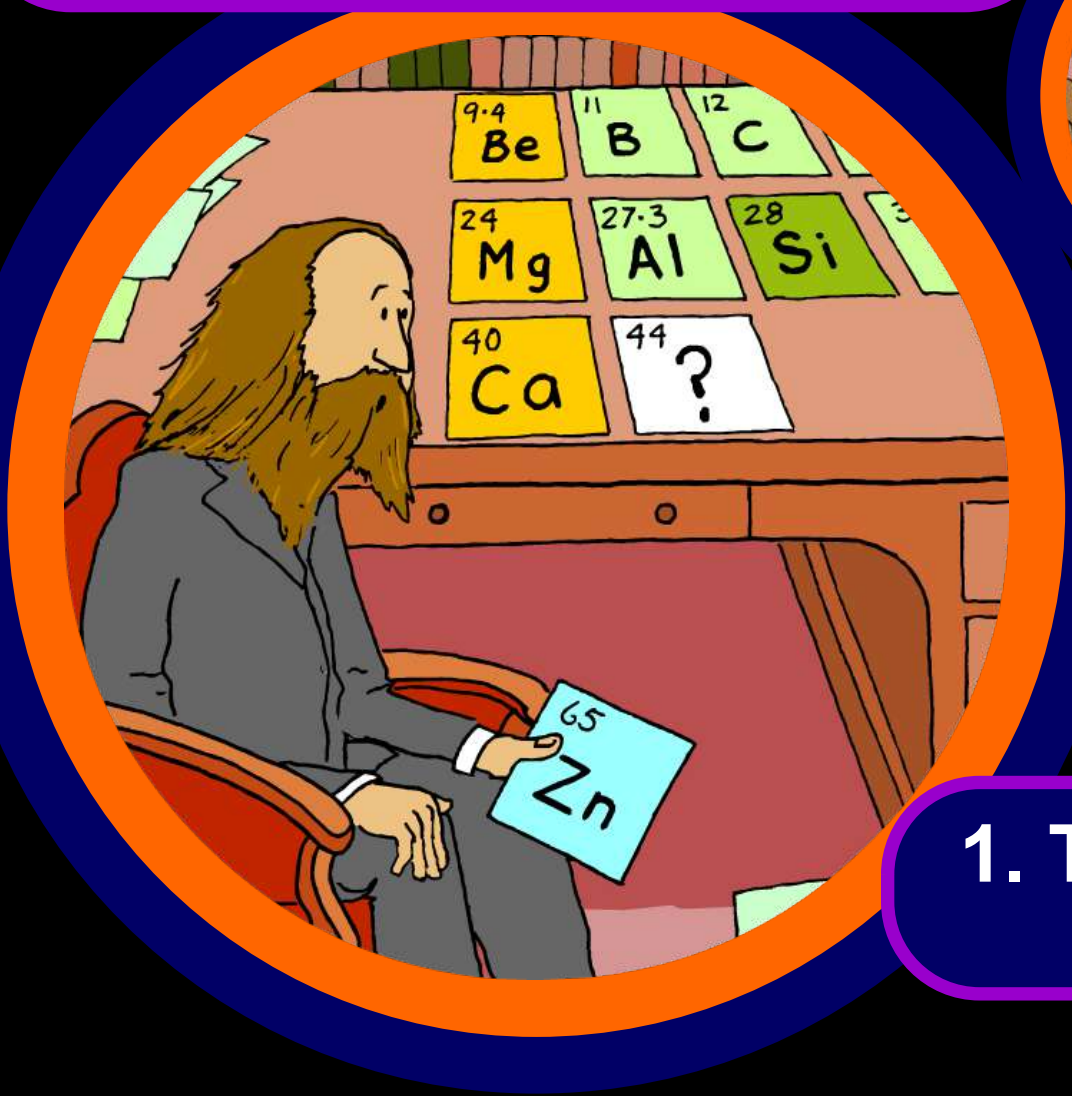
History of Periodic T.



1. The Periodic Table

Today's objectives

You should know the following by the end of today's class…

- History of the idea of elements including the contributions of the Greeks, Boyle and Davy and Moseley
- Symbols of elements 1–36.
- History of the periodic table, including the contributions of Dobereiner and Newlands
- The differences between the first Periodic table and the modern table

The Elements

Definition

- ***An element is a substance that cannot be broken down into a simpler substance.*** (same name)

Examples of Elements

Carbon (C)

Sodium (Na)

Examples of Elements

Gold (Au)

Bromine (Br)

Examples of Elements

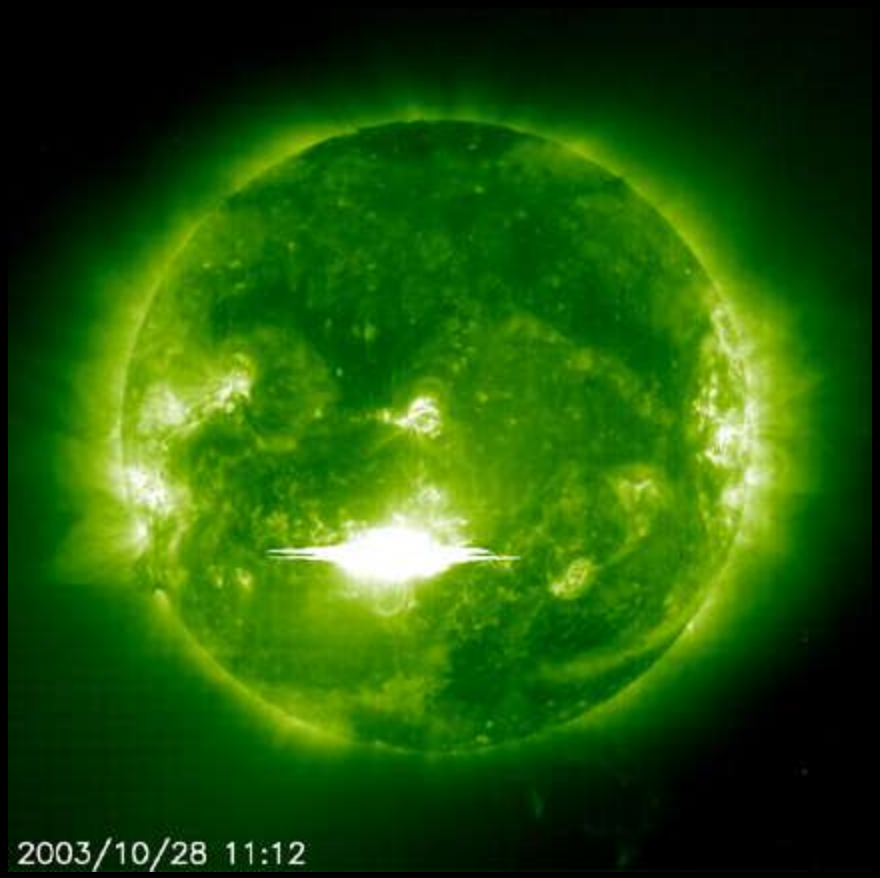
Aluminium (Al)

The most abundant metal in the Earth's crust

Silver (Ag)

Examples of Elements

Chlorine (Cl)



Hydrogen (H)

Examples of Elements

Tin (Sn)

Platinum (Pt)

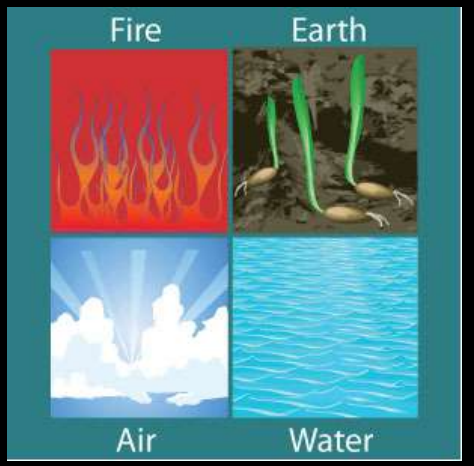
Question?

- But where did the idea of these "elements" first come from?

The Ancient Greeks

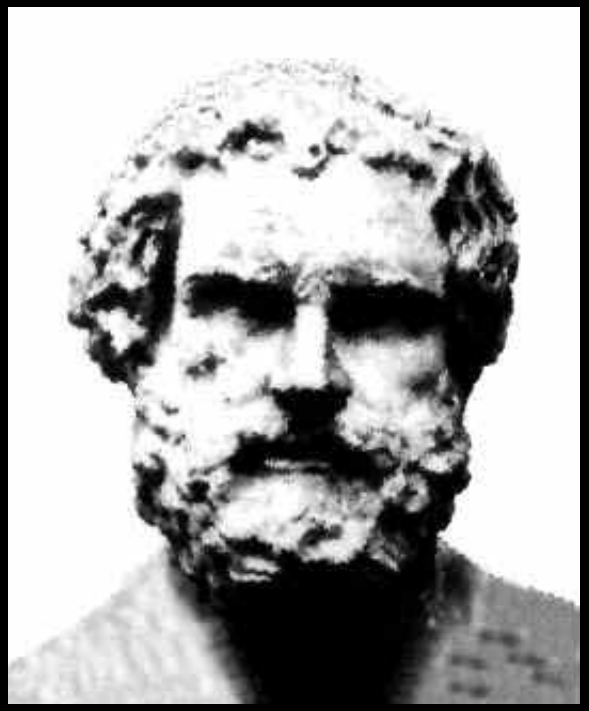
In particular **Empedocles 490 – 435 BCE,** had the idea that there were four basic building blocks (elements) from which everything was made:

earth,
fire,
water
and air



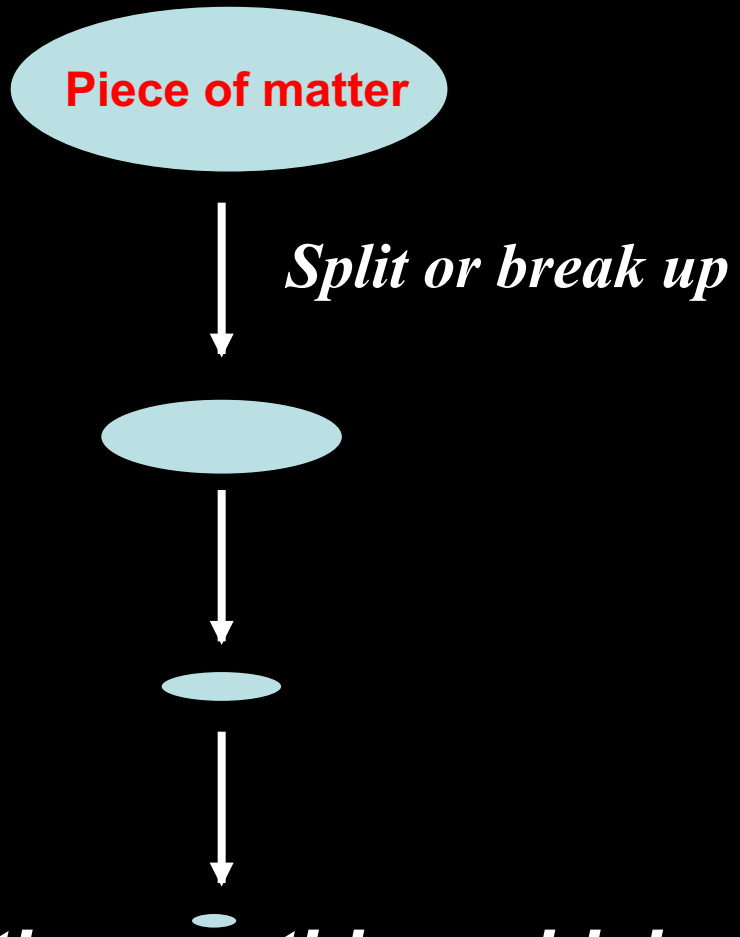
IDEA THAT MATTER IS COMPOSED OF ELEMENTS AND THAT DIFFERENT ELEMENTS COMBINE TO MAKE NEW THINGS

The Ancient Greeks



Democritus

Around 2500 years ago



Eventually I end up with something which cannot be broken up – called an element

Robert Boyle

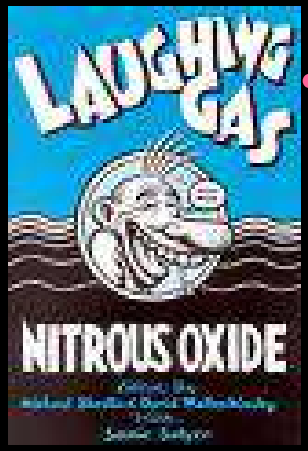
Robert Boyle

17th Century

Irish scientist, Robert Boyle, later defined what an element was:

An ***element*** is a substance that cannot be broken down into any simpler substance

Humphrey Davy



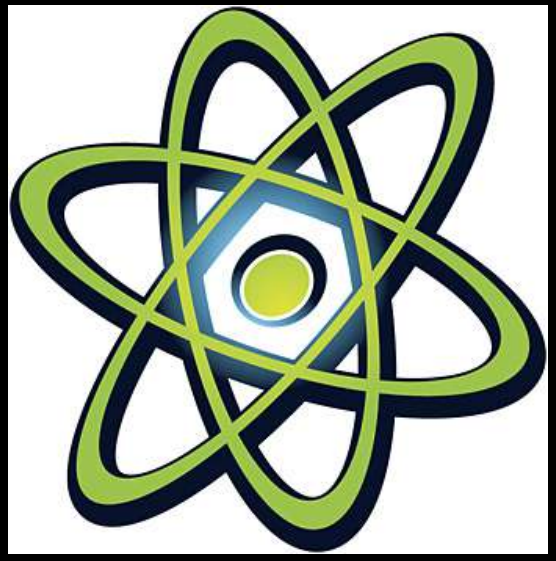
- Davy was an English chemist who started out his research examining the medicinal effect of various gases

Humphry Davy

Humphry Davy

19th Century

Davy used electricity to split up compounds to form elements



Davy's Elemental Discoveries

1807

1808

Elements are made up of only one type of atom.

Naming the elements

- After a planet ….mercury, uranium
- European mythological figures….Titanium after the Titans
- After its colour…. Gold
- After a physical property… Bromine= bad smell
- After a country…. francium = France
- After yourself….?
- After a scientist… Es = Einsteinium

The elements song

- http://youtu.be/aPq3SEteEJc - YouTube

Recap

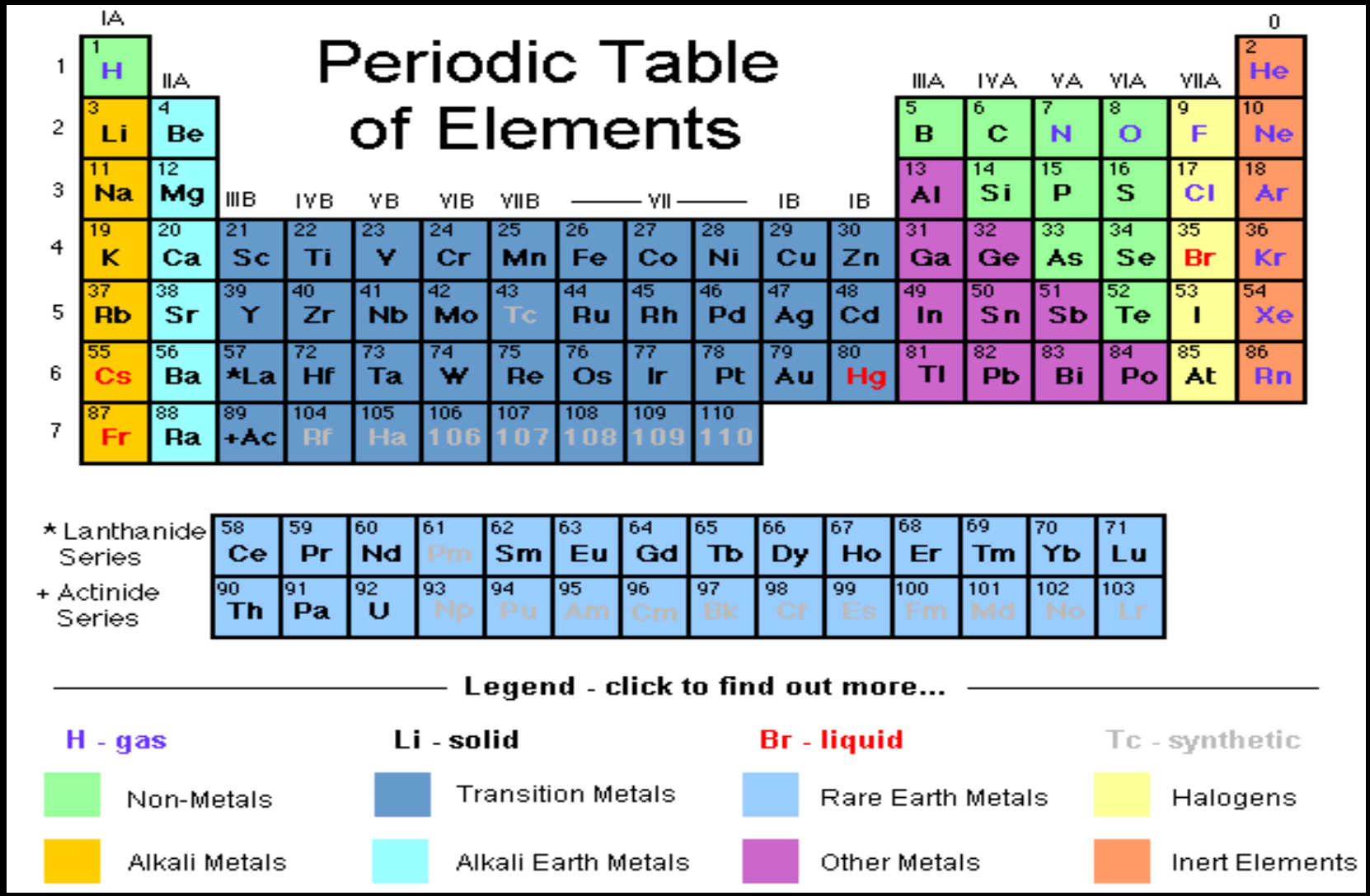
- What is an element?
- What did the ancient Greeks think materials were made of?
- Who was Robert Boyle?
- What contribution did Davy make to the knowledge of the elements?

The Periodic Table

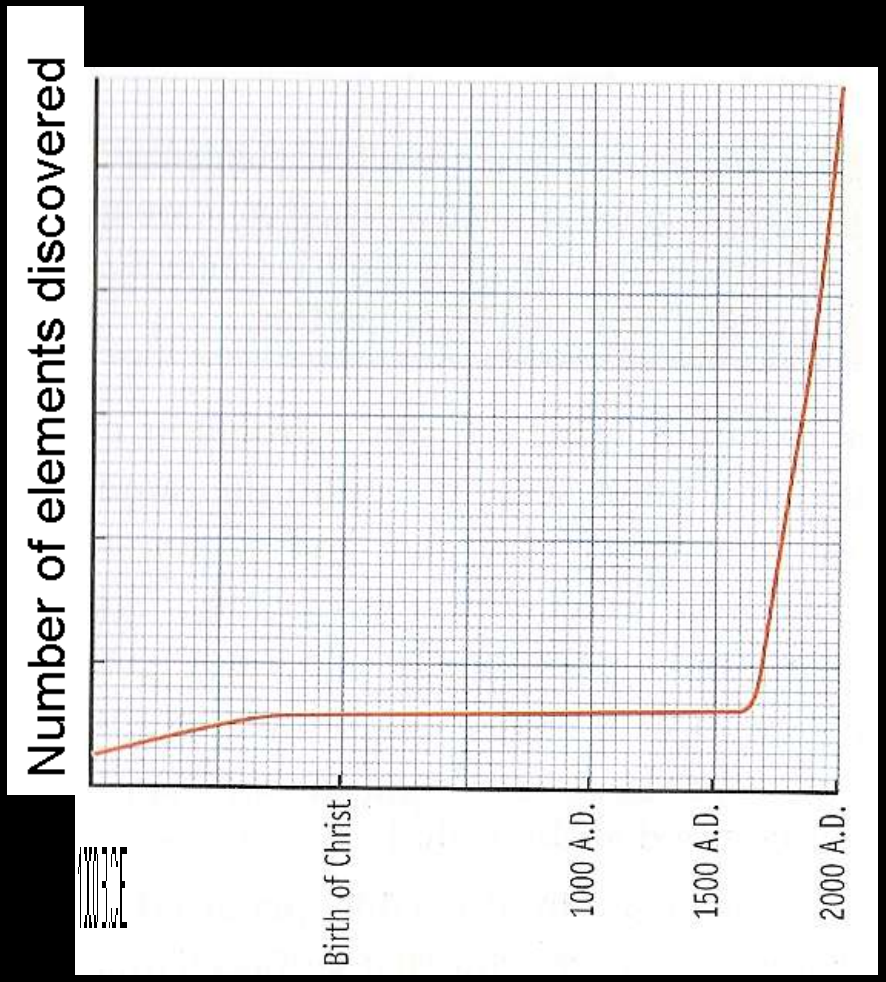
Arrangement of the elements

- All of the known elements of today are arranged on ….The Periodic Table of Elements

Pictorial view of the Modern Periodic Table



Looking for a pattern in the elements



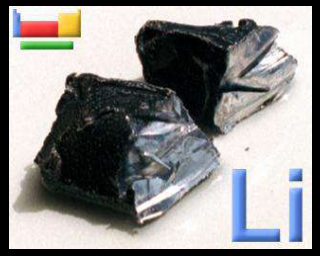
- In the 1800s over 50 elements had been discovered and more were being found!
- Chemists wanted to find if there was any pattern to the elements

Johann Dobereiner

Dobereiner

2005 Q. 4 (*d*) (6)

1829 – His theory of triads



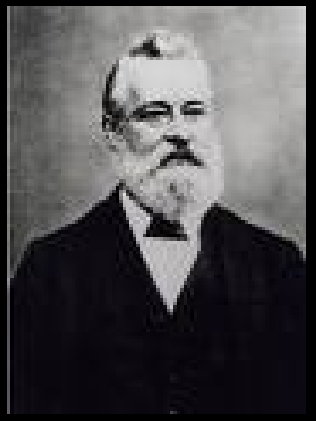
He noticed that certain elements in groups of 3 had similar physical & chemical properties with the atomic weight of the middle element being halfway between the other two.

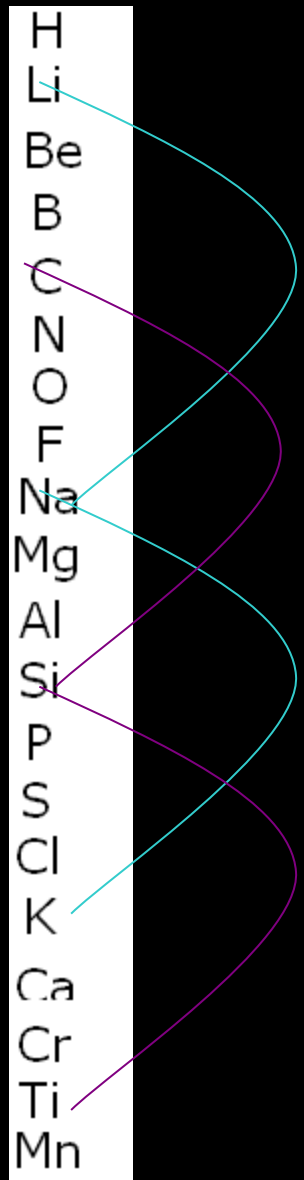
He called such a group of elements a triad.

What contribution did Dobereiner make to the systematic arrangement of the elements?(6)

Higher level only

Newlands -1864





Newland arranged all of the known elements in order of increasing atomic weight and he noticed the chemical and physical properties of the elements repeated with every 8th element.

John Newlands

Newlands

2006 Q. 4 (*f*) (6)

Law of octaves

He arranged the elements in order of increasing atomic weight

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S

Every 8th known element had similar physical & chemical properties.

What contribution did Newlands make to the systematic arrangement of the elements known to him?(6)

Higher level only

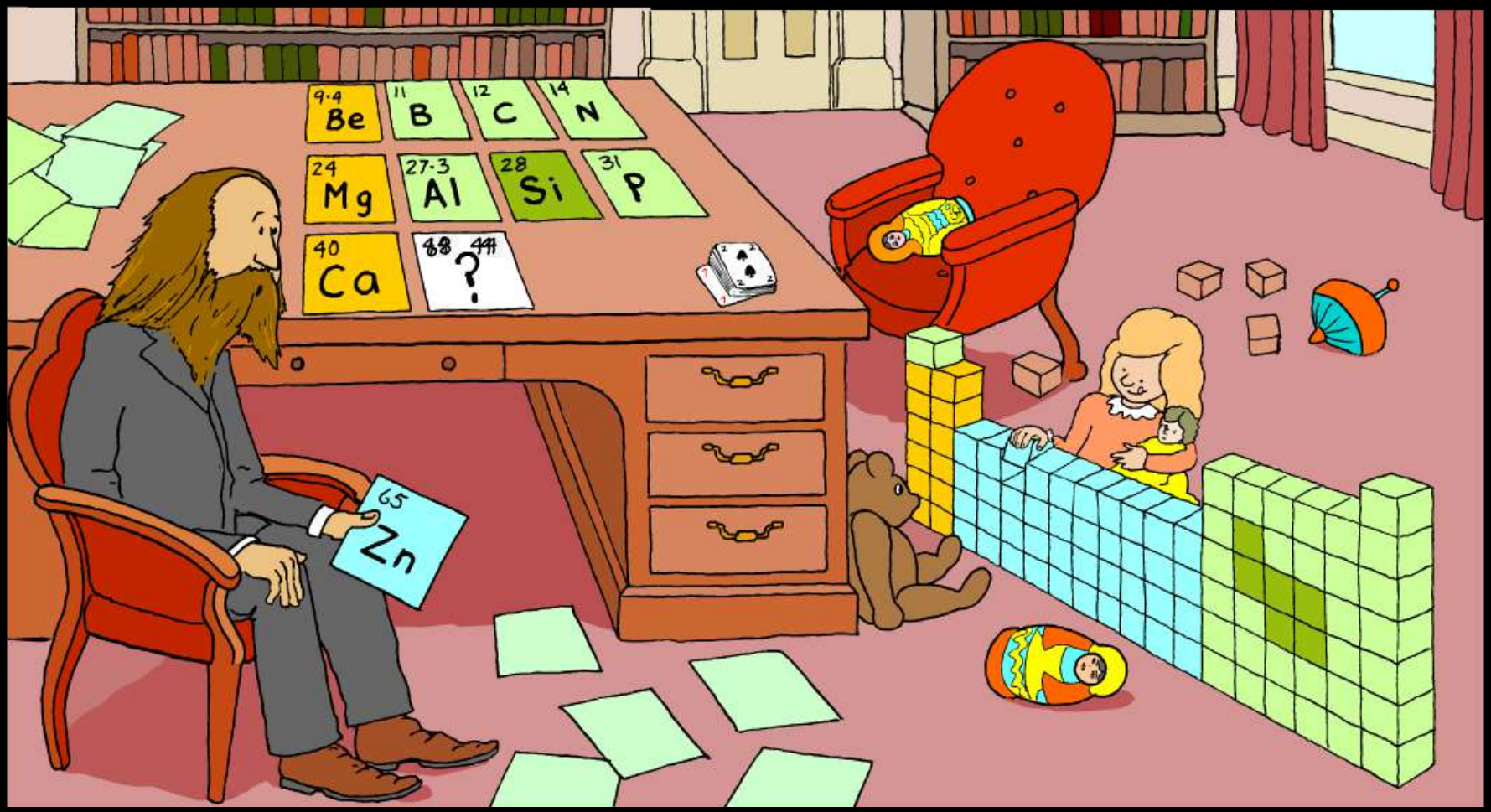
Newlands Octaves

- The problem is that after Calcium the pattern starts to break down.

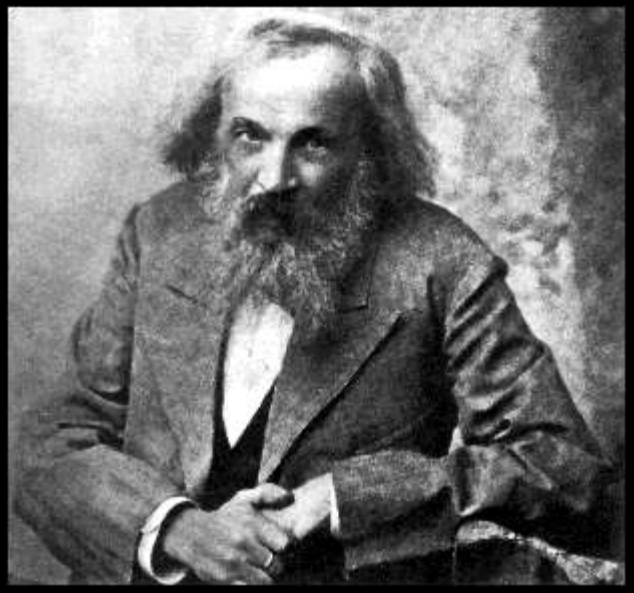
- Although Newland had the right idea, some of the elements hadn't been discovered yet and

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe

- Mendeleev created the first periodic table by grouping together elements in a certain way.



Dmitri Mendeleev



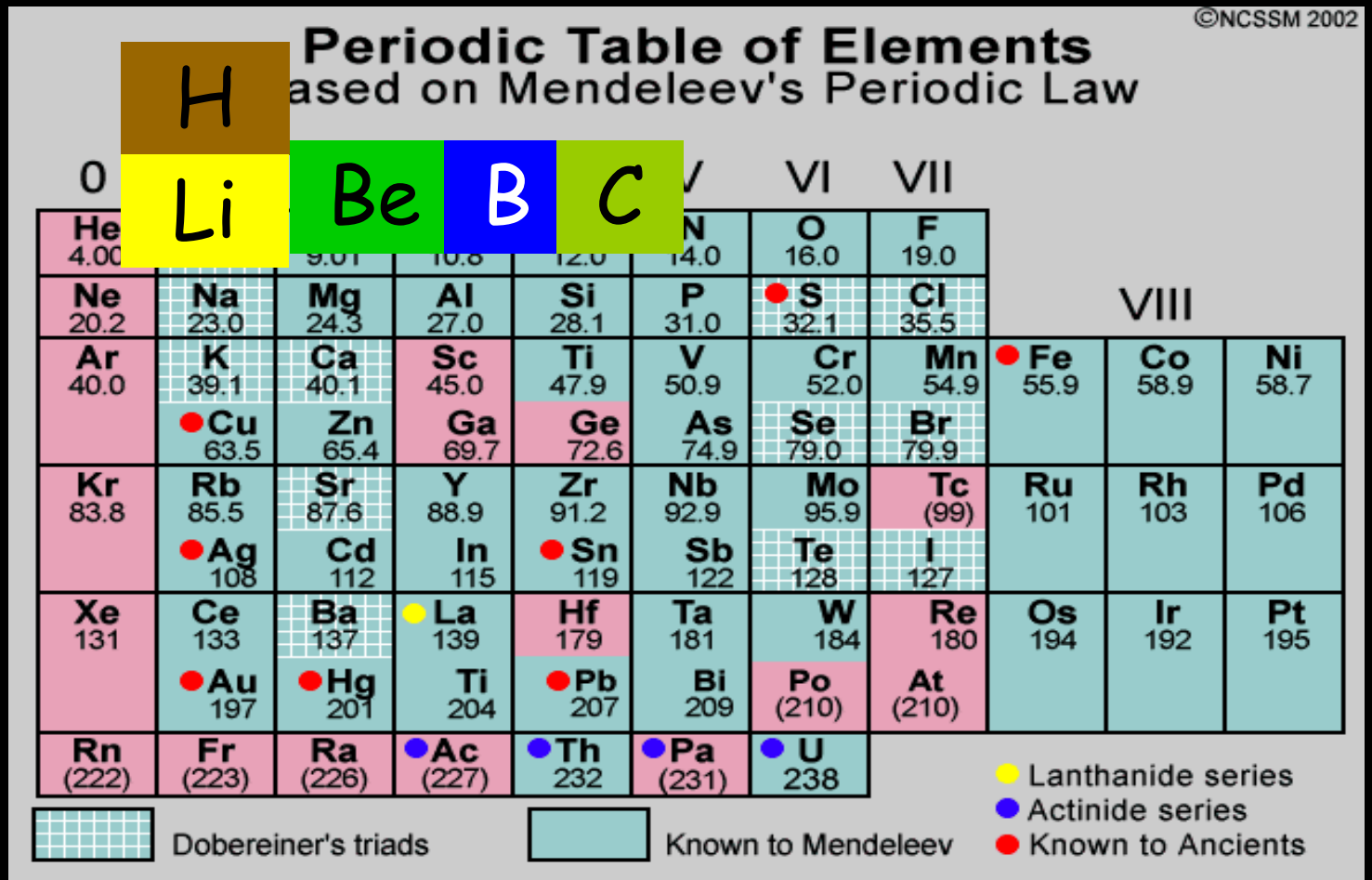
Mendeleev

1869 – He drew up the first periodic table of the known elements of his time by arranging the elements in order of increasing atomic weight.

He noticed repeating patterns which lead him to make very accurate predictions about undiscovered elements.

Mendeleev's Periodic Table

No Helium discovered



Mendeleev's Predictions

A Mendeleev Prediction (1871)

	PREDICTED PROPERTIES Ekasilicon (Es)	ACTUAL PROPERTIES Germanium(Ge)
ATOMIC WEIGHT	72	72.59
DENSITY	5.5 g/cm^3	5.35 g/cm^3
VALENCE	4	4
MELTING POINT	high	937.4°C
COLOR OF METAL	dark gray	gray-white
FORM OF OXIDE	EsO_2	GeO_2
DENSITY OF OXIDE	4.7 g/cm^3	4.23 g/cm^3
FORM OF CHLORIDE	$EsCl_4$	$GeCl_4$
DENSITY OF CHLORIDE	1.9 g/cm^3	1.84 g/cm^3
B.P. OF CHLORIDE	<100°C	84°C

The differences in Mendeleev's table and the modern periodic table

1. Mendeleev's table was arranged in order of increasing atomic mass. Modern table is arranged in order of increasing atomic number.

2. In Mendeleev's table the noble gases are not included in the modern Table they are.

3. There are gaps in Medeleev's table but there are none in the modern periodic table as they have been discovered..

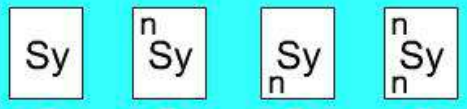
2003 Q. 4 (*i*) (6)

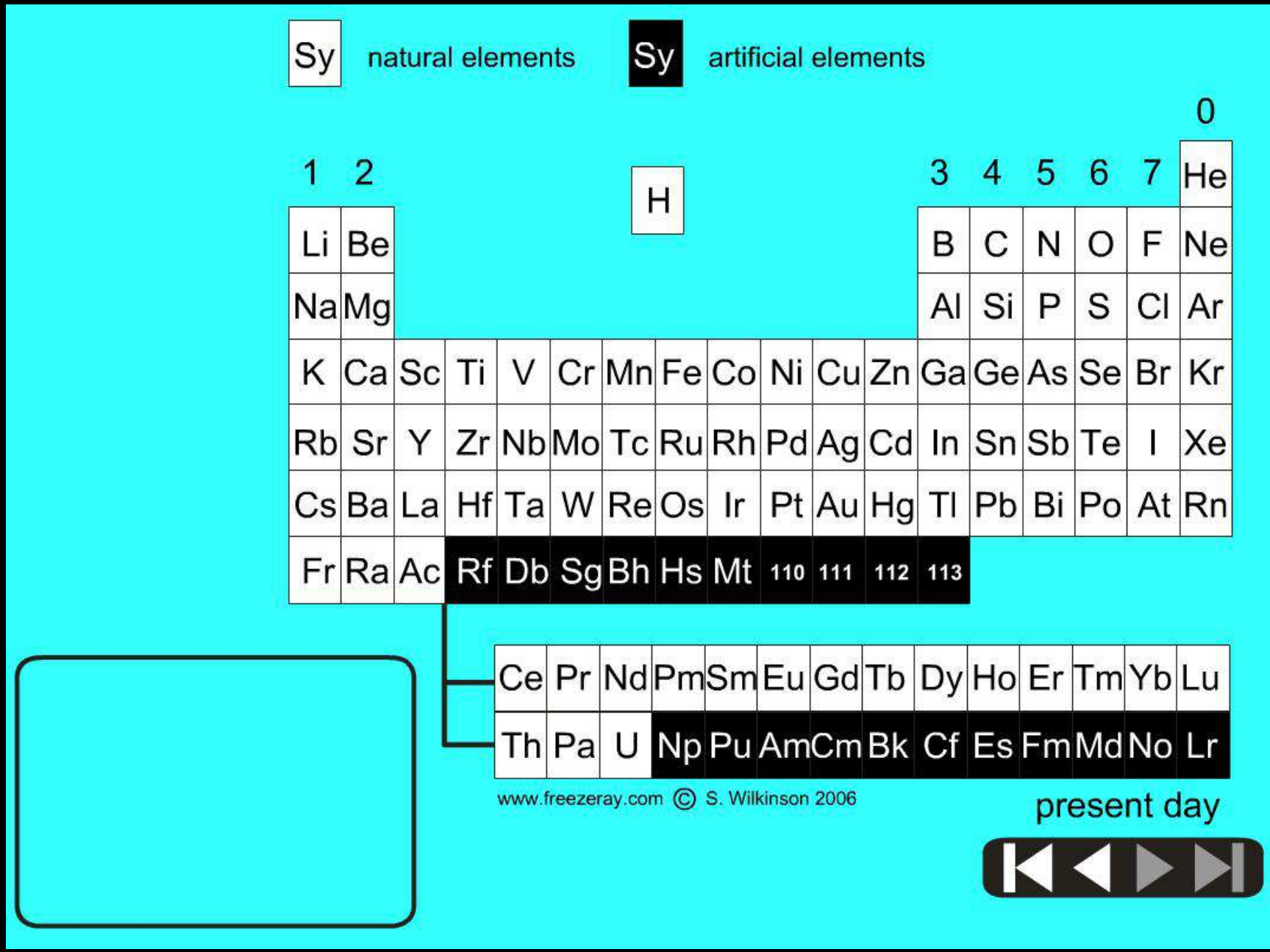
State two ways in which Mendeleev's periodic table of the elements differs from that of Moseley.

main groups

- ✓
- ×

1	2	3	4	5	6	7
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe




Sy natural elements
Sy artificial elements
0
1 2
3 4 5 6 7
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
Fr Ra Ac Rf Db Sg Bh Hs Mt 110 111 112 113
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
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present day

What have you learnt about..

Dobereiner

Mendeleev

Octaves

Triads

Newlands

Henry Moseley

oseley

1913 – Henry Moseley discovered that the positive charge in the nucleus of an atom of any element is of a definite amount.

These units of positive charge became known as protons. The periodic table is now arranged in order of increasing atomic number.

The ***atomic number*** of and element is the number of protons in the nucleus of an atom of that element

2008 Q. 4 (*b*) (6)

What contribution did Henry Moseley, the scientist shown in the photograph, make to the systematic arrangement of the elements in the periodic table?

The elements in the periodic table

Click an element for more information.

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
Fr	Ra	Ac*	Rf	Db	Sg	Bh	Hs	Ms	Ds	Rg	?	?	?	?	?	?	?

How elements are alike each other in each main group

Today's objectives

- Learning about Group 1 in the Periodic Table – their properties and reactions.

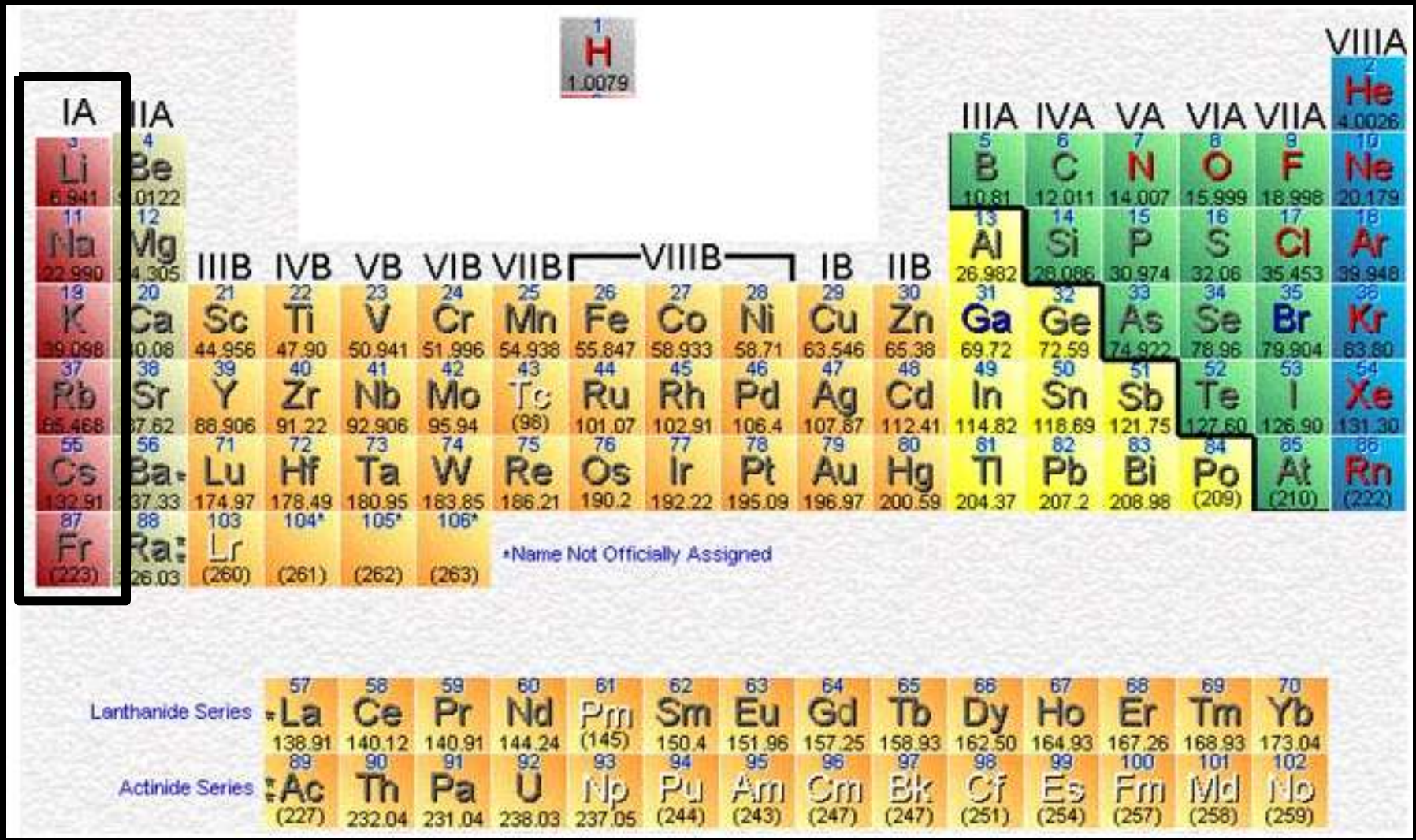
Metals, non-metals or metalloids

Click an element or button for more information.

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
Fr	Ra	Ac*	Rf	Db	Sg	Bh	Hs	Ms	Ds	Rg	?	?	?	?	?	?	?

metals metalloids non-metals

Group 1 – The Alkali metals



Group 1 – The Alkali Metals

1. They are all shiny metals which are easily cut with a knife.

2. They all float on water

3. They are all extremely reactive and have to be stored in oil to prevent them from reacting with the oxygen in the air.

Demonstration – The reaction of the alkali metals with water

1 – The reaction of lithium with water

2 – The reaction of sodium with water

3 – The reaction of potassium with water

Explain, in terms of the structures of the atoms, the trend in reactivity down Group I (the alkali metal group) of the periodic table.

6

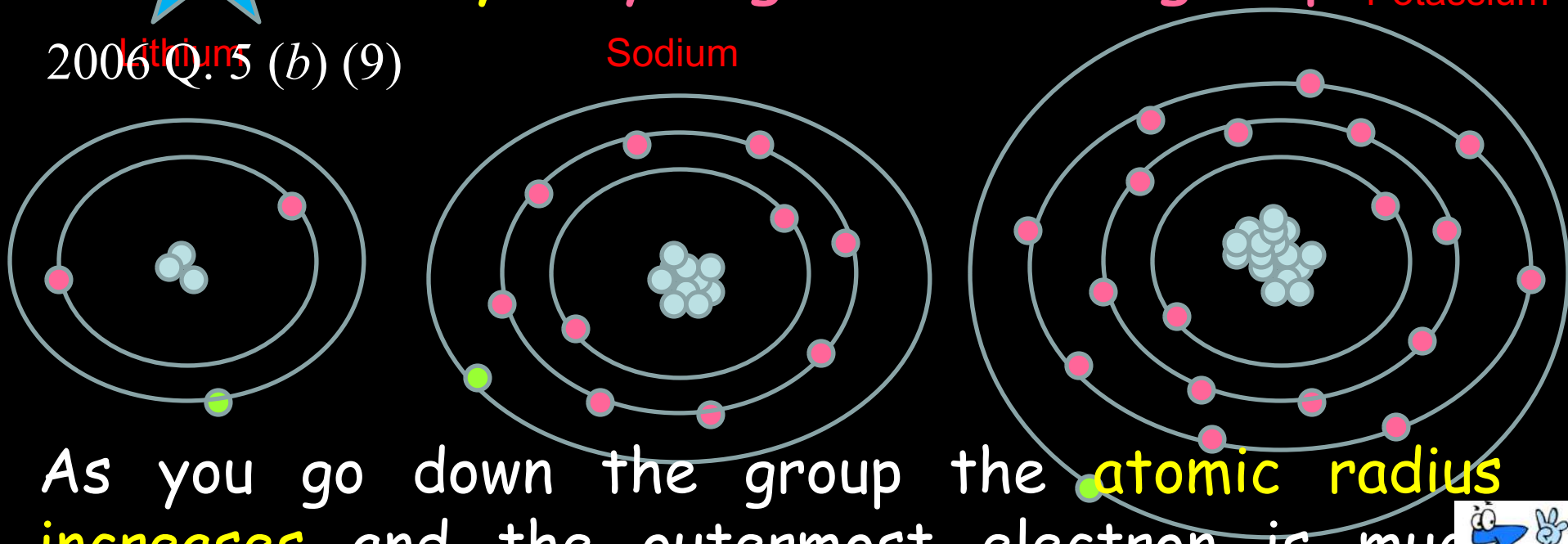
Why do the alkali metals increase in reactivity as you go down the group?

Potassium

2006 Q.5 (*b*) (9)

Lithium

Sodium



As you go down the group the atomic radius increases and the outermost electron is much further from the nucleus and is under less of an effect so that element is more reactive. This outer electron is also protected from the nucleus by an inner 'screening effect' of the inner electrons.

Balanced Equations

$2Li + 2H_2O \rightarrow \frac{1}{2}H_2 + 2\ LiOH$

Lithium + Water → Hydrogen + Lithium Hydroxide

$2Na + 2H_2O \rightarrow \frac{1}{2}H_2 + 2\ NaOH$

Sodium + Water → Hydrogen + Sodium Hydroxide

$2K + 2H_2O \rightarrow \frac{1}{2}H_2 + 2\ KOH$

Potassium + Water → Hydrogen + Potassium Hydroxide

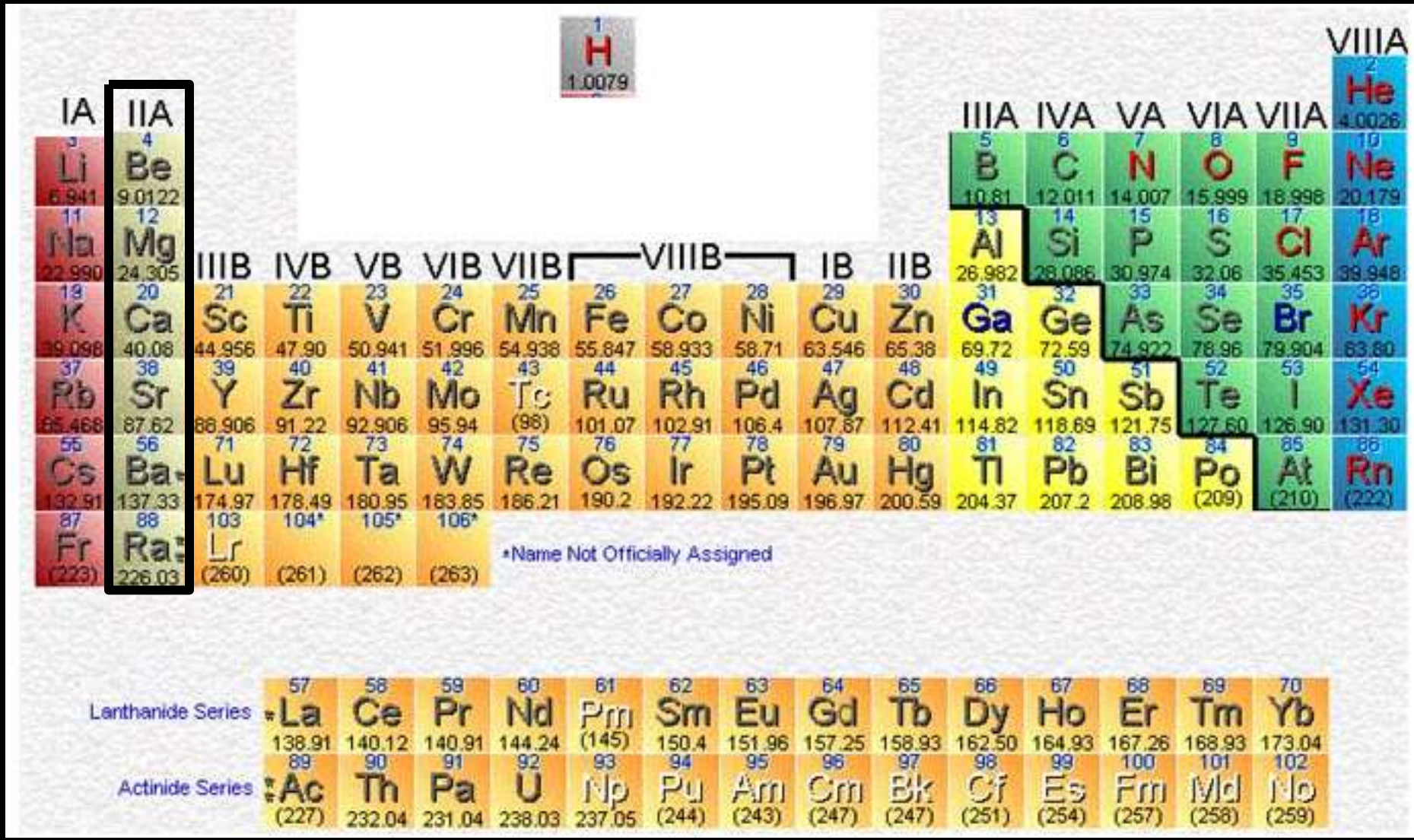
Check if you have learned..

- What group 1 in the Table is called?
- How many electrons are in the outer shell of group 1 elements?
- Some properties of group 1 metals?
- What happens when they are reacted with water?
- What is the reactivity trend as you go down the group?

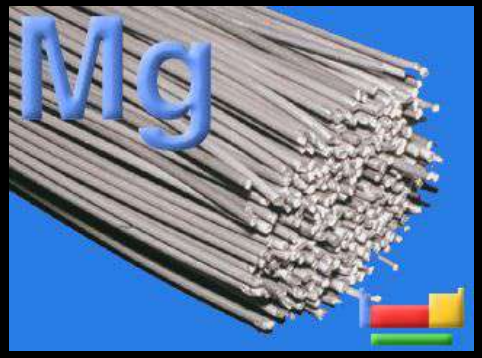
In today's class

- We will look at the properties of the rest of the groups in the Periodic table.

Group 2 – The earth alkali metals



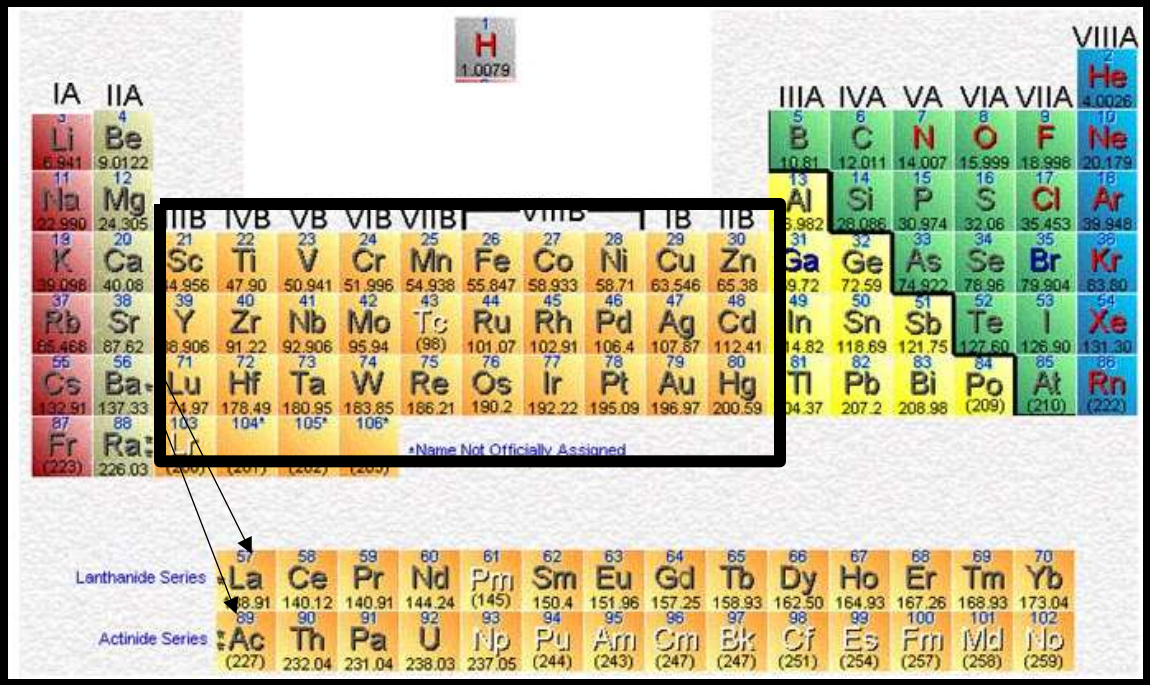
Group 2 – The Alkaline Earth Metals



1. They all have 2 electrons in their outer shell

2. They are reactive but not as reactive as the alkali metals

Groups 3 -11 The d block metals



They are all metals and are usually brightly coloured and act as catalysts for chemical reactions

Includes the following elements:

Scandium (Sc)

Titanium (Ti)

Vanadium (V)

Chromium (Cr)

Manganese (Mn)

Iron (Fe)

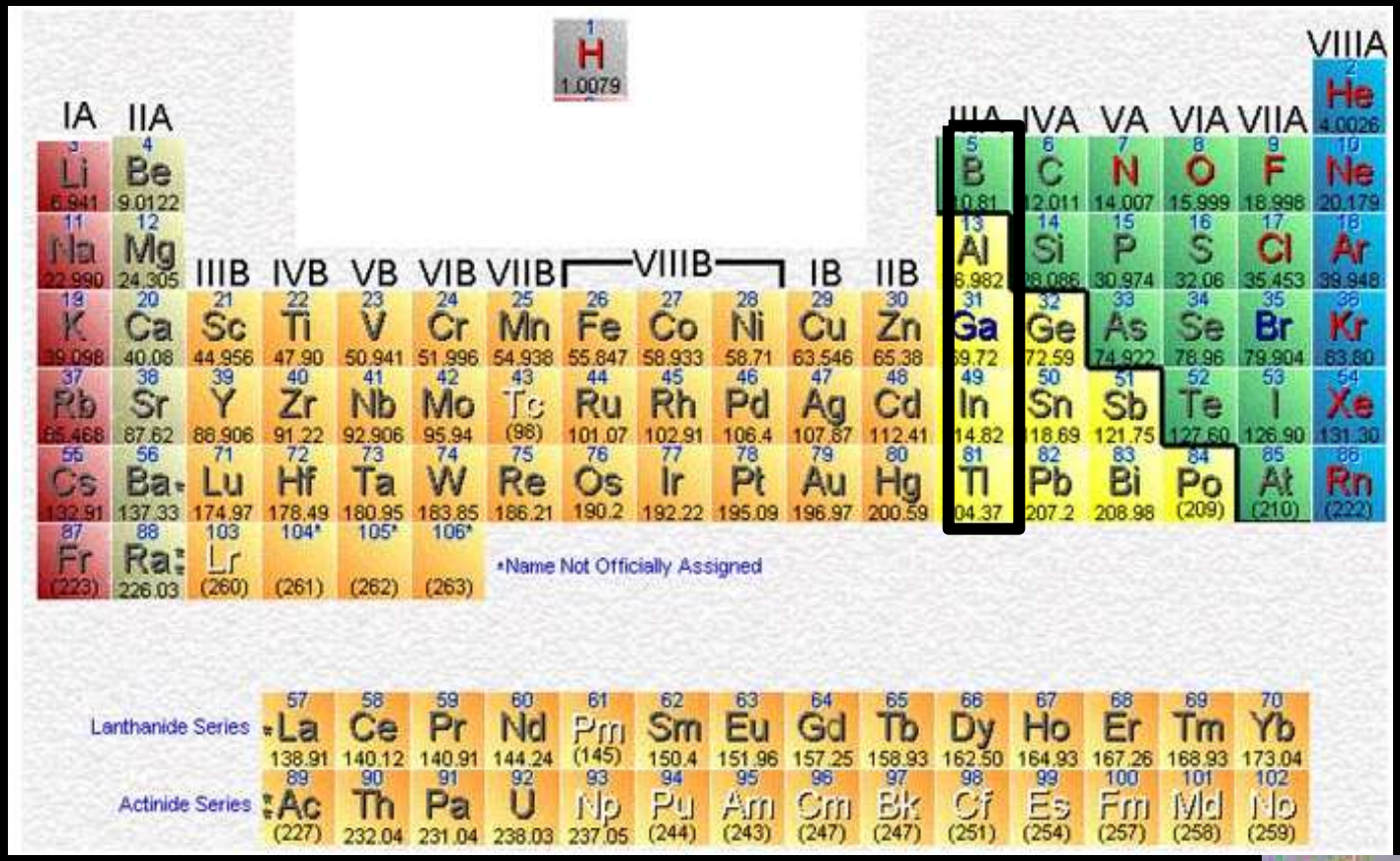
Cobalt (Co)

Nickel (Ni)

Copper (Co)

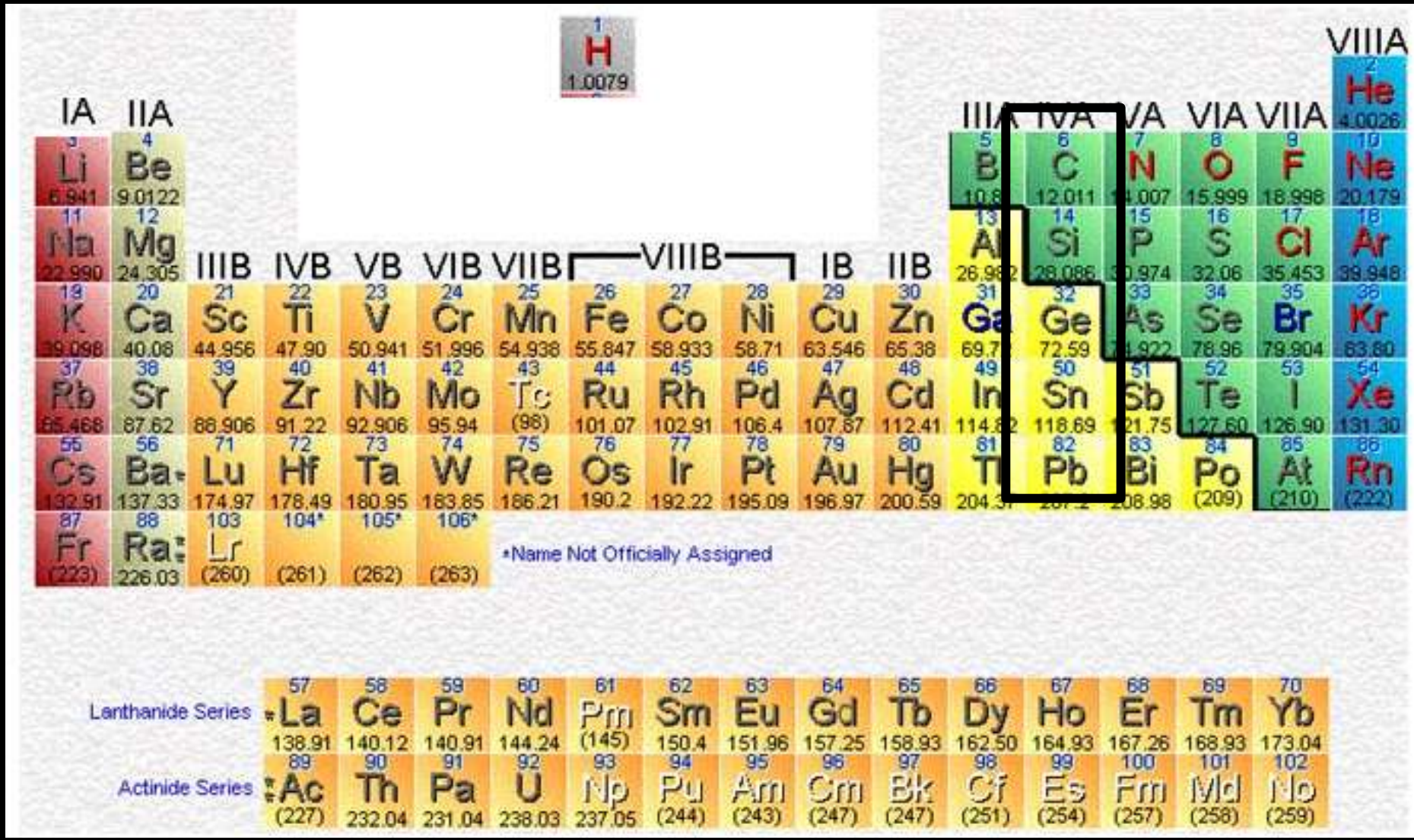
Zinc (Zn) and others!

Group 13

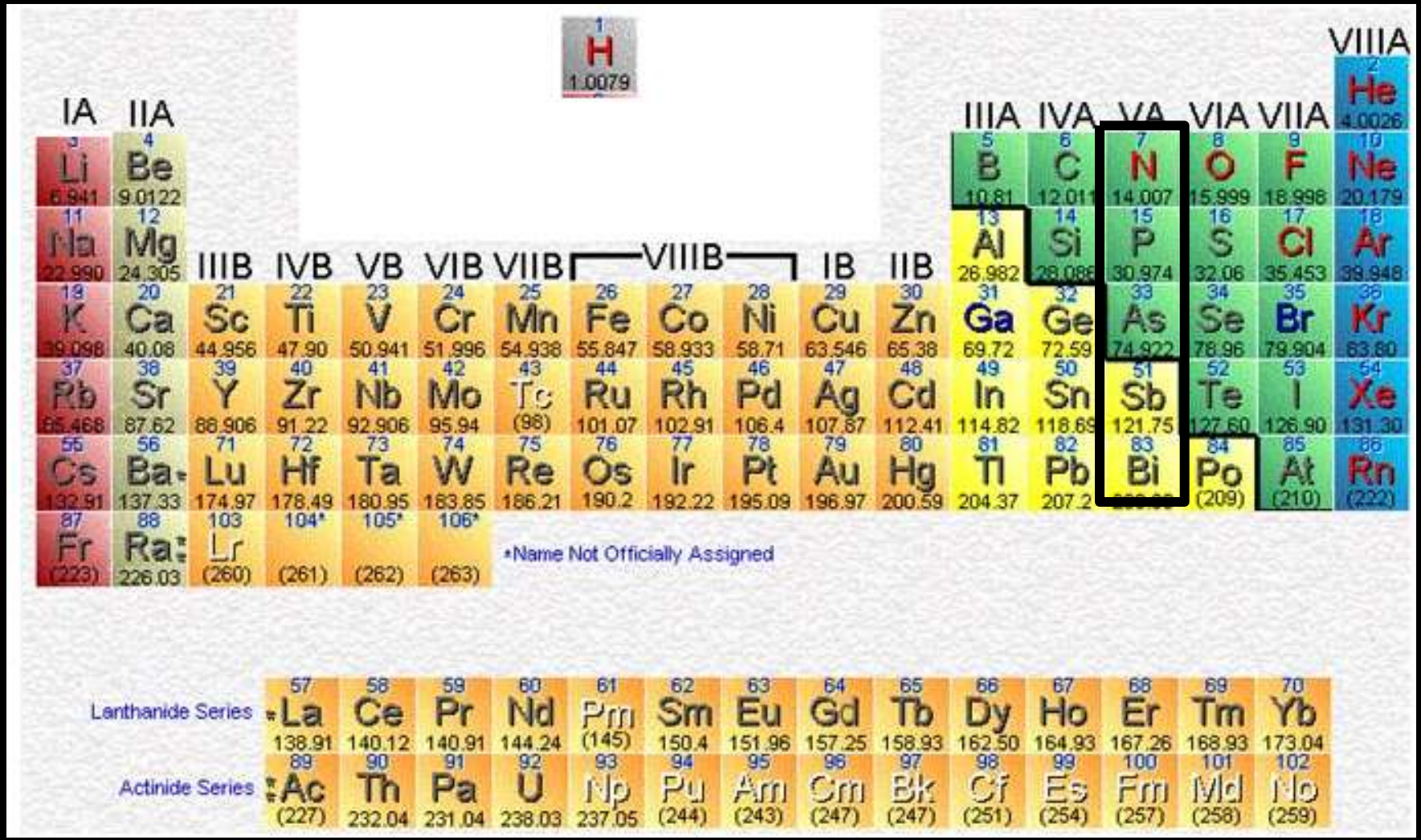


All have 3 electrons on their outermost shell!

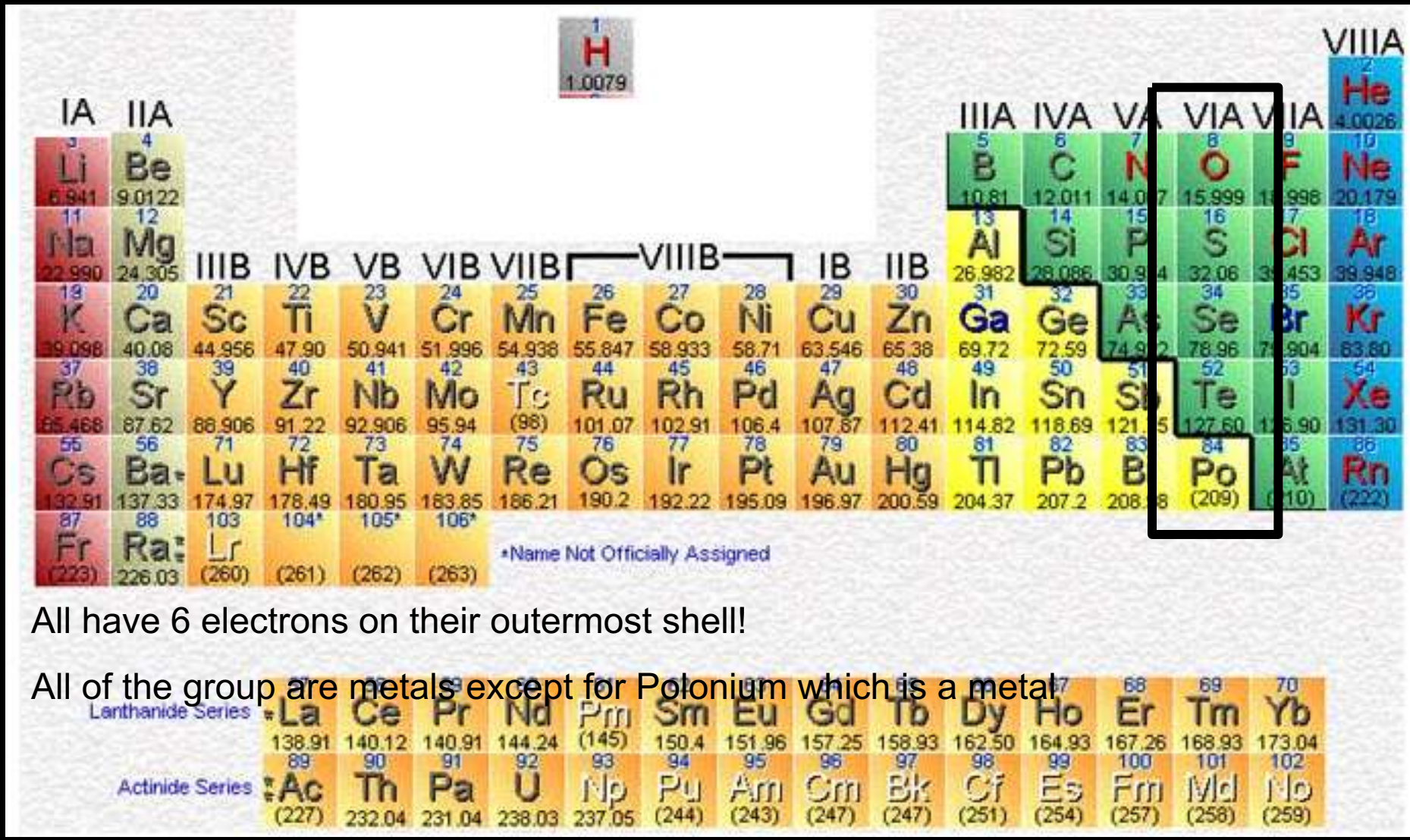
Group 14


IA
IIA
IIIB
IVB
VB
VIB
VIIB
VIIIB
IB
IIB
IIIA
IVA
VA
VIA
VIIA
VIIIA
H 1.0079
He 4.0026
Li 6.941
Be 9.0122
B 10.8
C 12.011
N 14.007
O 15.999
F 18.998
Ne 20.179
Na 22.990
Mg 24.305
Al 26.982
Si 28.086
P 30.974
S 32.06
Cl 35.453
Ar 39.948
K 39.098
Ca 40.08
Sc 44.956
Ti 47.90
V 50.941
Cr 51.996
Mn 54.938
Fe 55.847
Co 58.933
Ni 58.71
Cu 63.546
Zn 65.38
Ga 69.72
Ge 72.59
As 74.922
Se 78.96
Br 79.904
Kr 83.80
Rb 85.468
Sr 87.62
Y 88.906
Zr 91.22
Nb 92.906
Mo 95.94
Tc (98)
Ru 101.07
Rh 102.91
Pd 106.4
Ag 107.87
Cd 112.41
In 114.82
Sn 118.69
Sb 121.75
Te 127.60
I 126.90
Xe 131.30
Cs 132.91
Ba 137.33
Lu 174.97
Hf 178.49
Ta 180.95
W 183.85
Re 186.21
Os 190.2
Ir 192.22
Pt 195.09
Au 196.97
Hg 200.59
Tl 204.37
Pb 207.2
Bi 208.98
Po (209)
At (210)
Rn (222)
Fr (223)
Ra 226.03
Lr (260)
104* (261)
105* (262)
106* (263)
*Name Not Officially Assigned
Lanthanide Series
La 138.91
Ce 140.12
Pr 140.91
Nd 144.24
Pm (145)
Sm 150.4
Eu 151.96
Gd 157.25
Tb 158.93
Dy 162.50
Ho 164.93
Er 167.26
Tm 168.93
Yb 173.04
Actinide Series
Ac (227)
Th 232.04
Pa 231.04
U 238.03
Np 237.05
Pu (244)
Am (243)
Cm (247)
Bk (247)
Cf (251)
Es (254)
Fm (257)
Md (258)
No (259)

Group 15


IA IIA IIIB IVB VB VIB VIIB VIIIB IB IIB IIIA IVA VA VIA VIIA VIIIA
1 H 1.0079
2 He 4.0026
3 Li 6.941
4 Be 9.0122
5 B 10.81
6 C 12.011
7 N 14.007
8 O 15.999
9 F 18.998
10 Ne 20.179
11 Na 22.990
12 Mg 24.305
13 Al 26.982
14 Si 28.088
15 P 30.974
16 S 32.06
17 Cl 35.453
18 Ar 39.948
19 K 39.098
20 Ca 40.08
21 Sc 44.956
22 Ti 47.90
23 V 50.941
24 Cr 51.996
25 Mn 54.938
26 Fe 55.847
27 Co 58.933
28 Ni 58.71
29 Cu 63.546
30 Zn 65.38
31 Ga 69.72
32 Ge 72.59
33 As 74.922
34 Se 78.96
35 Br 79.904
36 Kr 83.80
37 Rb 85.468
38 Sr 87.62
39 Y 88.906
40 Zr 91.22
41 Nb 92.906
42 Mo 95.94
43 Tc (98)
44 Ru 101.07
45 Rh 102.91
46 Pd 106.4
47 Ag 107.87
48 Cd 112.41
49 In 114.82
50 Sn 118.69
51 Sb 121.75
52 Te 127.60
53 I 126.90
54 Xe 131.30
55 Cs 132.91
56 Ba 137.33
71 Lu 174.97
72 Hf 178.49
73 Ta 180.95
74 W 183.85
75 Re 186.21
76 Os 190.2
77 Ir 192.22
78 Pt 195.09
79 Au 196.97
80 Hg 200.59
81 Tl 204.37
82 Pb 207.2
83 Bi
84 Po (209)
85 At (210)
86 Rn (222)
87 Fr (223)
88 Ra 226.03
103 Lr (260)
104* (261)
105* (262)
106* (263)
*Name Not Officially Assigned
Lanthanide Series
57 La 138.91
58 Ce 140.12
59 Pr 140.91
60 Nd 144.24
61 Pm (145)
62 Sm 150.4
63 Eu 151.96
64 Gd 157.25
65 Tb 158.93
66 Dy 162.50
67 Ho 164.93
68 Er 167.26
69 Tm 168.93
70 Yb 173.04
Actinide Series
89 Ac (227)
90 Th 232.04
91 Pa 231.04
92 U 238.03
93 Np 237.05
94 Pu (244)
95 Am (243)
96 Cm (247)
97 Bk (247)
98 Cf (251)
99 Es (254)
100 Fm (257)
101 Md (258)
102 No (259)

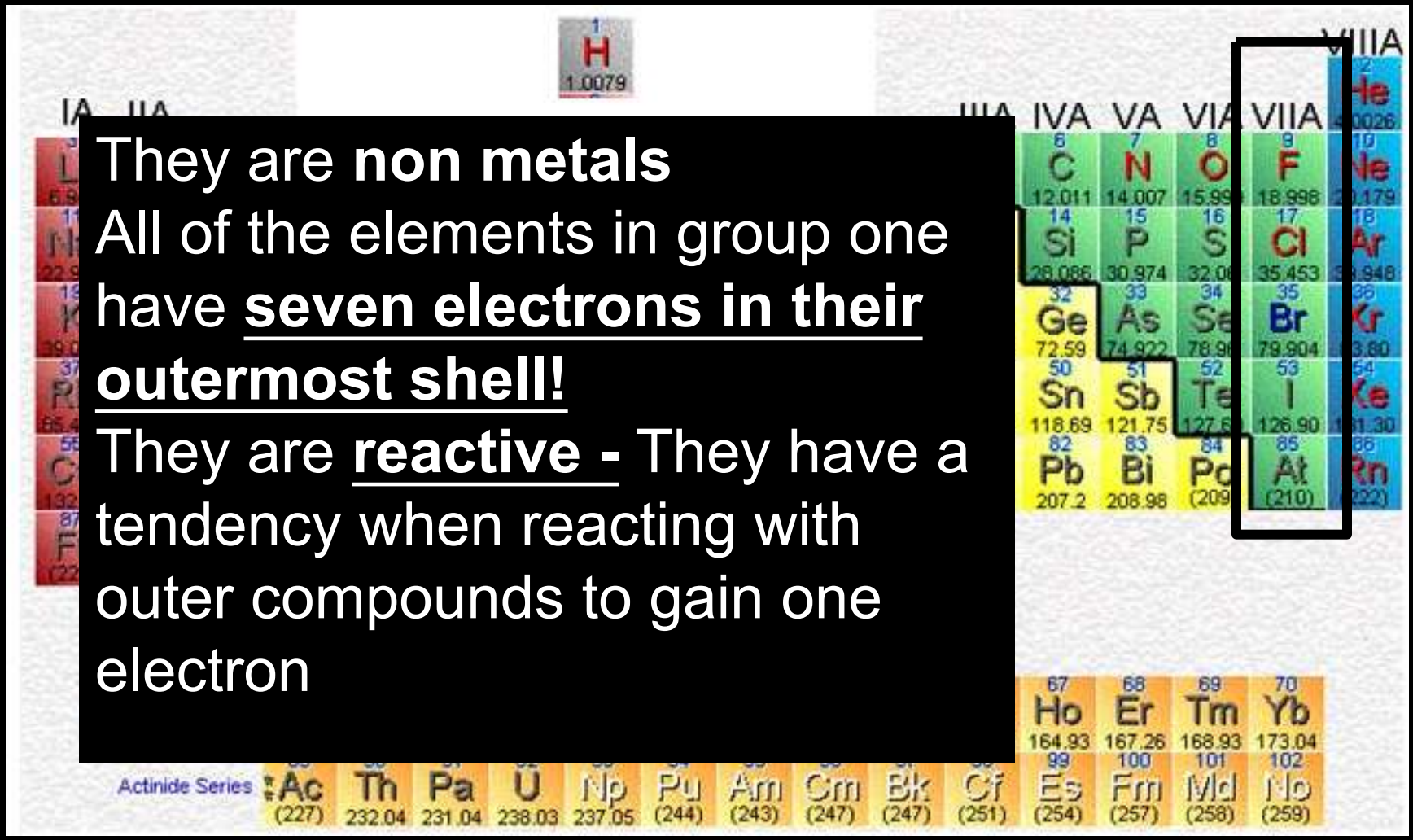
Group 16



All have 6 electrons on their outermost shell!

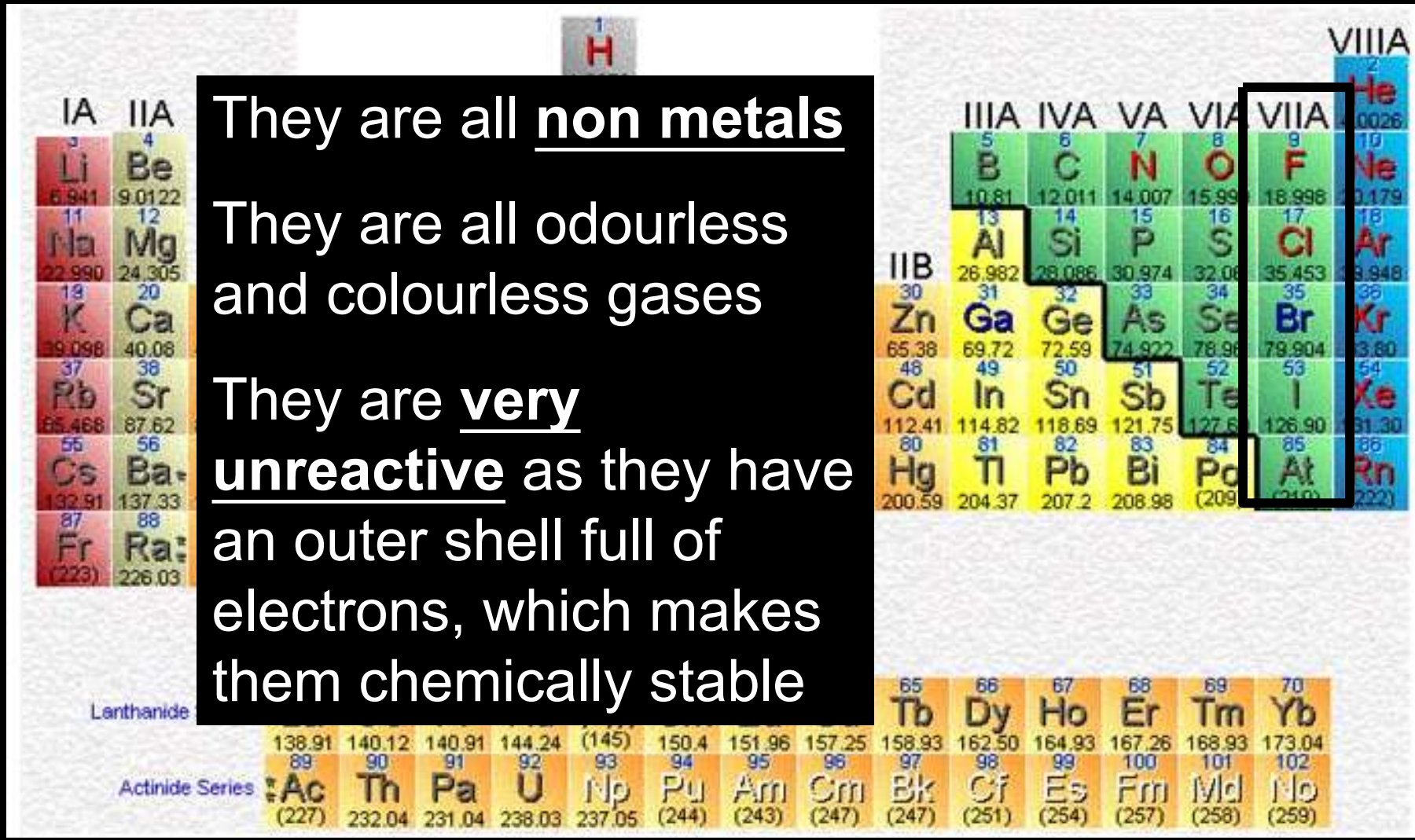
All of the group are metals except for Polonium which is a metal

Group 17 - The Halogens



Group 17 - The Halogens

Group 18 - The Noble gases



Group 18 - The Noble gases

The odd one out.. Hydrogen