

Periodic Table of the Elements

Group	1	2											13	14	15	16	17	18
	1A	2A											3A	4A	5A	6A	7A	8A
1	1 H Hydrogen 1.0078																	2 He Helium 4.0026
2	3 Li Lithium 6.938	4 Be Beryllium 9.0122											5 B Boron 10.806	6 C Carbon 12.009	7 N Nitrogen 14.006	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
3	11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.981	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.059	17 Cl Chlorine 35.446	18 Ar Argon 39.948
4	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.63	33 As Arsenic 74.912	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798
5	37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.96	43 Tc Technetium 98.906	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29
6	55 Cs Cesium 132.91	56 Ba Barium 137.33											81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
7	87 Fr Francium (223)	88 Ra Radium (226)											113 Uut Ununtrium (268)	114 Fl Flerovium (268)	115 Uup Ununpentium (268)	116 Lv Livermorium (268)	117 Uus Ununseptium (268)	118 Uuo Ununoctium (268)
			Lanthanides															
			57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.97	
			Actinides															
			89 Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)	

11 — Atomic number
 Na — Element symbol
 Sodium — Element name
 22.990 — Atomic weight

Alkalai metals
 Alkaline earth metals
 Lanthanides
 Actinides
 Transition metals
 Unknown properties
 Post-transition metals
 Metalloids
 Other nonmetals
 Halogens
 Noble gases

PERIODIC TABLE

Hollis-Physical

Periodic Table of the Elements

Ancient Greeks thought everything

was made up of 4 basic elements:

- Earth
- Wind
- Fire
- Water

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6	55 Cs Cesium 132.91	56 Ba Barium 137.33		72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
7	87 Fr Francium (223)	88 Ra Radium (226)		104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (268)	111 Rg Roentgenium (268)	112 Cn Copernicium (288)	113 Uut Ununtrium (288)	114 Fl Flerovium (288)	115 Uup Ununpentium (288)	116 Lv Livermorium (288)	117 Uus Ununseptium (288)	118 Uuo Ununoctium (288)
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SOURCES: National Institute of Standards and Technology, International Union of Pure and Applied Chemistry

In 1808, John Dalton developed the atomic theory:

- Elements are made of unique particles that can't be divided
- Atoms of the same element are identical
- Atoms of different elements can combine to form molecules.
- In 1900, scientist found atoms can be broken down to simpler substances.

Group 1 1A 2 3 4 5 6 7 8 9 10 11 12 13 3A 14 4A 15 5A 16 6A 17 7A 18 8A

1 H Hydrogen 1.00794

2 He Helium 4.002602

3 Li Lithium 6.941

4 Be Beryllium 9.0122

5 B Boron 10.811

6 C Carbon 12.011

7 N Nitrogen 14.0064

8 O Oxygen 15.999

9 F Fluorine 18.998

10 Ne Neon 20.180

11 Na Sodium 22.990

12 Mg Magnesium 24.305

13 Al Aluminum 26.982

14 Si Silicon 28.086

15 P Phosphorus 30.974

16 S Sulfur 32.065

17 Cl Chlorine 35.446

18 Ar Argon 39.948

19 K Potassium 39.098

20 Ca Calcium 40.078

21 Sc Scandium 44.956

22 Ti Titanium 47.867

23 V Vanadium 50.942

24 Cr Chromium 51.996

25 Mn Manganese 54.938

26 Fe Iron 55.845

27 Co Cobalt 58.933

28 Ni Nickel 58.693

29 Cu Copper 63.546

30 Zn Zinc 65.38

31 Ga Gallium 69.723

32 Ge Germanium 72.63

33 As Arsenic 74.922

34 Se Selenium 78.96

35 Br Bromine 79.904

36 Kr Krypton 83.798

37 Rb Rubidium 85.468

38 Sr Strontium 87.62

39 Y Yttrium 88.906

40 Zr Zirconium 91.224

41 Nb Niobium 92.906

42 Mo Molybdenum 95.94

43 Tc Technetium 98.9062

44 Ru Ruthenium 101.07

45 Rh Rhodium 101.91

46 Pd Palladium 106.42

47 Ag Silver 107.87

48 Cd Cadmium 112.41

49 In Indium 114.82

50 Sn Tin 118.71

51 Sb Antimony 121.76

52 Te Tellurium 127.60

53 I Iodine 126.90

54 Xe Xenon 131.29

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58 Ce Cerium 140.12

59 Pr Praseodymium 140.91

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62 Sm Samarium 150.36

63 Eu Europium 151.96

64 Gd Gadolinium 157.25

65 Tb Terbium 158.93

66 Dy Dysprosium 162.50

67 Ho Holmium 164.93

68 Er Erbium 167.26

69 Tm Thulium 168.93

70 Yb Ytterbium 173.04

71 Lu Lutetium 174.97

72 Hf Hafnium 178.49

73 Ta Tantalum 180.95

74 W Tungsten 183.84

75 Re Rhenium 186.21

76 Os Osmium 190.23

77 Ir Iridium 192.22

78 Pt Platinum 195.08

79 Au Gold 196.97

80 Hg Mercury 200.59

81 Tl Thallium 204.38

82 Pb Lead 207.2

83 Bi Bismuth 208.98

84 Po Polonium (209)

85 At Astatine (210)

86 Rn Radon (222)

87 Fr Francium (223)

88 Ra Radium 226

89 Ac Actinium (227)

90 Th Thorium 232.04

91 Pa Protactinium 231.04

92 U Uranium 238.03

93 Np Neptunium (237)

94 Pu Plutonium (244)

95 Am Americium (243)

96 Cm Curium (247)

97 Bk Berkelium (247)

98 Cf Californium (251)

99 Es Einsteinium (252)

100 Fm Fermium (257)

101 Md Mendelevium (258)

102 No Nobelium (259)

103 Lr Lawrencium (260)

104 Rf Rutherfordium (261)

105 Db Dubnium (262)

106 Sg Seaborgium (266)

107 Bh Bohrium (264)

108 Hs Hassium (277)

109 Mt Meitnerium (268)

110 Ds Ds (271)

111 Rg Rutherfordium (272)

112 Cn Copernicium (285)

113 Uut Ununtrium (288)

114 Fl Flerovium (289)

115 Uup Ununpentium (288)

116 Lv Livermorium (293)

117 Uus Ununseptium (294)

118 Uuo Ununoctium (294)

119 La Lanthanum

120 Ce Cerium

121 Pr Praseodymium

122 Nd Neodymium

123 Pm Promethium

124 Sm Samarium

125 Eu Europium

126 Gd Gadolinium

127 Tb Terbium

128 Dy Dysprosium

129 Ho Holmium

130 Er Erbium

131 Tm Thulium

132 Yb Ytterbium

133 Lu Lutetium

134 Ac Actinium

135 Th Thorium

136 Pa Protactinium

137 U Uranium

138 Np Neptunium

139 Pu Plutonium

140 Am Americium

141 Cm Curium

142 Bk Berkelium

143 Cf Californium

144 Es Einsteinium

145 Fm Fermium

146 Md Mendelevium

147 No Nobelium

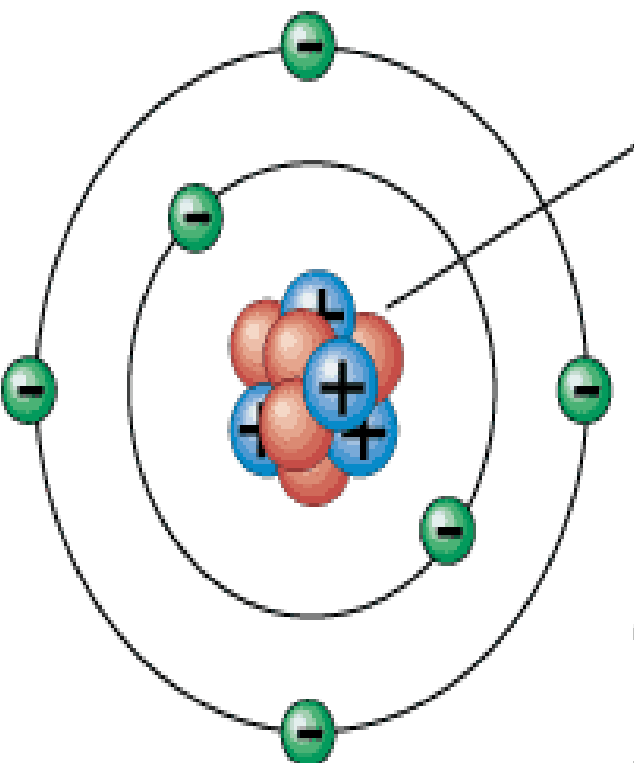
148 Lr Lawrencium

ATOM

Periodic Table of the Elements

NUCLEUS- located at the core, is **positively** charged, contains **protons** and **neutrons**

	5	6	7	8	9	10
	B	C	N	O	F	Ne
	Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon
	10.806	12.009	14.006	15.999	18.998	20.180
	13	14	15	16	17	18
	Al	Si	P	S	Cl	Ar
	Aluminum	Silicon	Phosphorus	Sulfur	Chlorine	Argon
	26.982	28.084	30.974	32.065	35.446	39.948



Carbon atom

Electrons- tiny **negatively** charged particles located in a “cloud” around the nucleus



Protons- located in the nucleus, and are **positively** charged particles



Neutrons- located in the nucleus, and are particles with **no charge**



	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
Lanthanide	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	Lanthanum	Cerium	Praseodymium	Neodymium	Promethium	Samarium	Europium	Gadolinium	Terbium	Dysprosium	Holmium	Erbium	Thulium	Ytterbium	Lutetium
	138.91	140.12	140.91	144.24	(145)	150.36	151.96	157.25	158.93	162.50	164.93	167.26	168.93	173.04	174.97
Actinide	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
	Actinium	Thorium	Protactinium	Uranium	Neptunium	Plutonium	Americium	Curium	Berkelium	Californium	Einsteinium	Fermium	Mendelevium	Nobelium	Lawrencium
	(227)	232.04	231.04	238.03	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(260)

Periodic Table of the Elements

- Every element has a unique number of protons that can be used to identify it.

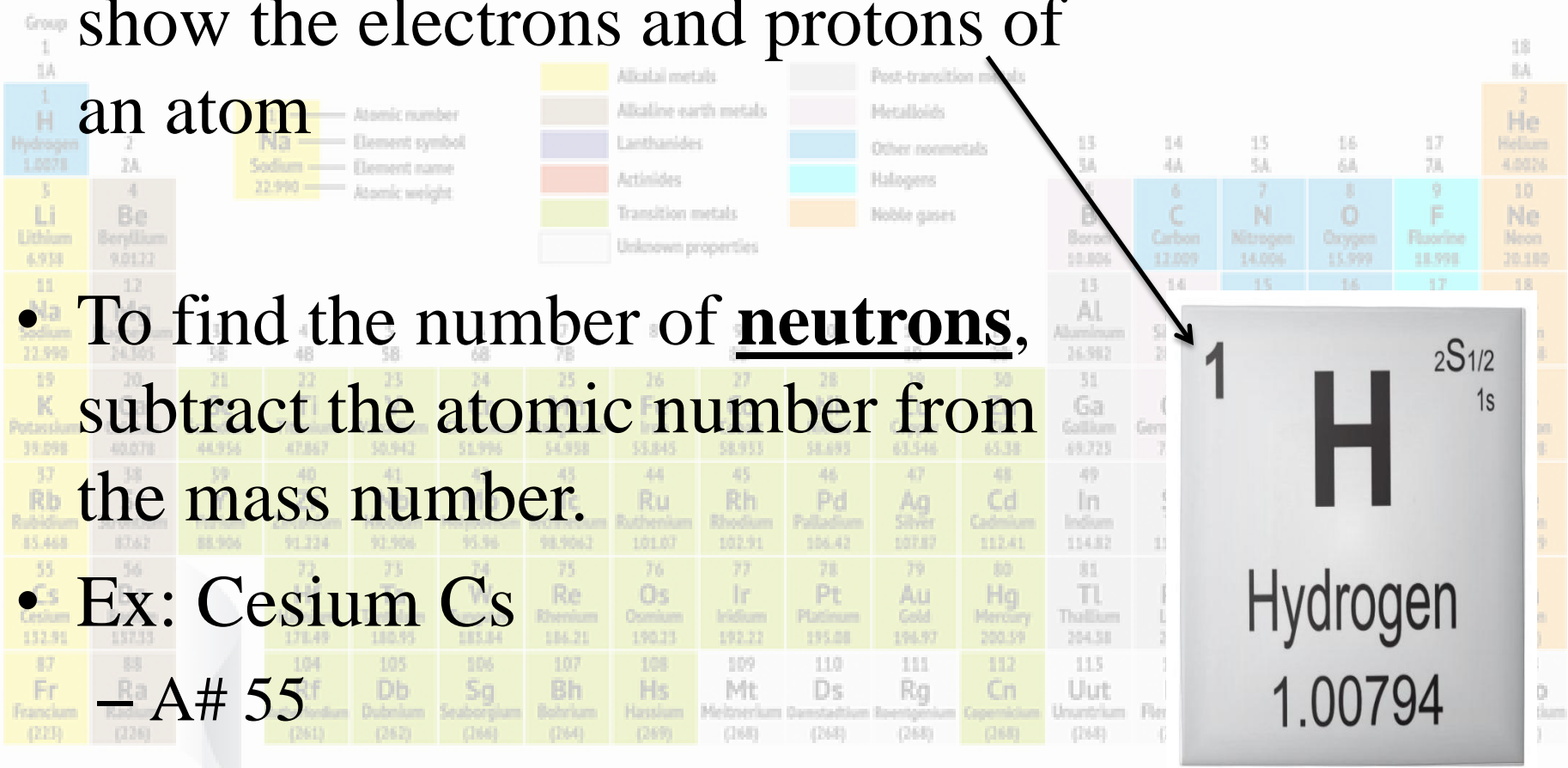
This is the atomic number.

- Atoms have a neutral charge because they have equal number of protons and electrons!

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2 3 Li Lithium 6.938											5 B Boron 10.806	6 C Carbon 12.009	7 N Nitrogen 14.006	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180	
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- **Atomic number** can be used to show the electrons and protons of an atom



- To find the number of **neutrons**, subtract the atomic number from the mass number.

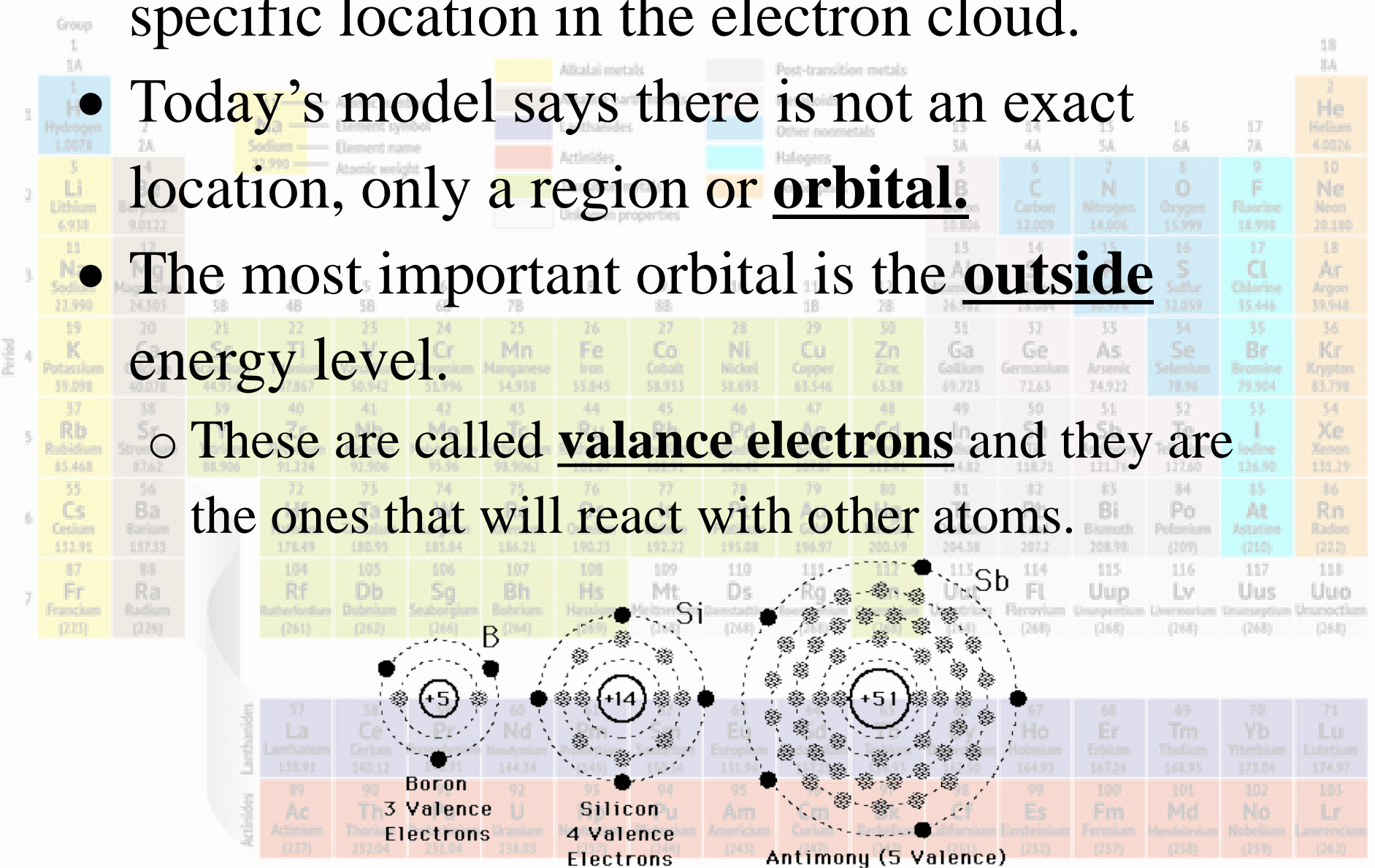
- Ex: Cesium Cs
 - A# 55
 - AM 132.9
 - **133-55=78 neutrons**

● In 1912, Neils Bohr said that electrons have a specific location in the electron cloud.

● Today's model says there is not an exact location, only a region or **orbital**.

● The most important orbital is the **outside** energy level.

○ These are called **valance electrons** and they are the ones that will react with other atoms.



Each energy level has a characteristic number of Valence electrons: $2N^2$,

where $N =$ level

11 — Atomic number
 Na — Element symbol
 Sodium — Element name
 22.990 — Atomic weight

Alkali metals
 Alkaline earth metals
 Transition metals
 Unknown properties
 Post-transition metals
 Metalloids
 Halogens
 Noble gases

- $1^{st} =$ max 2 electrons
- $2^{nd} =$ max 8 electrons
- $3^{rd} =$ max 18 electrons
- $4^{th} =$ max 32 electrons

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Periodic Table of the Elements

- Elements in the same **column** have the same number of valence electrons
- These valence electrons form **bonds** with other atoms
- Atoms without **8** valence electrons can **lose or gain** them in order to achieve 8 electrons.

○ Ex: NaCl

Lanthanides	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Actinides	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Periodic Table of the Elements

ATOMIC NUMBER

1

$2S_{1/2}$
 $1s$

H

Hydrogen

1.00794

SYMBOL

MASS NUMBER

1A	2	3A	4A	5A	6A	7A	8A		
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87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)
101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (260)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (264)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 Ds Darmstadtium (267)

15 N Nitrogen 14.006	16 O Oxygen 15.999	17 F Fluorine 18.998	18 Ne Neon 20.180
33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798
51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.905	54 Xe Xenon 131.29
85 At Astatine (210)	86 Rn Radon (222)	115 Uup Ununpentium (288)	116 Uuq Ununquadium (288)
68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (260)

ELEMENT NAME

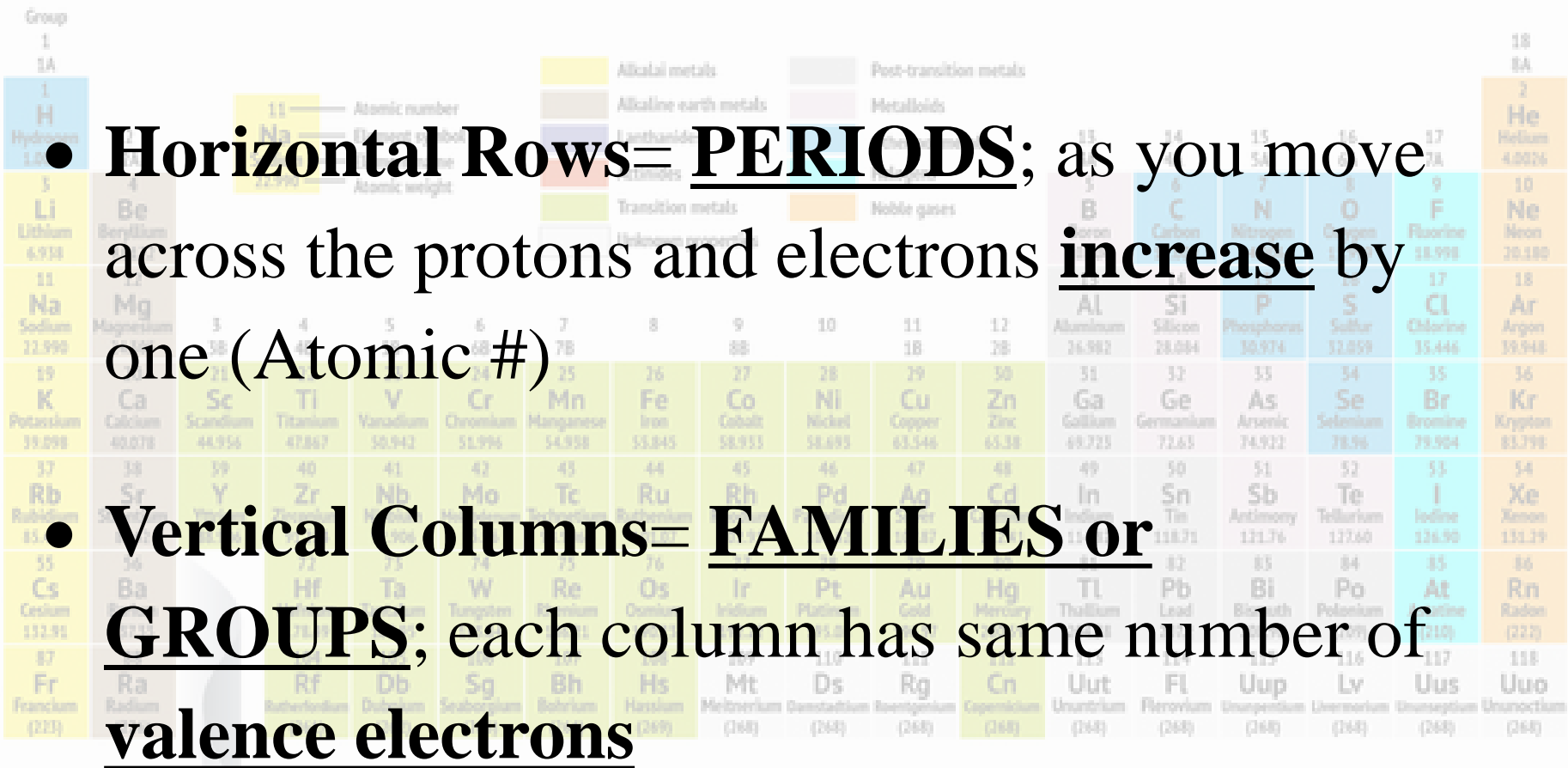


Periodic Table of the Elements

Group 1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 9B	10 10B	11 11B	12 12B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A					
1 H Hydrogen 1.0078	2 He Helium 4.0026	3 Li Lithium 6.938	4 Be Beryllium 9.0122	5 B Boron 10.806	6 C Carbon 12.009	7 N Nitrogen 14.006	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180	11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.981	14 Si Silicon 28.084	15 P Phosphorus 30.974	16 S Sulfur 32.059	17 Cl Chlorine 35.446	18 Ar Argon 39.948					
4 K Potassium 39.098	5 Ca Calcium 40.078	6 Sc Scandium 44.956	7 Ti Titanium 47.867	8 V Vanadium 50.942	9 Cr Chromium 51.996	10 Mn Manganese 54.938	11 Fe Iron 55.845	12 Co Cobalt 58.933	13 Ni Nickel 58.693	14 Cu Copper 63.546	15 Zn Zinc 65.38	16 Ga Gallium 69.723	17 Ge Germanium 72.63	18 As Arsenic 74.912	19 Se Selenium 78.96	20 Br Bromine 79.904	21 Kr Krypton 83.798					
5 Rb Rubidium 85.468	6 Sr Strontium 87.62	7 Y Yttrium 88.906	8 Zr Zirconium 91.224	9 Nb Niobium 92.906	10 Mo Molybdenum 95.94	11 Tc Technetium 98.906	12 Ru Ruthenium 101.07	13 Rh Rhodium 102.91	14 Pd Palladium 106.42	15 Ag Silver 107.868	16 Cd Cadmium 112.411	17 In Indium 114.818	18 Sn Tin 118.710	19 Sb Antimony 121.757	20 Te Tellurium 127.603	21 I Iodine 126.905	22 Xe Xenon 131.29					
6 Cs Cesium 132.91	7 Ba Barium 137.33	8 Hf Hafnium 178.49	9 Ta Tantalum 180.95	10 W Tungsten 183.84	11 Re Rhenium 186.21	12 Os Osmium 190.23	13 Ir Iridium 192.22	14 Pt Platinum 195.08	15 Au Gold 196.967	16 Hg Mercury 200.59	17 Tl Thallium 204.38	18 Pb Lead 207.2	19 Bi Bismuth 208.98	20 Po Polonium (209)	21 At Astatine (210)	22 Rn Radon (222)						
7 Fr Francium (223)	8 Ra Radium (226)	9 Rf Rutherfordium (261)	10 Db Dubnium (262)	11 Sg Seaborgium (266)	12 Bh Bohrium (264)	13 Hs Hassium (269)	14 Mt Meitnerium (268)	15 Ds Darmstadtium (268)	16 Rg Roentgenium (268)	17 Cn Copernicium (284)	18 Uut Ununtrium (284)	19 Fl Flerovium (284)	20 Uup Ununpentium (284)	21 Uuq Ununquadium (284)	22 Uus Ununseptium (284)	23 Uuo Ununoctium (284)						
		Lanthanides																				
		57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.97						
		Actinides																				
		89 Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)						

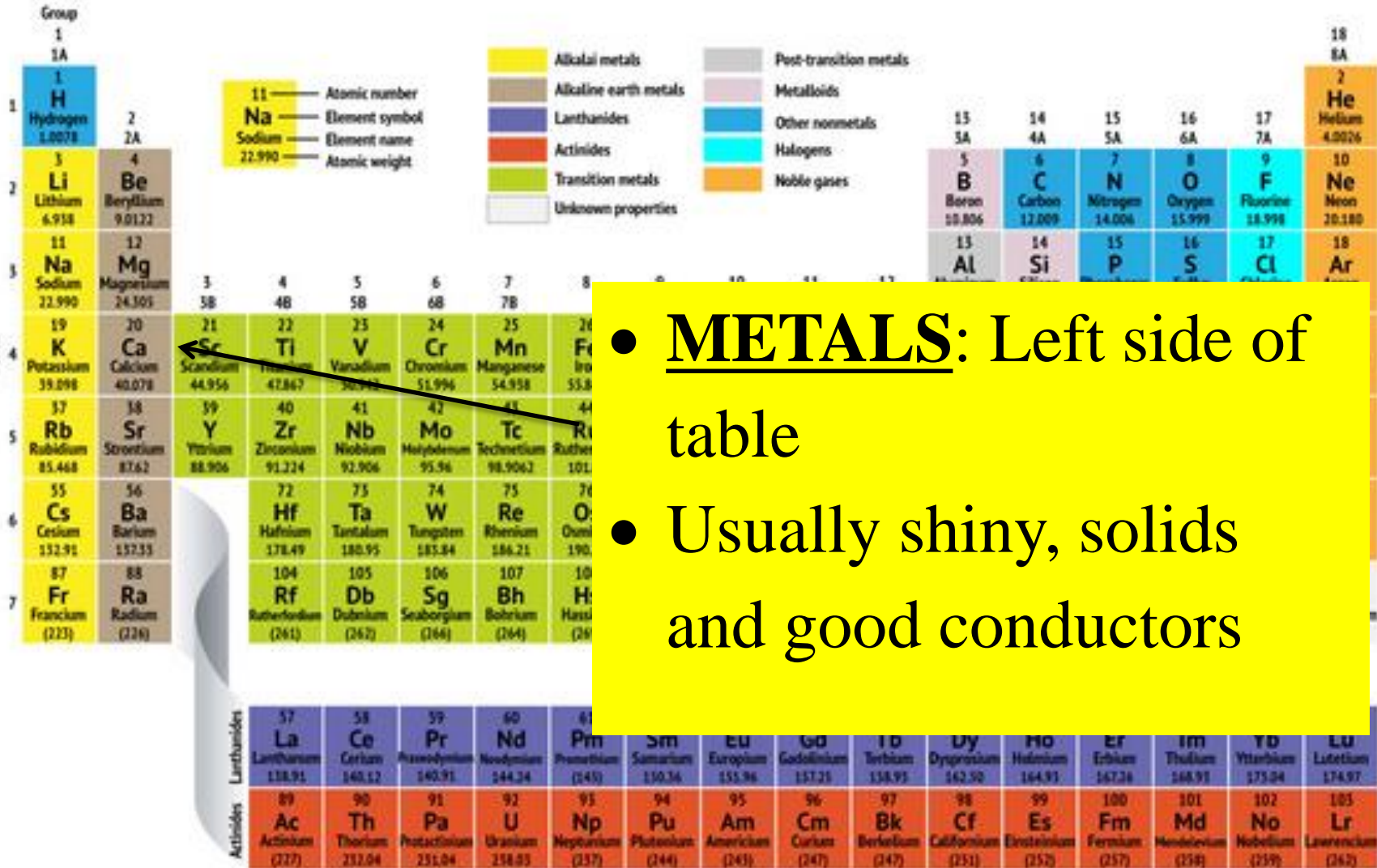
- Periodic Table groups elements with similar properties.
- Today's arrangement is based on atomic number.

Periodic Table of the Elements



Lanthanoids	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	La Lanthanum 138.91	Ce Cerium 140.12	Pr Praseodymium 140.91	Nd Neodymium 144.24	Pm Promethium (145)	Sm Samarium 150.36	Eu Europium 151.96	Gd Gadolinium 157.25	Tb Terbium 158.93	Dy Dysprosium 162.50	Ho Holmium 164.93	Er Erbium 167.26	Tm Thulium 168.93	Yb Ytterbium 173.04	Lu Lutetium 174.97
Actinoids	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
	Ac Actinium (227)	Th Thorium 232.04	Pa Protactinium 231.04	U Uranium 238.03	Np Neptunium (237)	Pu Plutonium (244)	Am Americium (243)	Cm Curium (247)	Bk Berkelium (247)	Cf Californium (251)	Es Einsteinium (252)	Fm Fermium (257)	Md Mendelevium (258)	No Nobelium (259)	Lr Lawrencium (262)

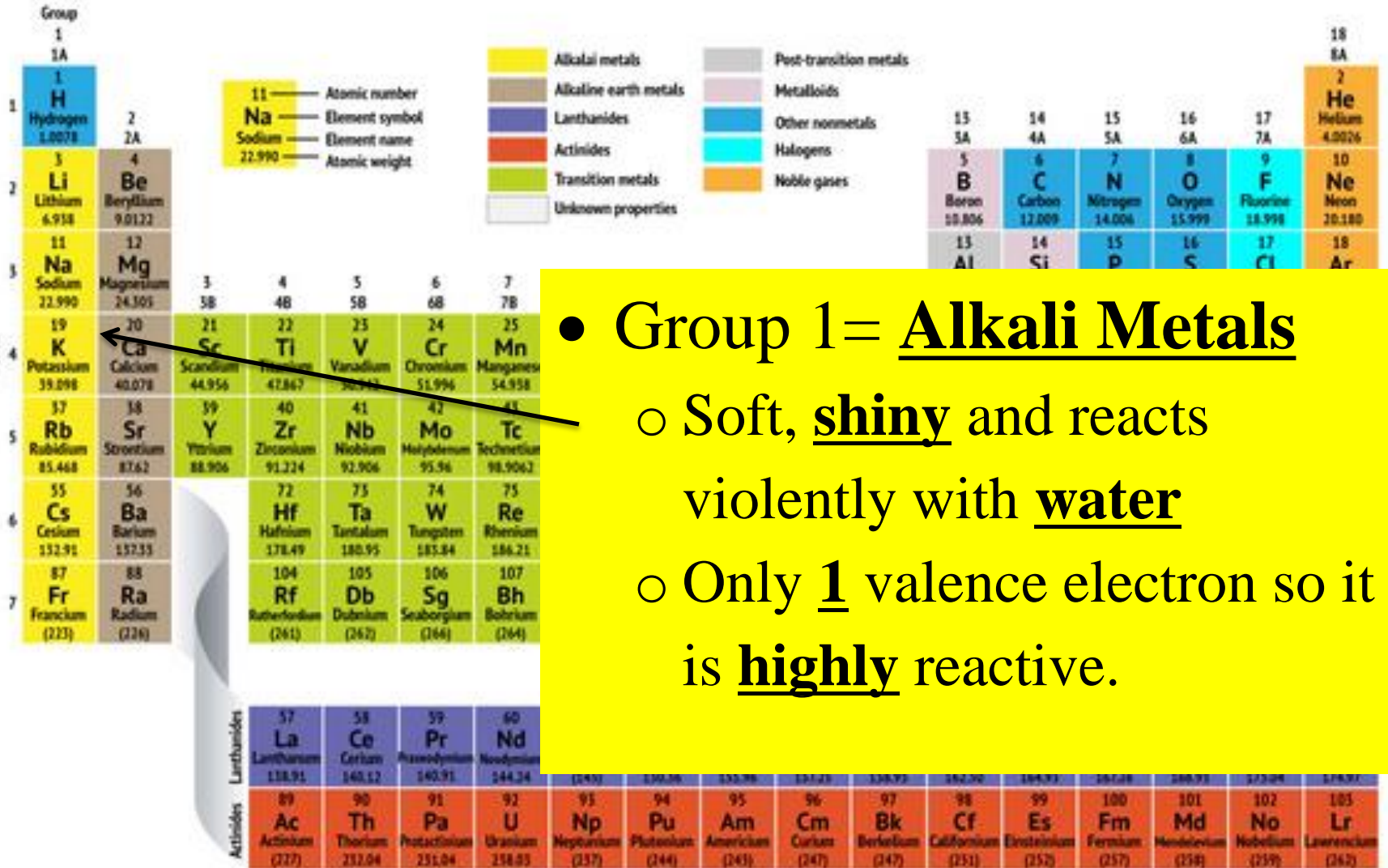
Periodic Table of the Elements



- **METALS**: Left side of table
- Usually shiny, solids and good conductors

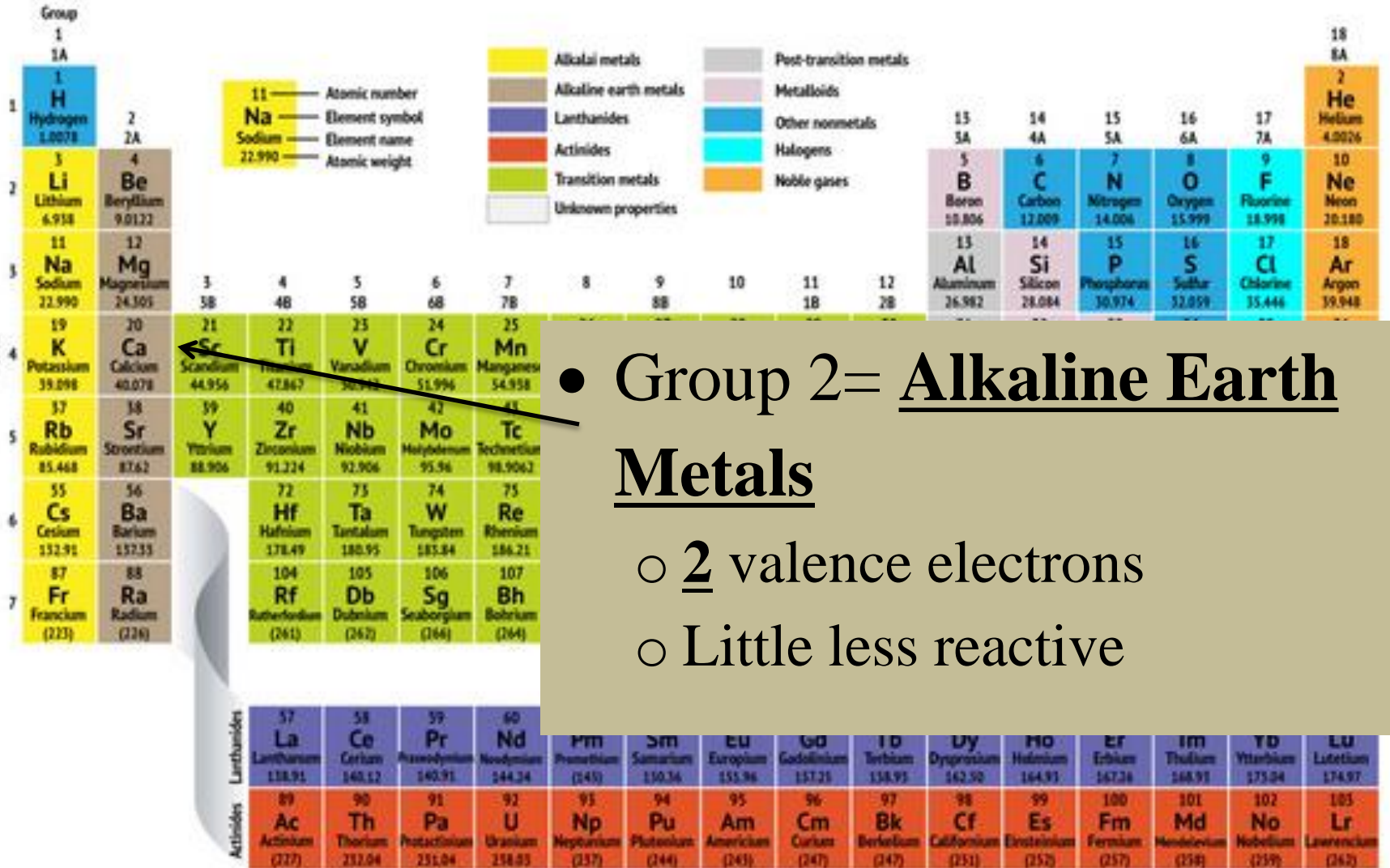
18	8A	2	He	Helium	4.0026
2		10	Ne	Neon	20.180
10		18	Ar	Argon	39.948
18		36	Kr	Krypton	83.798
36		54	Xe	Xenon	131.29
54		86	Rn	Radon	(222)
86		118	Uuo	unocium	(286)
118		71	Lu	Lutetium	174.97
71		103	Lr	Lawrencium	(262)

Periodic Table of the Elements



18	8A
2	He
Helium	4.0026
10	Ne
Neon	20.180
18	Ar
Argon	39.948
36	Kr
Krypton	83.798
54	Xe
Xenon	131.29
86	Rn
Radon	(222)
118	Uuo
Ununoctium	(284)
71	Lu
Lutetium	174.967
103	Lr
Lawrencium	(262)

Periodic Table of the Elements



18
8A
2
He
Helium
4.0026
10
Ne
Neon
20.180
18
Ar
Argon
39.948
36
Kr
Krypton
83.798
54
Xe
Xenon
131.29
86
Rn
Radon
(222)
118
Uuo
unocrium
(288)
71
Lu
Lutetium
174.97
103
Lr
Lawrencium
(262)

Periodic Table of the Elements

Legend:

- Atomic number
- Element symbol
- Element name
- Atomic weight
- Alkalal metals
- Alkaline earth metals
- Lanthanides
- Actinides
- Transition metals
- Unknown properties
- Post-transition metals
- Metalloids
- Other nonmetals
- Halogens
- Noble gases

2 2A Be Beryllium 9.0122	3 Li Lithium 6.941	4 Be Beryllium 9.0122	5 B Boron 10.806	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180	11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.06	17 Cl Chlorine 35.45	18 Ar Argon 39.948	
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.8
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.96	43 Tc Technetium 98.9062	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.6	53 I Iodine 126.905	54 Xe Xenon 131.29
55 Cs Cesium 132.91	56 Ba Barium 137.33	57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.05	71 Lu Lutetium 174.967	
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (260)	

• Center= Transition Metals

- Good conductors
- Can be shaped or pulled into wire
- Often form colored compounds
- Less reactive than group 1 and 2
- Hg (mercury) is the only metal that is liquid at room temp.

Periodic Table of the Elements

Group
1 1A
2 2A
3
4
5
6
7
8
9
10
11
12
13 3A
14 4A
15 5A
16 6A
17 7A
18 8A

Period
1
2
3
4
5
6
7

1	2
1 H Hydrogen 1.0078	2 He Helium 4.0026
3 Li Lithium 6.93	4 Be Beryllium 9.0122

11 — Atomic number
Na — Element symbol
Sodium — Element name
22.990 — Atomic weight

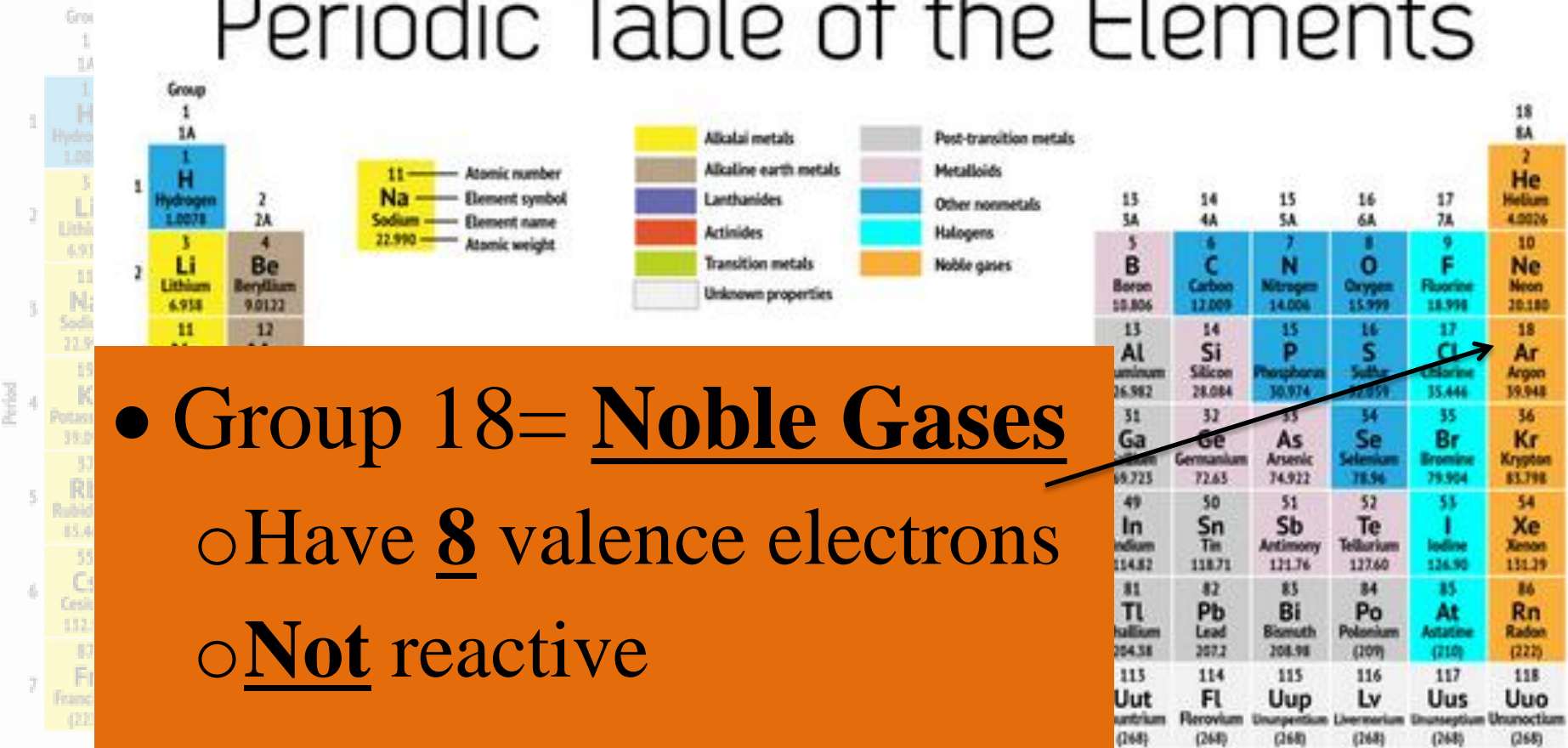
- Alkali metals
- Alkaline earth metals
- Lanthanides
- Actinides
- Transition metals
- Unknown properties
- Post-transition metals
- Metalloids
- Other nonmetals
- Halogens
- Noble gases

- NON-METALS= Right side of table (except for hydrogen)
- Many of these are highly reactive

10	11	12	13	14	15	16	17	18
			Al Aluminum 26.982	Si Silicon 28.084	P Phosphorus 30.974	S Sulfur 32.059	Cl Chlorine 35.444	Ar Argon 39.948
28	29	30	31	32	33	34	35	36
Ni Nickel 58.693	Cu Copper 63.546	Zn Zinc 65.38	Ga Gallium 69.723	Ge Germanium 72.63	As Arsenic 74.922	Se Selenium 78.96	Br Bromine 79.904	Kr Krypton 83.798
46	47	48	49	50	51	52	53	54
Pd Palladium 106.42	Ag Silver 107.87	Cd Cadmium 112.41	In Indium 114.82	Sn Tin 118.71	Sb Antimony 121.76	Te Tellurium 127.60	I Iodine 126.90	Xe Xenon 131.29
78	79	80	81	82	83	84	85	86
Pt Platinum 195.08	Au Gold 196.97	Hg Mercury 200.59	Tl Thallium 204.38	Pb Lead 207.2	Bi Bismuth 208.98	Po Polonium (209)	At Astatine (210)	Rn Radon (222)
110	111	112	113	114	115	116	117	118
Ds Darmstadtium (268)	Rg Roentgenium (268)	Cn Copernicium (268)	Uut Ununtrium (268)	Fl Flerovium (268)	Uup Ununpentium (268)	Lv Livermorium (268)	Uus Ununseptium (268)	Uuo Ununoctium (268)

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
La Lanthanum 138.91	Ce Cerium 140.12	Pr Praseodymium 140.91	Nd Neodymium 144.24	Pm Promethium (145)	Sm Samarium 150.36	Eu Europium 151.96	Gd Gadolinium 157.25	Tb Terbium 158.93	Dy Dysprosium 162.50	Ho Holmium 164.93	Er Erbium 167.26	Tm Thulium 168.93	Yb Ytterbium 173.04	Lu Lutetium 174.97
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Ac Actinium (227)	Th Thorium 232.04	Pa Protactinium 231.04	U Uranium 238.03	Np Neptunium (237)	Pu Plutonium (244)	Am Americium (243)	Cm Curium (247)	Bk Berkelium (247)	Cf Californium (251)	Es Einsteinium (252)	Fm Fermium (257)	Md Mendelevium (258)	No Nobelium (259)	Lr Lawrencium (262)

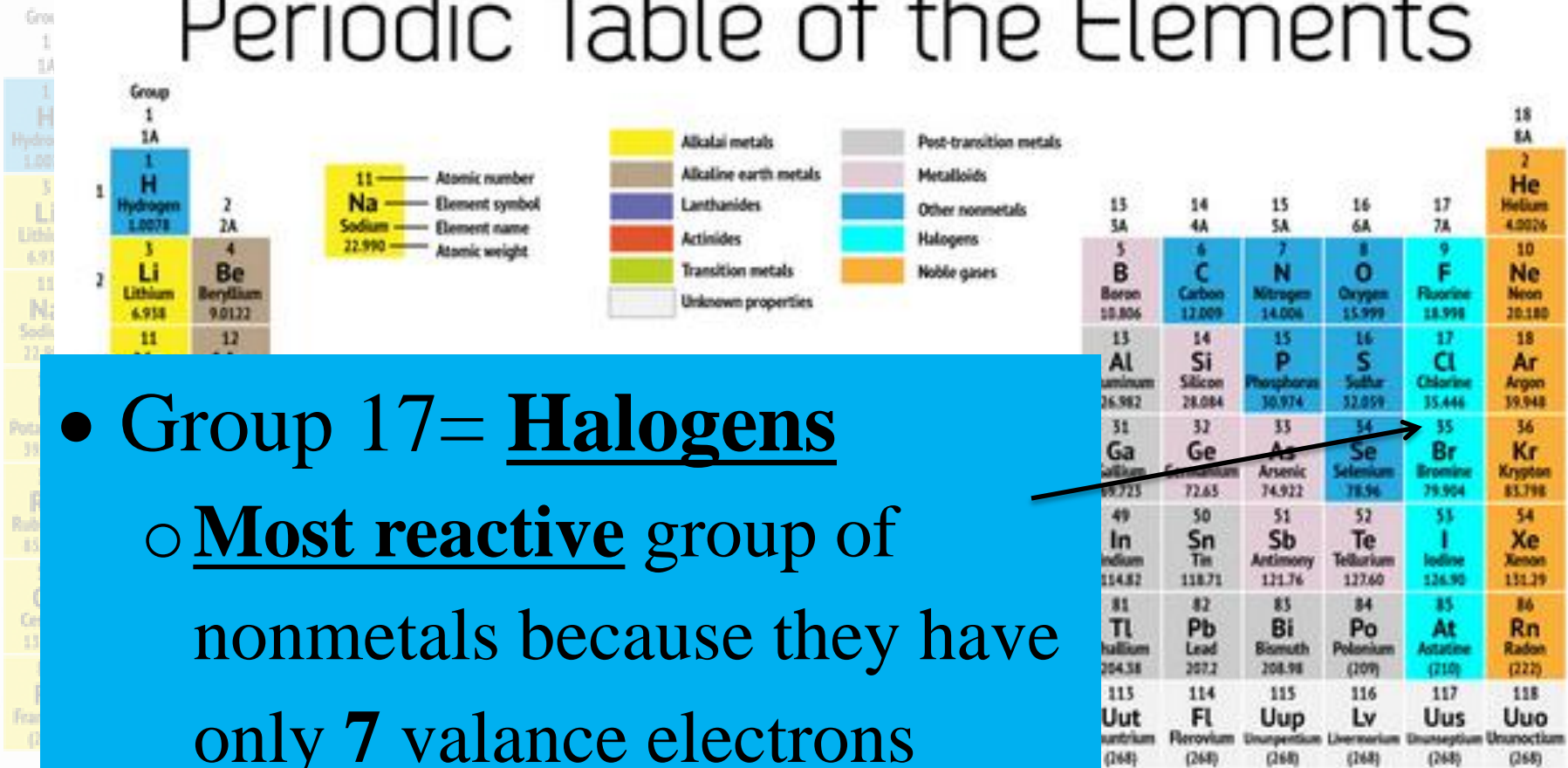
Periodic Table of the Elements



- Group 18 = Noble Gases
 - Have 8 valence electrons
 - Not reactive

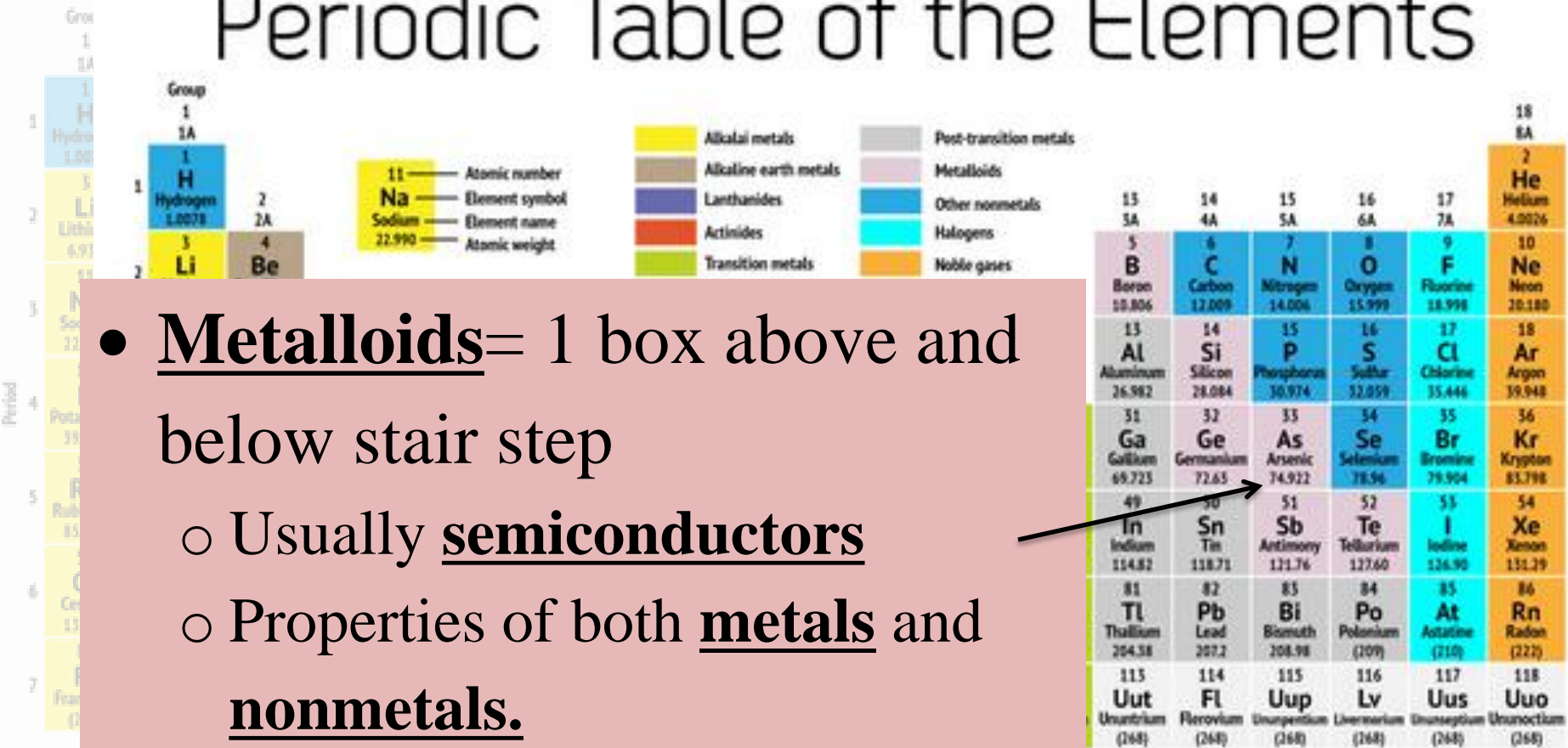
Lanthanides	57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.97
Actinides	89 Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

Periodic Table of the Elements



Lanthanides	57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.97
Actinides	89 Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

Periodic Table of the Elements



- Metalloids = 1 box above and below stair step
 - Usually semiconductors
 - Properties of both metals and nonmetals.



Lanthanides	57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.97
Actinides	89 Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

Periodic Table of the Elements

Group
1 1A
2 2A
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18 8A

Period
1
2
3
4
5
6
7

Legend:
 Alkali metals
 Post-transition metals
 Alkaline earth metals
 Metalloids

Central Text:
 • Rare Earth Metals = bottom of table
 ○ Many are radioactive
 ○ All elements above 92 are synthetic or man-made.

1	H	2	He																	18	18		
2	Li	Be	B	C	N	O	F	Ne											10	10			
3	Na	Mg	Al	Si	P	S	Cl	Ar									18	18					
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr			36	36	
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe				54	54
6	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn				86	86
7	Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo				118	118
			La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu						
			Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr						

SOURCES: National Institute of Standards and Technology, International Union of Pure and Applied Chemistry

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