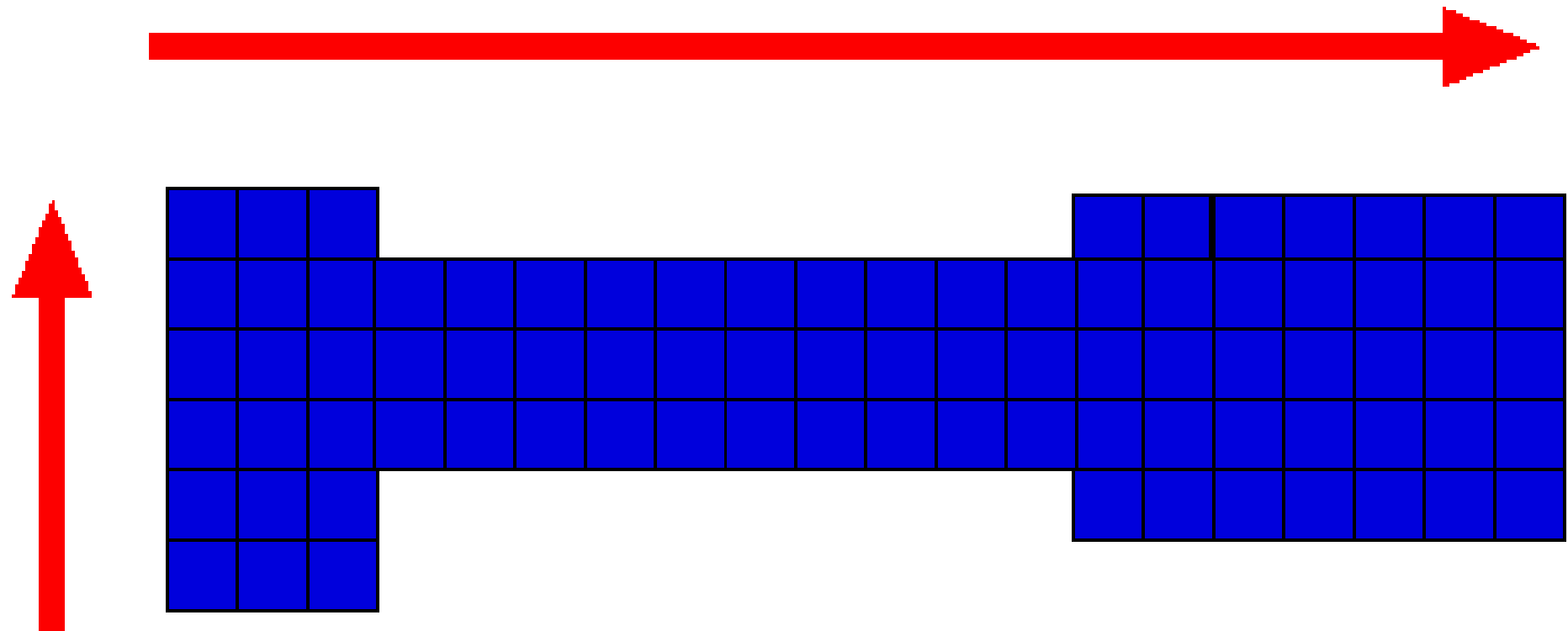
Atomic Radii

DECREASING ATOMIC RADIUS

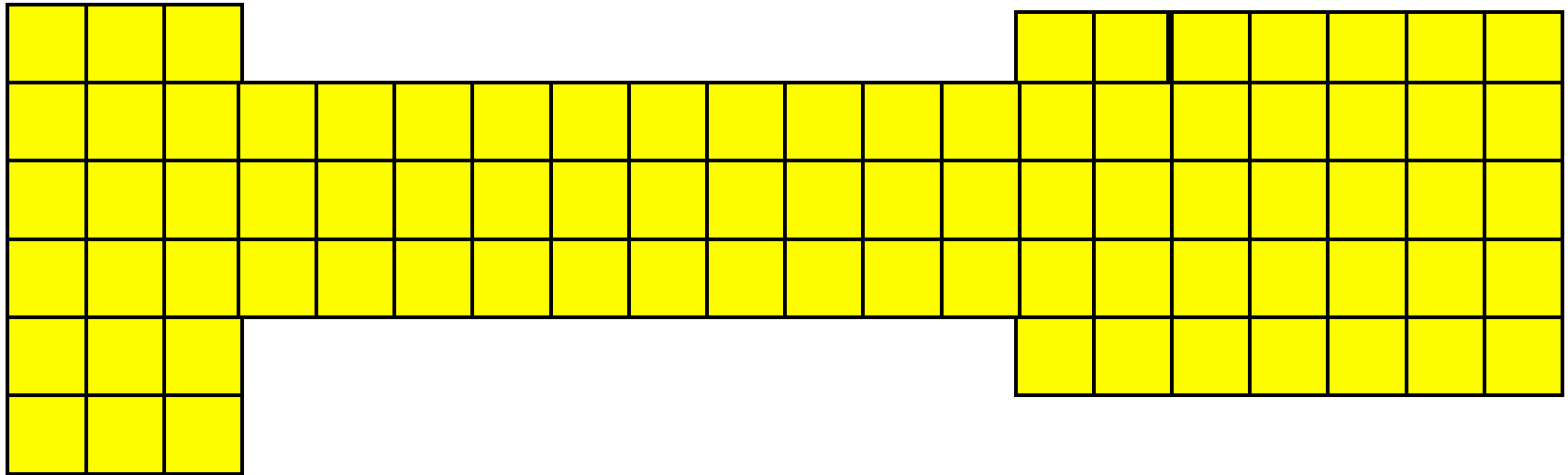
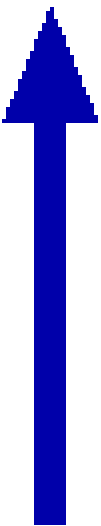
I	II	III	IV	V	VI	VII	VIII
H							He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar
K	Ca	Ga	Ge	As	Se	Br	Kr
Rb	Sr	In	Sn	Sb	Te	I	Xe
Cs	Ba	Tl	Pb	Bi	Po	At	Rn

The greater the number of protons present, the stronger the attraction that holds the electrons closer to the nucleus, and the smaller the size of the shells.

Ionization Energy Increases With Arrows



Electron Affinity Increases With Arrows



atomic radii decrease

metallic properties decrease

Periodic Table
of
The Elements

ionisation energies decrease
atomic numbers increase

atomic numbers increase
ionisation energies increase

metallic properties increase

atomic radii increase

Alkali Metals

Clip

1/IA

1

H

1.008

3

Li

6.941

11

Na

22.99

19

K

39.10

37

Rb

85.47

55

Cs

132.9

87

Fr

223.0

- **Soft Metals, solids @room temp**
- **Very reactive metals that do not occur freely in nature.**
- **Only one valence electron**
- **malleable, ductile, and are good conductors of heat and electricity.**
- **Cesium and francium are the most reactive elements in this group.**
- **Alkali metals can explode if they are exposed to water.**

Alkaline Earth Metals

4
Be
9.012

12
Mg
24.30

20
Ca
40.08

38
Sr
87.62

56
Ba
137.3

88
Ra
226.0

- Two valence electrons
- Because of their reactivity, the alkaline metals are not found free in nature.

Transition Metals

Clip

- All solids at room temp.
- Are both ductile and malleable, and conduct electricity and heat.
- The interesting thing about transition metals is that their valence electrons change.
- There are three noteworthy elements in the transition metals family. -iron, cobalt, and nickel, and they are the only elements known to produce a magnetic field.

3/IIIB	4/IVB	5/VB	6/VIB	7/VIIB	8	9	10	11/IB
21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55
39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98.91	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9
La-Lu	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0
Ac-Lr	104 Db	105 Jl	106 Rf	107 Bh	108 Hn	109 Mt	110 Uun	111 Uuu

Metalloids

Clip

5 B 10.81	6 C 12.01			
13 Al 26.98	14 Si 28.09	15 P 30.97		
31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	
	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	
		83 Bi 209.0	84 Po 210.0	85 At 210.0

- Metalloids have properties of both metals and non-metals.
- Some of the metalloids, such as silicon and germanium, are semi-conductors. This means that they can carry an electrical charge under special conditions. This property makes metalloids useful in computers and calculators
- All solids at room temperature

Halogens

9 F 19.00
17 Cl 35.05
35 Br 79.90
53 I 126.9
85 At 210.0

- "halogen" means "salt-former" and compounds containing halogens are called "salts".
- All have 7 valence electrons.
- Form many compounds with the alkali metals.
- exist, at room temperature, in all three states of matter:

Solid- Iodine, Astatine

Liquid- Bromine

Gas- Fluorine, Chlorine

Noble Gases

Clip

2 He 4.003

10 Ne 20.18

18 Ar 39.95

36 Kr 83.80

54 Xe 131.3

86 Rn 222.0

- All have 8 valence electrons
- Chemically inert
- All gases at room temp.
- They all have very low boiling and melting points.
- They all put out a color in the visible wavelengths when a low pressure of the gas is put into a tube and a high voltage current is run through the tube. This type of tube is called a neon light whether the tube has neon in it or not.

Rare Earth Metals



Clip

- The thirty rare earth elements are composed of the lanthanide and actinide series.
- One element of the lanthanide series and most of the elements in the actinide series are called trans-uranium, which means synthetic or man-made.
- All of the rare earth metals are found in group 3 of the periodic table, and the 6th and 7th periods.
- All rare earth elements have 3 valence electrons and are solid at room temp.

Lanthanides

57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm 146.9	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

Actinides

89 Ac 227.0	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu 239.1	95 Am 241.1	96 Cm 244.1	97 Bk 249.1	98 Cf 252.1	99 Es 252.1	100 Fm 257.1	101 Md 258.1	102 No 259.1	103 Lr 262.1
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THE ISOTOPES

Homer and the Straw



Periodic
Table
Review