Chemistry I
(Materials)
Unit Five:
The Periodic Table

Part 1: Development of the Periodic Table

Part 2: Reading the Periodic table

Part 3: Periodic Trends

The Periodic Table

Big Idea (December):

How is the periodic table organized, and how does it allow us to predict the properties of elements?

The Periodic Table

Performance Standards

II.I.I. 4 and 8

Properties of Matter

4. Describe trends in properties (e.g., ionization energy or reactivity as a function of location on the periodic table, boiling point of organic liquids as a function of molecular weight).

Structure of Matter

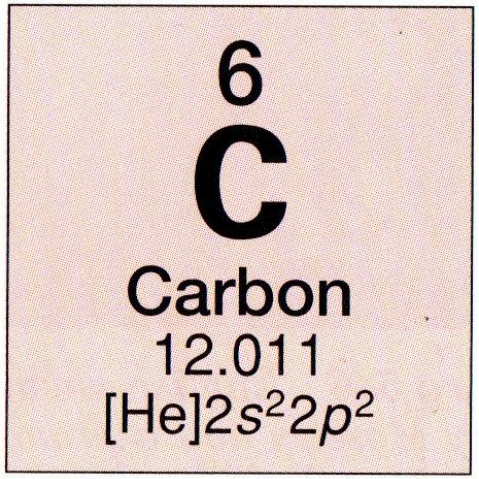
8. Make predictions about elements using the periodic table (e.g., number of valence electrons, metallic character, reactivity, conductivity, type of bond between elements).

The Periodic Table

II. Reading the Periodic Table

A. Organizing the squares:

1. The periodic table is made of squares each of which represents a unique element.



2. What information does this square provide about carbon? _____

_____

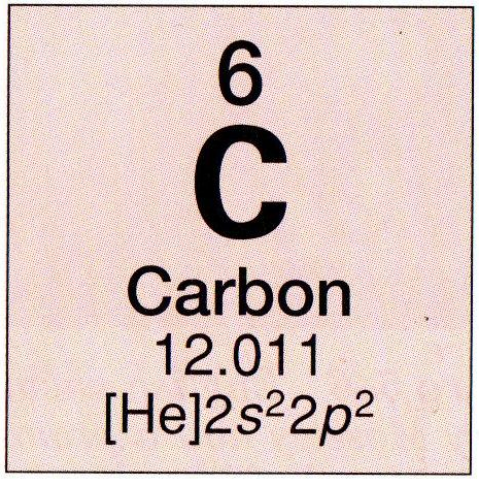
_____

The Periodic Table

II. Reading the Periodic Table

A. Organizing the squares:

1. The periodic table is made of squares each of which represents a unique element.



2. What information does this square provide about carbon? Carbon's atomic number is 6, its element symbol is C and its atomic mass is 12.011

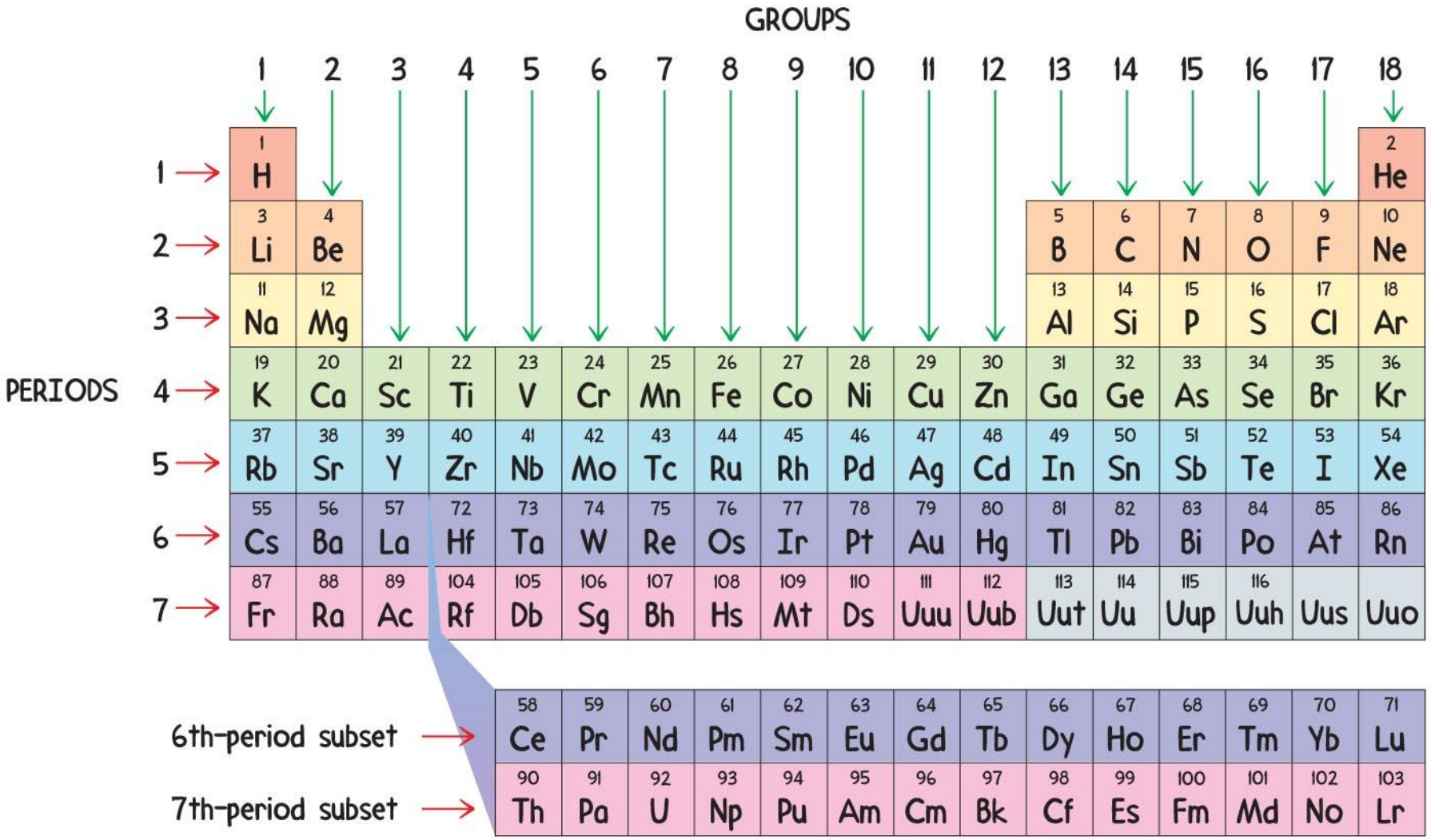
The Periodic Table

II. Reading the Periodic Table

A. Organizing the squares:

3. Different periodic tables may present different kinds of information or present information in different ways.
4. Elements with similar properties are aligned in vertical columns called groups or families
5. The horizontal rows are called periods
6. There are 7 periods and 18 groups

The Periodic Table



The Periodic Table

II. Reading the Periodic Table

A. Organizing the squares:

7. Look at periods 6 and 7. To keep the periodic table from being too wide 14 elements each were taken out of periods 6 and 7 and placed under the main body of the table.

8. How many elements does the 1st period have?___ The 3rd? ___ The 5th? ____ The 7th?____

The Periodic Table

II. Reading the Periodic Table

A. Organizing the squares:

7. Look at periods 6 and 7. To keep the periodic table from being too wide 14 elements each were taken out of periods 6 and 7 and placed under the main body of the table.

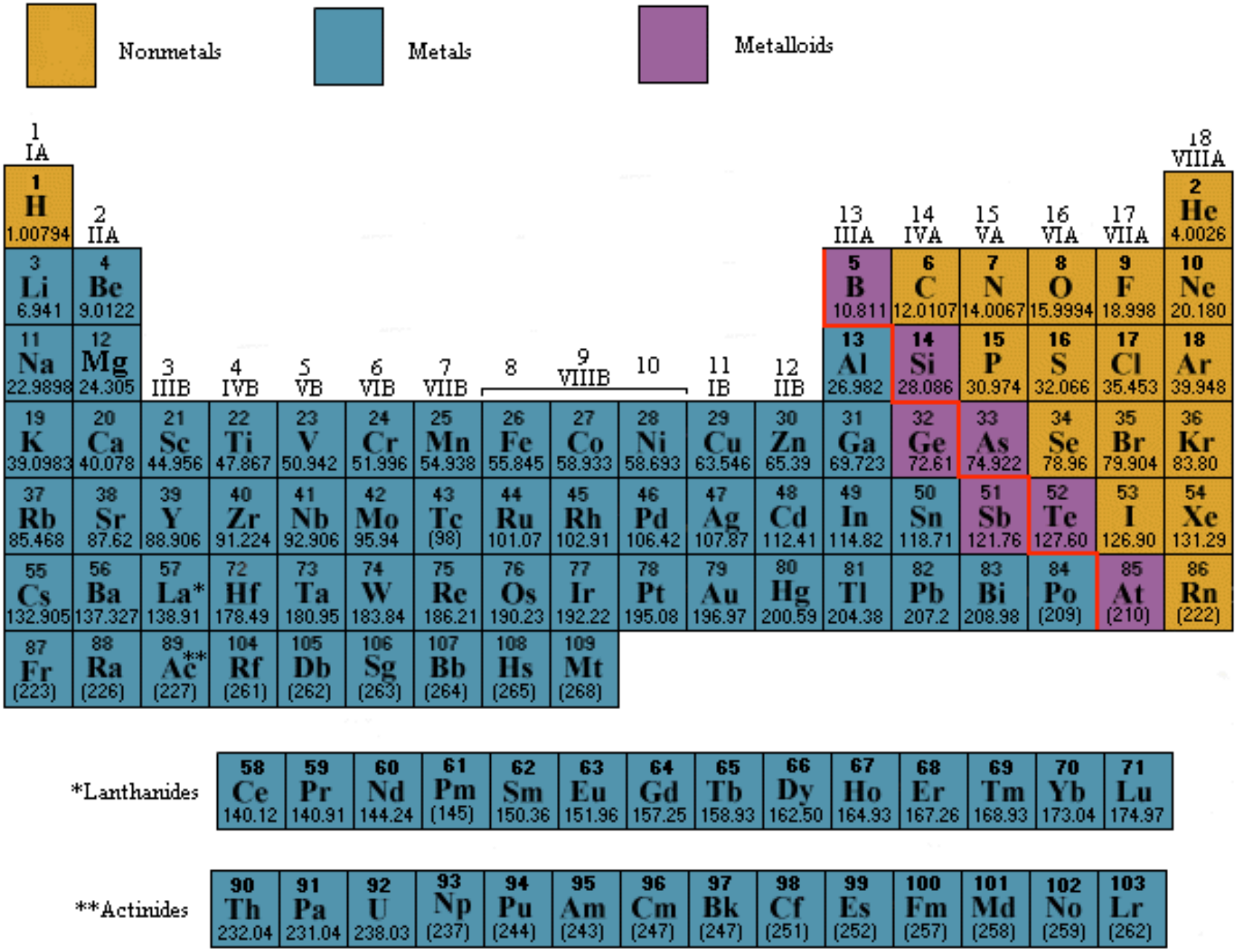
8. How many elements does the 1st period have? 2 The 3rd? 8 The 5th? 18 The 7th? 30

The Periodic Table

II. Reading the Periodic Table

B. Labeling and Naming Groups:

1. Groups are labeled one of two ways: with roman numerals or Arabic numerals followed by an A or B and/or by Arabic numerals 1-18.


Nonmetals
Metals
Metalloids
1 IA
2 IIA
3 IIIB
4 IVB
5 VB
6 VIB
7 VIIB
8
9 VIIIB
10
11 IB
12 IIB
13 IIIA
14 IVA
15 VA
16 VIA
17 VIIA
18 VIIIA
1 H 1.00794
2 He 4.0026
3 Li 6.941
4 Be 9.0122
5 B 10.811
6 C 12.0107
7 N 14.0067
8 O 15.9994
9 F 18.998
10 Ne 20.180
11 Na 22.9898
12 Mg 24.305
13 Al 26.982
14 Si 28.086
15 P 30.974
16 S 32.066
17 Cl 35.453
18 Ar 39.948
19 K 39.0983
20 Ca 40.078
21 Sc 44.956
22 Ti 47.867
23 V 50.942
24 Cr 51.996
25 Mn 54.938
26 Fe 55.845
27 Co 58.933
28 Ni 58.693
29 Cu 63.546
30 Zn 65.39
31 Ga 69.723
32 Ge 72.61
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 91.224
41 Nb 92.906
42 Mo 95.94
43 Tc (98)
44 Ru 101.07
45 Rh 102.91
46 Pd 106.42
47 Ag 107.87
48 Cd 112.41
49 In 114.82
50 Sn 118.71
51 Sb 121.76
52 Te 127.60
53 I 126.90
54 Xe 131.29
55 Cs 132.905
56 Ba 137.327
57 La* 138.91
72 Hf 178.49
73 Ta 180.95
74 W 183.84
75 Re 186.21
76 Os 190.23
77 Ir 192.22
78 Pt 195.08
79 Au 196.97
80 Hg 200.59
81 Tl 204.38
82 Pb 207.2
83 Bi 208.98
84 Po (209)
85 At (210)
86 Rn (222)
87 Fr (223)
88 Ra (226)
89 Ac** (227)
104 Rf (261)
105 Db (262)
106 Sg (263)
107 Bb (264)
108 Hs (265)
109 Mt (268)
*Lanthanides
58 Ce 140.12
59 Pr 140.91
60 Nd 144.24
61 Pm (145)
62 Sm 150.36
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
71 Lu 174.97
**Actinides
90 Th 232.04
91 Pa 231.04
92 U 238.03
93 Np (237)
94 Pu (244)
95 Am (243)
96 Cm (247)
97 Bk (247)
98 Cf (251)
99 Es (252)
100 Fm (257)
101 Md (258)
102 No (259)
103 Lr (262)

The Periodic Table

II. Reading the Periodic Table

B. Labeling and Naming Groups:

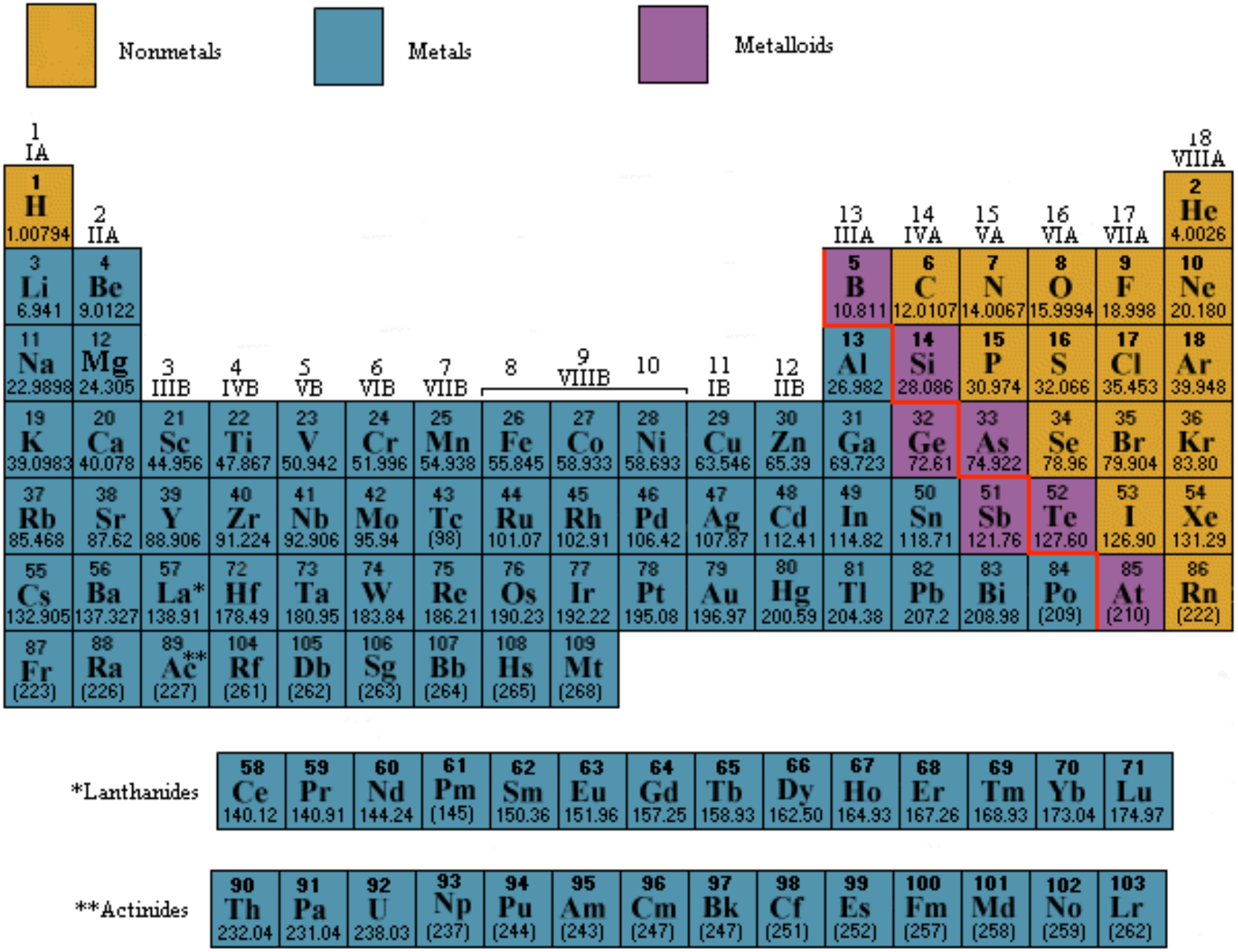
2. Some groups are also given family names

a) Group 1 (1A): alkali metals

b) Group 2 (2A): alkaline earth metals

c) Group 17 (7A): halogens

d) Group 18 (8A): noble gases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The Periodic Table

II. Reading the Periodic Table

B. Labeling and Naming Groups:

3. Other groups/families are identified by the name of the first element. Example: Group 14 (4A) is called the carbon group/family.

C. The hydrogen square is often separated from the periodic table. It is really not a member of any family. Although it is placed with the alkali metals, it is not a metal. Its best fit is with the halogens.

The Periodic Table

Reading the Periodic Table

D. Metals, Nonmetals, and Semimetals

1. Most elements are metals.
   a) Shiny, they have a metallic luster
   b) Good conductors of heat and electricity
   c) Solids at room temperature (except mercury which is a liquid)
   d) Most are malleable and ductile

The Periodic Table

II. Reading the Periodic Table

D. Metals, Nonmetals, and Semimetals

i. Define malleable: _____

_____

The Periodic Table

II. Reading the Periodic Table

D. Metals, Nonmetals, and Semimetals

i. Define malleable: Capable of being shaped or formed, as by hammering or pressure.

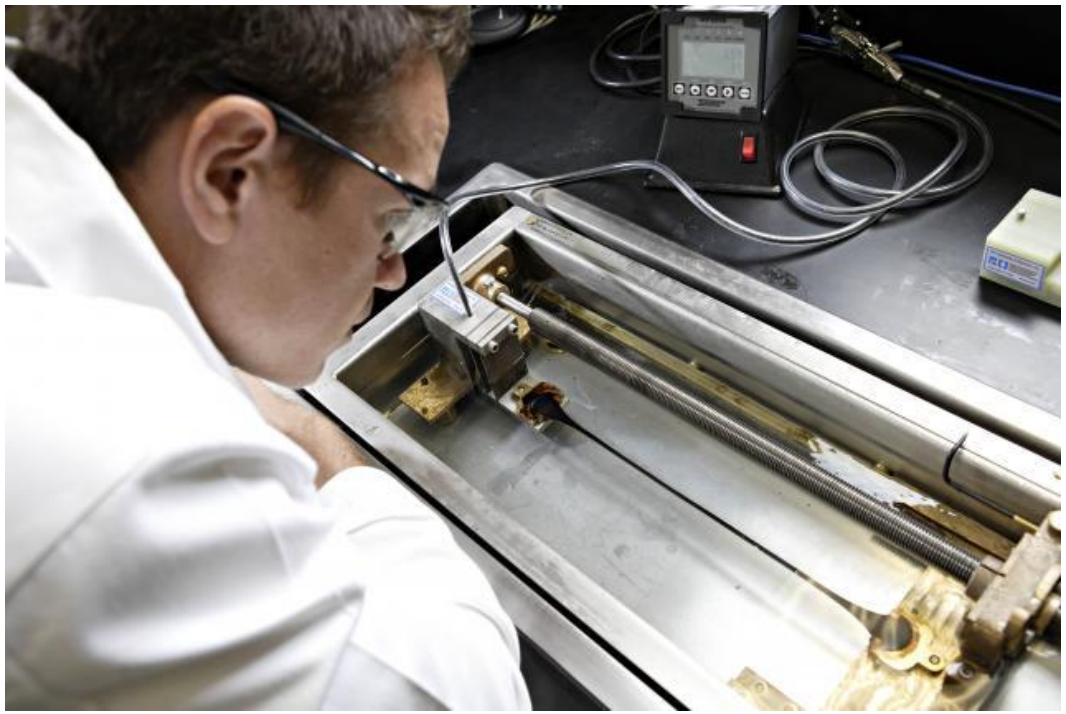
The Periodic Table

II. Reading the Periodic Table

D. Metals, Nonmetals, and Semimetals

ii. Define ductile: _____

_____

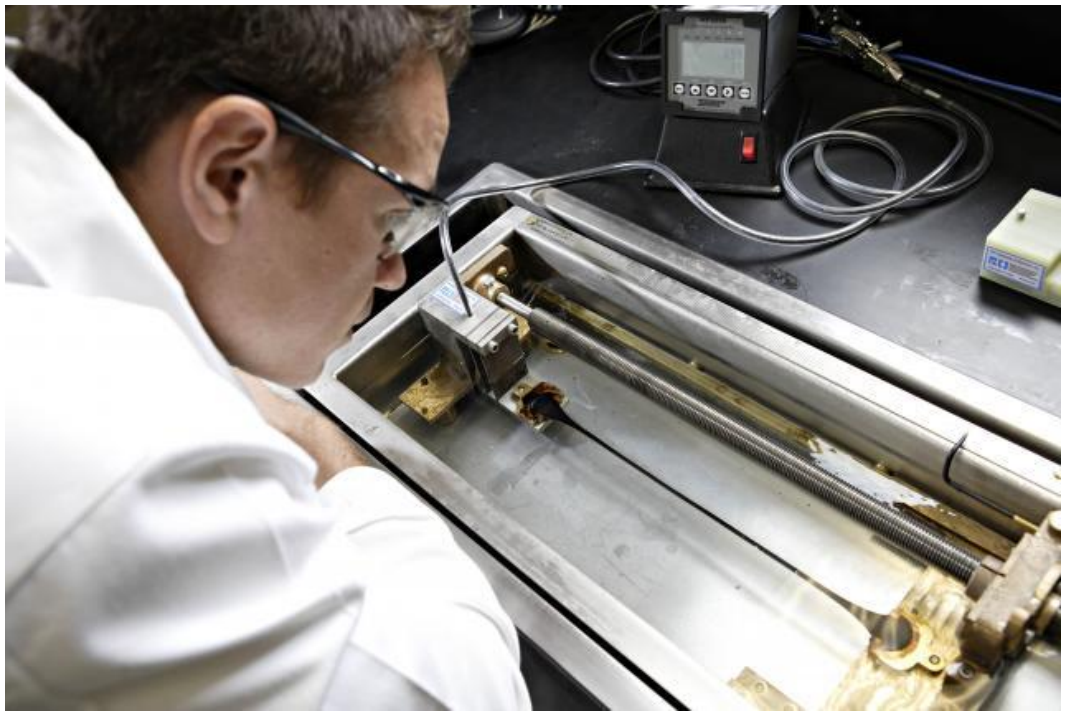


The Periodic Table

II. Reading the Periodic Table

D. Metals, Nonmetals, and Semimetals

ii. Define ductile: Easily drawn into wire.



The Periodic Table

II. Reading the Periodic Table

D. Metals, Nonmetals, and Semimetals

2. Nonmetals have none of the characteristics listed above.

a) Many are gases at room temperature

b) Others are solids

c) Bromine is the only liquid

d) Vary in physical properties: colored/colorless, soft solids/hard solids

The Periodic Table

II. Reading the Periodic Table

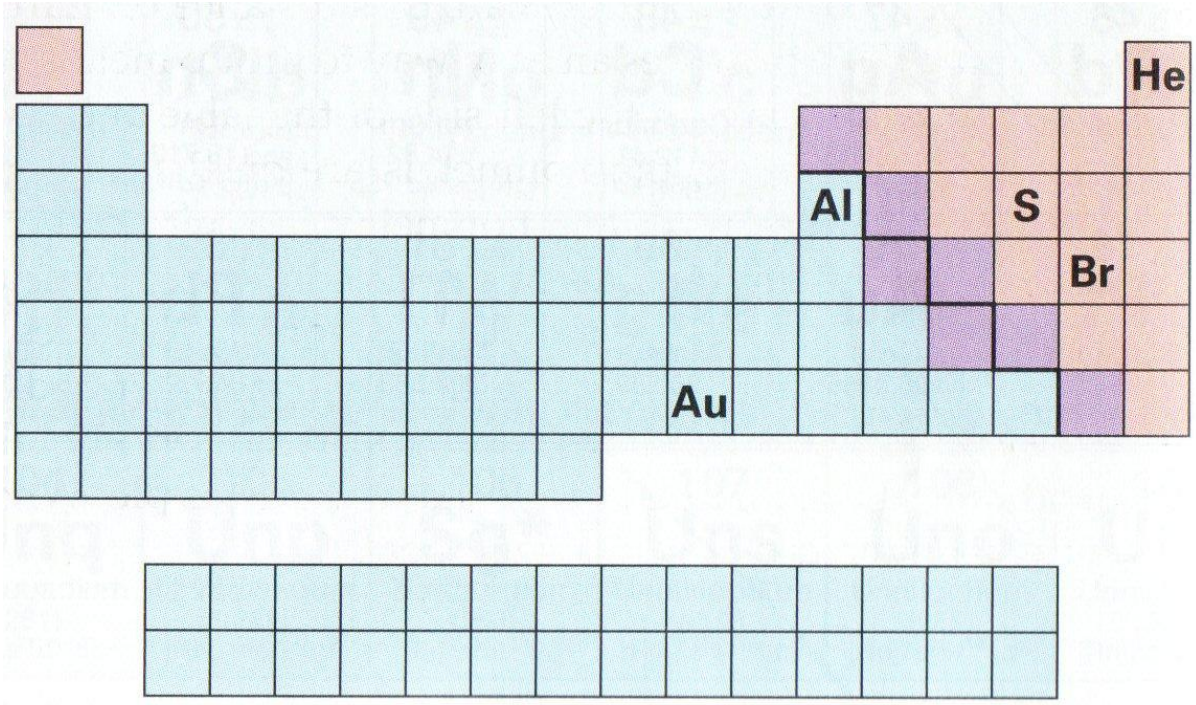
D. Metals, Nonmetals, and Semimetals

3. Metals are on the left side of the table (except hydrogen)
4. Nonmetals are on the far right
5. Semimetals (also called metalloids) are located between the metals and nonmetals. Have properties of both metals and nonmetals.

The Periodic Table

Reading the Periodic Table

- Metals, Nonmetals, and Semimetals



- In this table, metals are shaded blue, nonmetals are shaded red and semimetals are shaded purple.

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations and the Periodic Table

1. To understand the periodic table, you need to know how an atom's electrons are arranged.
2. Electrons that occupy the highest principal energy level are the atom's outermost electrons called valence electrons.

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations and the Periodic Table

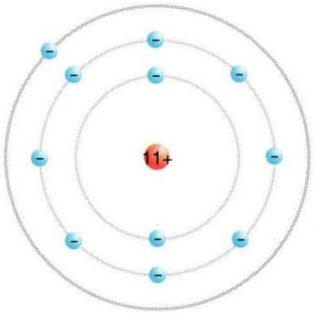
3. Valence electron are responsible for an atom's chemical behavior.

4. Elements in a group have similar properties because they have valence electrons in similar configurations.

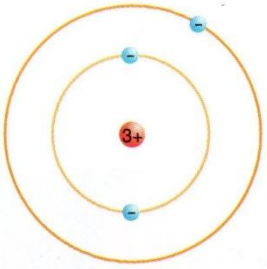
The Periodic Table

II. Reading the Periodic Table

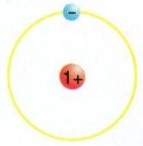
E. Electron Configurations & the Periodic Table



Sodium (Na)
$1s^2 2s^2 2p^6 3s^1$



Lithium (Li)
$1s^2 2s^1$



Hydrogen (H)
$1s^1$

5. How many valence electrons do sodium, lithium and hydrogen have?

___

6. Should they have similar properties? ___

7. Do they belong to the same group?

___

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table

8. Elements with similar valence electrons are placed in the same columns or groups/families on the periodic table.

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table

9. Abbreviated electron configurations have an atom's inner electrons represented by the symbol for the nearest noble gas with a lower atomic number.

10. These inner electrons are called the noble gas inner core of the atom.

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table

11. Abbreviated electron configurations:

a) Lithium = $[He]2s^1$.

i. $[He]$ represents helium's electron configuration which is $1s^2$.

ii. Outside this helium inner core lithium has a single valence electron in a $2s$ orbital.

The Periodic Table

II. Reading the Periodic Table

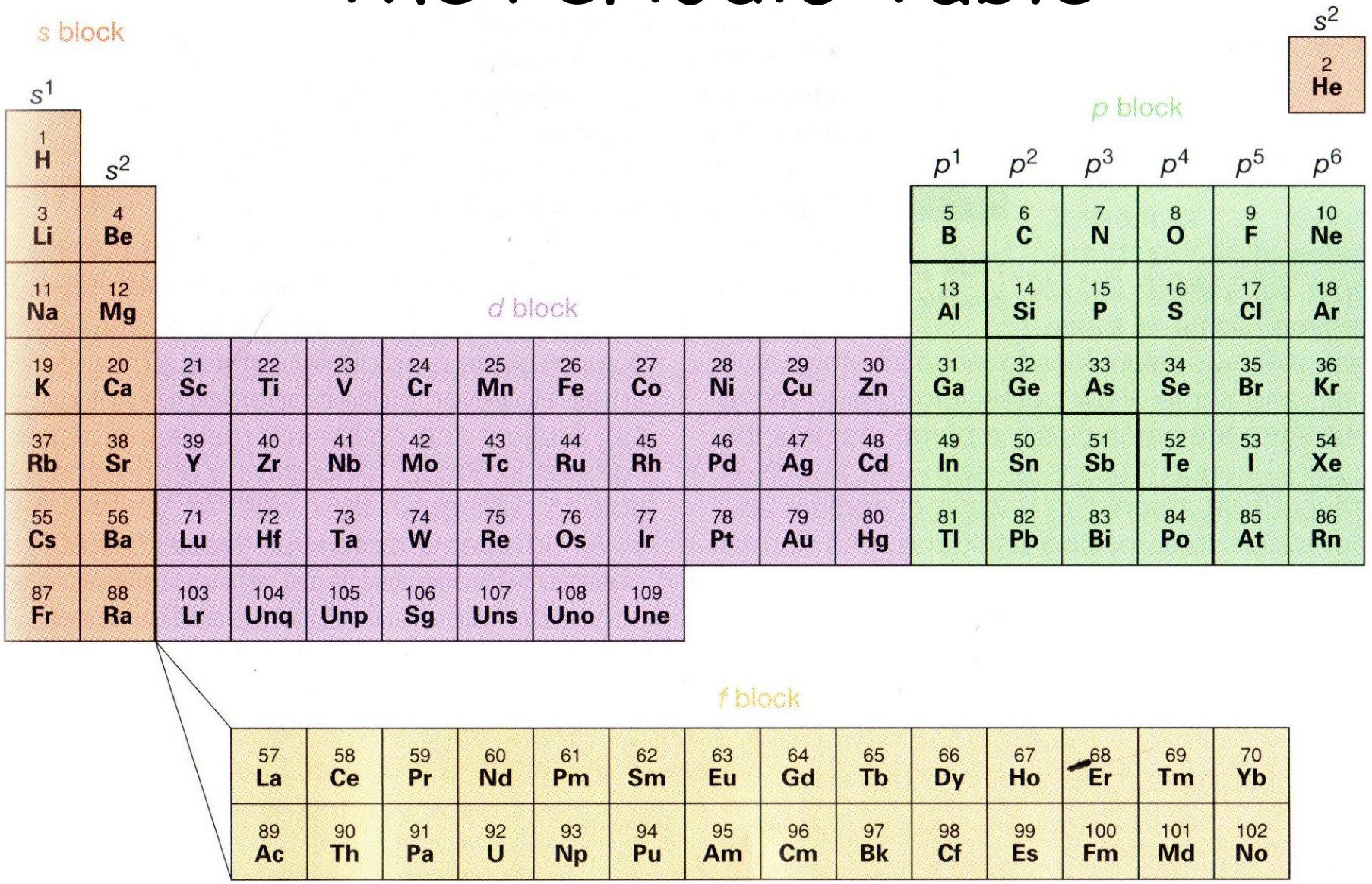
E. Electron Configurations and the Periodic Table

11. Abbreviated electron configurations:

b) Write the symbol and abbreviated electron configurations for all elements in Group 1A:

_____

The Periodic Table



The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations and the Periodic Table

12. The periodic table is divided into four blocks according to valence electrons.

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations and the Periodic Table

13. The *s*-block is composed of hydrogen, helium and elements in Groups 1A and 2A (the alkali metals and the alkaline earth metals). Valence electrons are in *s* orbitals only. Group 1A has 1 valence electron in an *s* orbital. Group 2A has 2 valence electrons in an *s* orbital. Can there be more than 2 electrons in an s orbital?

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table

14. The *p*-block: from left to right, the elements' valence electrons fill *p* orbitals (progress from p^1 to p^6).

a) Why does the 1st period of the table have no *p*-block elements? _____

_____

b) Why is the *p*-block 6 elements wide?

_____

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table

14. The *p*-block: from left to right, the elements' valence electrons fill *p* orbitals (progress from p^1 to p^6).

a) Why does the 1st period of the table have no *p*-block elements? The 1st principal energy level has no *p* sublevels

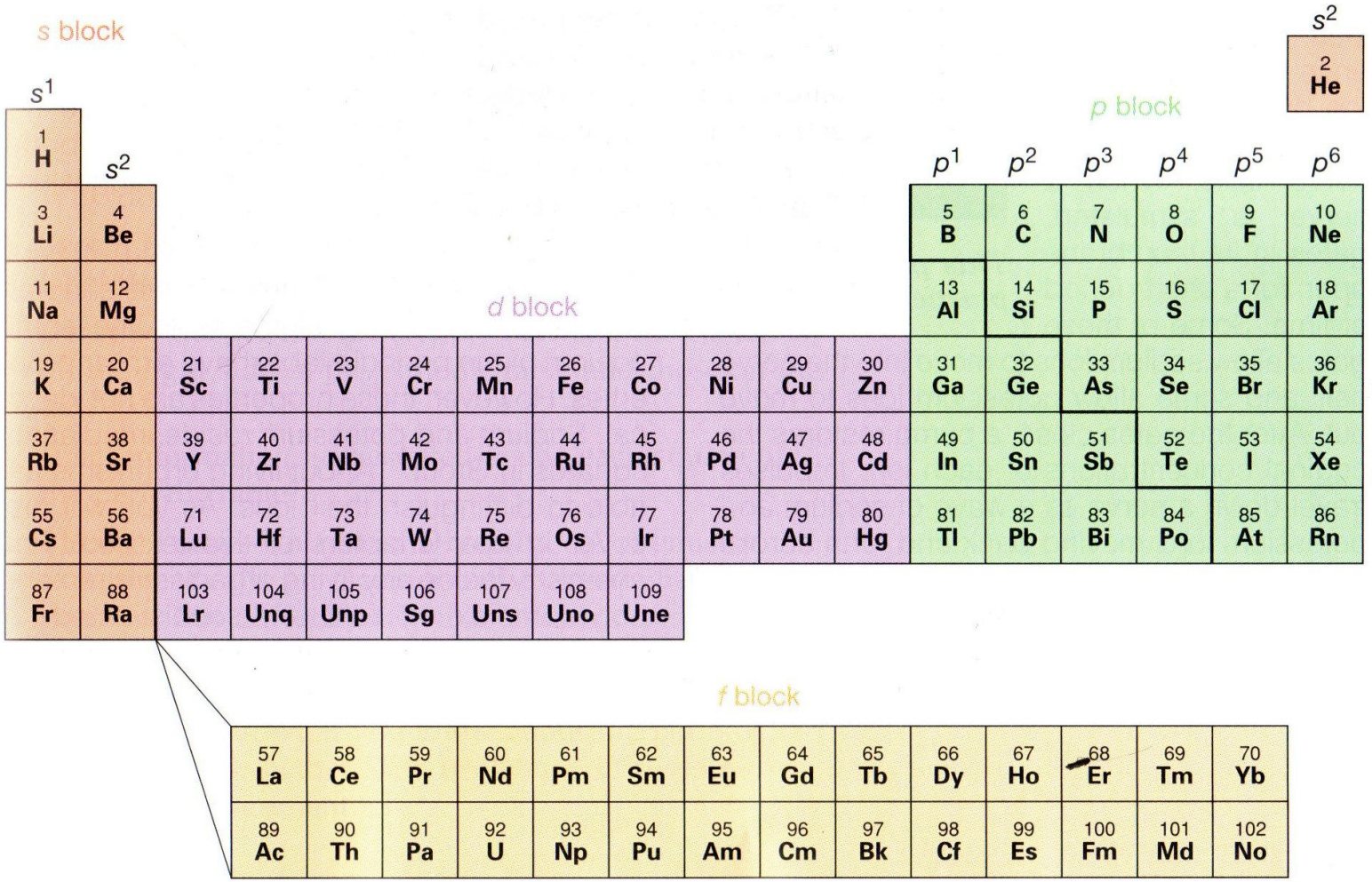
b) Why is the *p*-block 6 elements wide?

p orbits can hold up to 6 electrons

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table



The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table

15. The *d*-block: from left to right, the elements' valence electrons fill *d* orbitals (progress from d^1 to d^{10}).

a) Why do the 1st three periods of the table have no *d*-block elements?

_____

b) Why is the *d*-block 10 elements wide?_____

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table

15. The *d*-block: from left to right, the elements' valence electrons fill *d* orbitals (progress from d^1 to d^{10}).

a) Why do the 1st three periods of the table have no *d*-block elements?

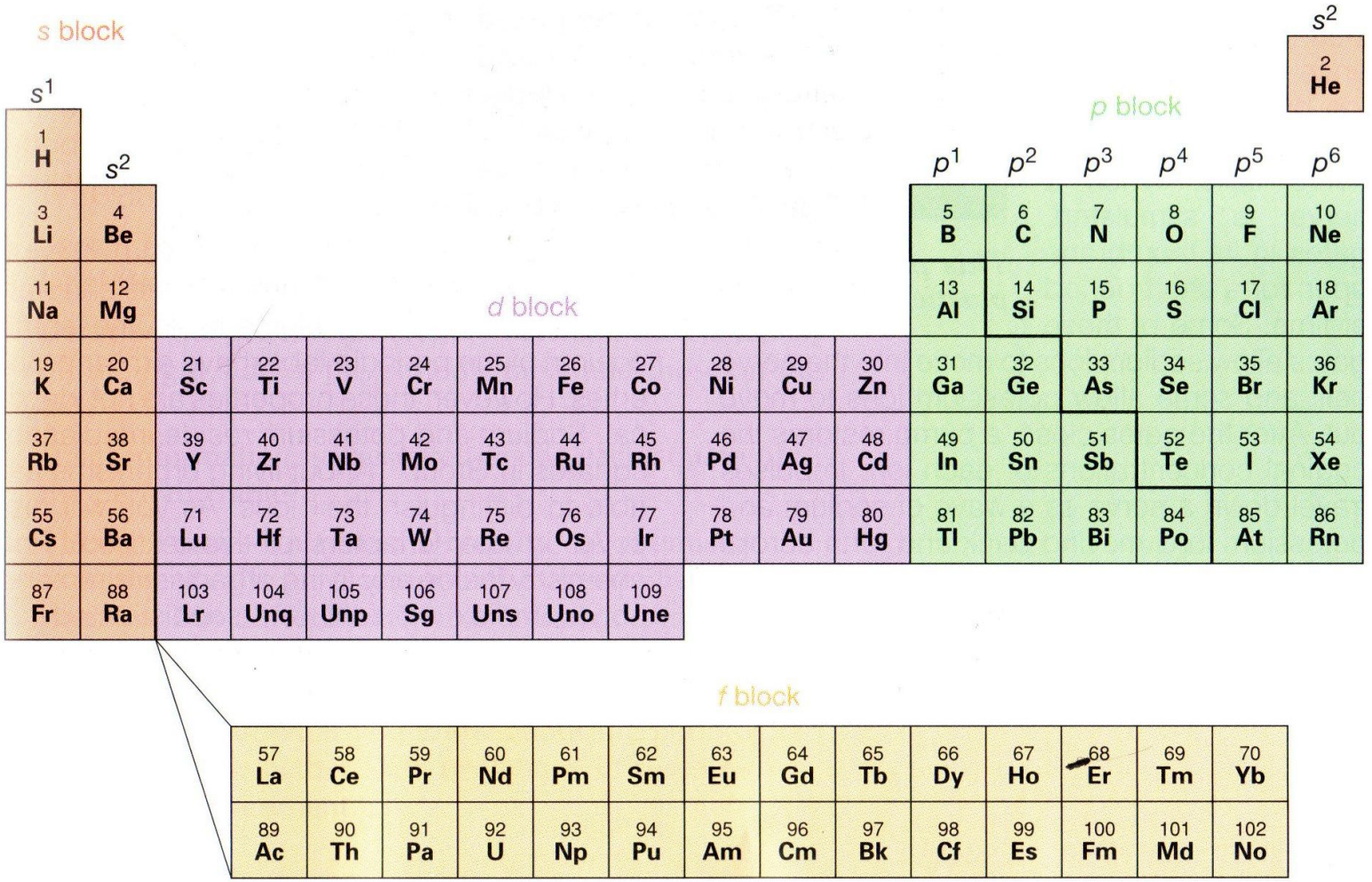
The 1st 3 principal energy levels have no *d* sublevels

b) Why is the *d*-block 10 elements wide? A d orbital can hold up to 10 electrons,

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table



The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table

16. The *f*-block. The 1st *f* orbital is the 4*f*, which begins filling with elements in the 6th period. The *f*-block is 14 elements wide because the *f* sublevel can hold 14 electrons. Electrons do not fill *f* orbitals sequentially from f^1 to f^{14}.

The Periodic Table

II. Reading the Periodic Table

E. Electron Configurations & the Periodic Table

17. The *s*-block and *p*-block elements are called the representative elements (or main-group elements).

18. The *d*-block elements are called the transition metals.

19. Elements in the *f*-block are known as the inner transition metals.

The Periodic Table

Reading the Periodic Table

Review Questions

1. Why do elements in a group have similar properties? _____
2. Sketch the general shape of the periodic table and label the *s*-, *p*-, *d*-, and *f*-blocks.

The Periodic Table

Reading the Periodic Table

Review Questions

1. Why do elements in a group have similar properties? They have valence electrons in similar configurations
2. Sketch the general shape of the periodic table and label the *s*-, *p*-, *d*-, and *f*-blocks.

The Periodic Table

Reading the Periodic Table

3. Describe the general differences between the elements on the right side of the periodic table and those on the left.

   Right side contains nonmetals (poor conductors of electricity). Left side contains the metals, except hydrogen, (solids, metallic luster, conduct electricity).

The Periodic Table

Reading the Periodic Table

4. What information is presented inside each square of the periodic table?

The Periodic Table

Reading the Periodic Table

4. What information is presented inside each square of the periodic table?

   Element's name, symbol, atomic number, atomic mass, abbreviated electron configuration.

The Periodic Table

Reading the Periodic Table

5. An experiment calls for bromine, which is not available. Which would be the better substitute, chlorine or selenium ?

The Periodic Table

Reading the Periodic Table

5. An experiment calls for bromine, which is not available. Which would be the better substitute, chlorine or selenium ?

Chlorine, because chlorine and bromine are both halogens and share similar chemical properties.