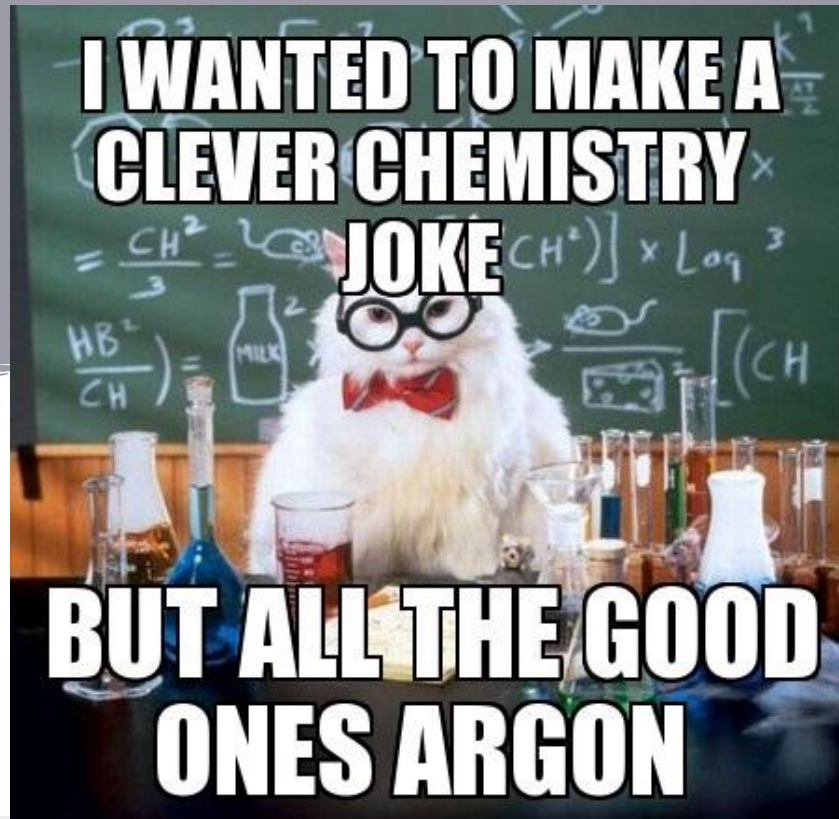


THE ELEMENTS



Looking for patterns

- Early “chemists” used symbols of the sun and planets to represent the seven metallic elements known at the time

Metal	gold	silver	iron	mercury	tin	copper	lead
Symbol							
Celestial Body	Sun	Moon	Mars	Mercury	Jupiter	Venus	Saturn

- John Dalton developed a new set of symbols in the early 1800s to improve communication between chemists

Symbol



hydrogen



oxygen



carbon



gold



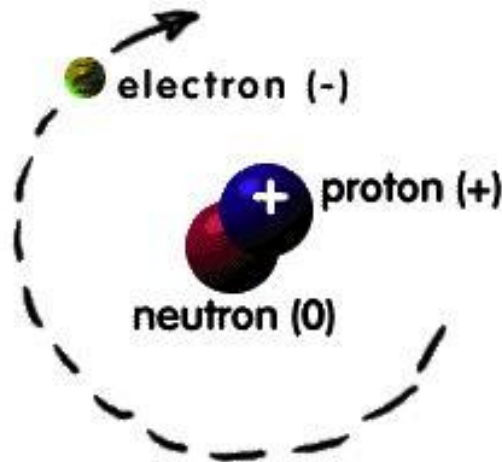
silver



mercury

Element

- Eventually elements were organized according to their atomic mass
- **Atomic mass** is the mass of one atom of that element



The known elements

- Dmitri Mendeleev grouped elements that had similar characteristics together and left blanks where he thought elements might fit
- He did not only classify by mass, he used ALL characteristics to make a pattern

Periodic Table of the Elements

1
IA
11A

2
He
Helium
4.003

3
Li
Lithium
6.941

4
Be
Beryllium
9.012

5
B
Boron
10.811

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
32.066

17
Cl
Chlorine
35.453

18
Ar
Argon
39.948

19
K
Potassium
39.098

20
Ca
Calcium
40.078

21
Sc
Scandium
44.956

22
Ti
Titanium
47.88

23
V
Vanadium
50.942

24
Cr
Chromium
51.996

25
Mn
Manganese
54.938

26
Fe
Iron
55.933

27
Co
Cobalt
58.933

28
Ni
Nickel
58.693

29
Cu
Copper
63.546

30
Zn
Zinc
65.39

31
Ga
Gallium
69.732

32
Ge
Germanium
72.61

33
As
Arsenic
74.922

34
Se
Selenium
78.09

35
Br
Bromine
79.904

36
Kr
Krypton
84.80

37
Rb
Rubidium
84.468

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
98.907

44
Ru
Ruthenium
101.07

45
Rh
Rhodium
102.906

46
Pd
Palladium
106.42

47
Ag
Silver
107.868

48
Cd
Cadmium
112.411

49
In
Indium
114.818

50
Sn
Tin
118.71

51
Sb
Antimony
121.760

52
Te
Tellurium
127.6

53
I
Iodine
126.904

54
Xe
Xenon
131.29

55
Cs
Cesium
132.905

56
Ba
Barium
137.327

57-71

72
Hf
Hafnium
178.49

73
Ta
Tantalum
180.948

74
W
Tungsten
183.85

75
Re
Rhenium
186.207

76
Os
Osmium
190.23

77
Ir
Iridium
192.22

78
Pt
Platinum
195.08

79
Au
Gold
196.967

80
Hg
Mercury
200.59

81
Tl
Thallium
204.383

82
Pb
Lead
207.2

83
Bi
Bismuth
208.980

84
Po
Polonium
[208.982]

85
At
Astatine
209.987

86
Rn
Radon
222.018

87
Fr
Francium
223.020

88
Ra
Radium
226.025

89-103

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
[269]

111
Rg
Roentgenium
[272]

112
Cn
Copernicium
[277]

113
Uut
Ununtrium
unknown

114
Fl
Flerovium
[289]

115
Uup
Ununpentium
unknown

116
Lv
Livermorium
[298]

117
Uus
Ununseptium
unknown

118
Uuo
Ununoctium
unknown

Periodic Table of the Elements

18
VIII
8A

2

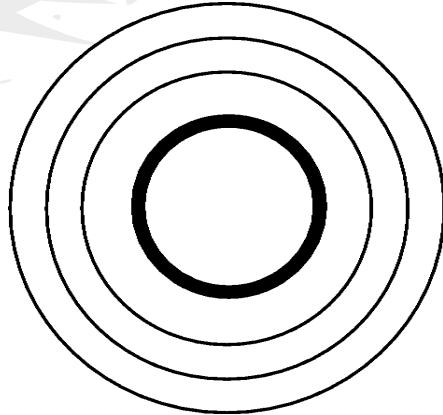
Lanthanide Series	57 La Lanthanum 138.906	58 Ce Cerium 140.115	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.966	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
	89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]

Alkali Metal	Alkaline Earth	Transition Metal	Semimetal	Nonmetal	Basic Metal	Halogen	Noble Gas	Lanthanide	Actinide
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- We now know that there are theoretically 118 elements
- The physical state of the element (in our textbook pg. 440) is represented by red blue or white
 - **Red** = gas
 - **Blue** = liquid
 - **White** = solid
- Horizontal rows are called **periods**
- - Vertical columns form a **group or family**
- - These groups have similar properties

Electrons

- Valence electrons tell us how reactive an element is
- Atoms always want a full valence (outer) shell



The Families

- Alkali Metals - Group 1
- Alkaline Earth Metals - Group 2
- Halogens - Group 17
- Noble Gases - Group 18

Alkali

- Group 1 Elements
- Very reactive
- Soft metals
- All have one extra valence electron

Alkaline Earth Metals

- Group 2
- Reactive
- Have 2 extra electrons in their valence shell



Halogens

- Group 17
- Very reactive
- Gases
- All are missing 1 electron in their valence shell

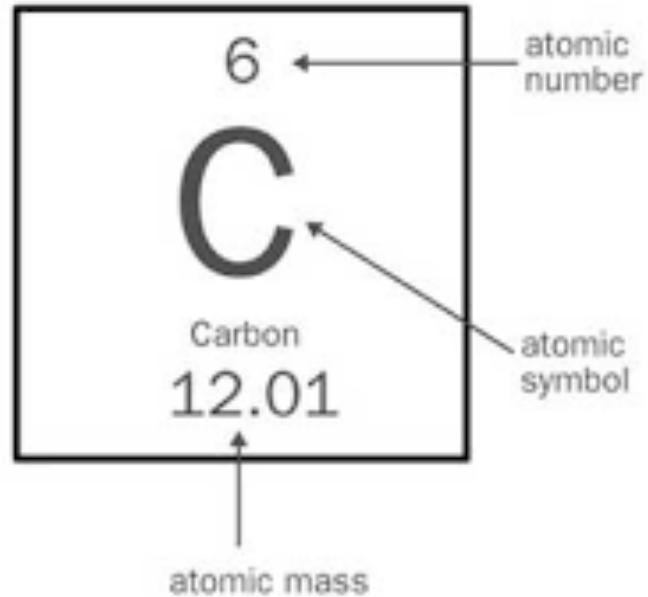


Noble Gases

- Group 18
- Stable gases
- Have full valence electron shells



The Periodic Table



The diagram shows a single element box from the periodic table for Carbon. The box is a square with a black border. Inside the box, the atomic number '6' is at the top, the atomic symbol 'C' is in the center, the element name 'Carbon' is below the symbol, and the atomic mass '12.01' is at the bottom. Three arrows point from labels outside the box to these elements: 'atomic number' points to '6', 'atomic symbol' points to 'C', and 'atomic mass' points to '12.01'.

6
C
Carbon
12.01

atomic number

atomic symbol

atomic mass

Valence Shells

- The periodic table tells us how many electrons can fit into each shell
- These shells orbit the atom and tell us how reactive an element is

Electron Shells

- Only so many electrons can go into each shell
- The first shell holds 2 electrons, the second 8, the third 8
- You can tell how many electrons each shell holds by counting how many elements there are in each row of the PT

Atomic Weight

- Protons - positive, very heavy, in nucleus
- Neutrons - neutral, very heavy, in nucleus
- Electrons - negative, very light, outside nucleus

Calculations

- The atomic mass tells us how many neutrons and protons there are in an atom
- $\# \text{ protons} = \text{atomic number}$
- $\text{Mass} - \text{atomic number} = \text{neutrons}$
- $\# \text{ protons} = \# \text{ electrons}$

Practice

Gold has an atomic number of 79

It has 79 protons and 79 electrons

It has an atomic mass of 197

$$197 - 79 = 118$$

Gold has 118 neutrons