

The Periodic Table of the Elements

What are some observations you made about the periodic table in your activity?

Mendeleev and the Periodic Table

- Dimitry Mendeleev put together the first periodic table by organizing the 60 (then) known elements by their mass.
 - > When organized, he saw repeating patterns of properties of the various elements.
 - > He was able to predict undiscovered elements based on the patterns of other known elements.



ОПЫТЪ СИСТЕМЫ ЭЛЕМЕНТОВЪ.

ОСНОВАННОЙ НА ИХЪ АТОМНОМЪ ВѢСѢ И ХИМИЧЕСКОМЪ СХОДСТВѢ.

			Ti=50	Zr=90	?=180.
			V=51	Nb=94	Ta=182.
			Cr=52	Mo=96	W=186.
			Mn=55	Rh=104,4	Pt=197,4.
			Fe=56	Ru=104,4	Ir=198.
			Ni=Co=59	Pd=106,8	Os=199.
			Cu=63,4	Ag=108	Hg=200.
H=1			Be=9,4	Mg=24	Zn=65,2
			B=11	Al=27,1	?=68
			C=12	Si=28	?=70
			N=14	P=31	As=75
			O=16	S=32	Se=79,4
			F=19	Cl=35,5	Br=80
					I=127
Li=7	Na=23		K=39	Rb=85,4	Cs=133
			Ca=40	Sr=87,6	Ba=137
			?=45	Ce=92	Pb=207.
			?Er=56	La=94	
			?Yt=60	Di=95	
			?In=75,6	Th=118?	

Д. Менделѣевъ

A later version of Mendeleev's Periodic Table

Reihen	Gruppe I. — R'O	Gruppe II. — R'O	Gruppe III. — R'O ³	Gruppe IV. RH ⁴ R'O ⁴	Gruppe V. RH ⁵ R'O ⁵	Gruppe VI. RH ⁶ R'O ⁶	Gruppe VII. RH R'O ⁷	Gruppe VIII. — R'O ⁶
1	II=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=63)	Zn=65	—=68	—=72	As=75	Se=78	Br=80	
6	Rb=85	Sr=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=199)	Hg=200	Tl=204	Pb=207	Bi=208	—	—	
12	—	—	—	Th=231	—	U=240	—	— — — —

The Periodic Table

- The periodic table is a tabular display of the chemical elements, organized by their atomic number, electron configuration, and recurring properties.

1
IA
1A

2
IIA
2A

13
IIIA
3A

14
IVA
4A

15
VA
5A

16
VIA
6A

17
VIIA
7A

18
VIIIA
8A

1
H
Hydrogen
1.008

2
He
Helium
4.003

3
Li
Lithium
6.941

4
Be
Beryllium
9.012

11
Na
Sodium
22.990

12
Mg
Magnesium
24.305

19
K
Potassium
39.098

20
Ca
Calcium
40.078

27
Co
Cobalt
58.933

28
Ni
Nickel
58.693

33
As
Arsenic
74.922

34
Se
Selenium
78.09

39
Y
Yttrium
88.906

40
Zr
Zirconium
91.224

45
Rh
Rhodium
102.906

46
Pd
Palladium
106.42

51
Sb
Antimony
121.760

52
Te
Tellurium
127.6

57-71
Lanthanide Series

72
Hf
Hafnium
178.49

89-103
Actinide Series

90
Th
Thorium
232.038

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

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

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Palladium
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Cd
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114.818

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Te
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53
I
Iodine
126.904

54
Xe
Xenon
131.29

55
Cs
Cesium
132.905

56
Ba
Barium
137.327

57-71
Lanthanide Series

72
Hf
Hafnium
178.49

73
Ta
Tantalum
180.943

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
[209]

85
At
Astatine
[210]

86
Rn
Radon
222.018

87
Fr
Francium
223.020

88
Ra
Radium
226.025

89-103
Actinide Series

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
[293]

117
Uus
Ununseptium
unknown

118
Uuo
Ununoctium
unknown

Atomic Number

Symbol

Name

Atomic Mass

8
VIII

9
VIII

10
VIII

Alkali Metal

Alkaline Earth

Transition Metal

Basic Metal

Semimetal

Nonmetal

Halogen

Noble Gas

Lanthanide

Actinide

Why is it called the periodic table?

- The properties of the elements in the table repeat in a "periodic" way (specific pattern).
- **Periodic law:** There is a periodic repetition of chemical and physical properties of the elements when they are arranged by increasing atomic number
- The modern periodic table is arranged by
 - > atomic number = # of protons
 - > properties
 - > electron configuration

Reading the Periodic Table

Atomic
number (Z)

3

Li

Element symbol

Lithium

6.941

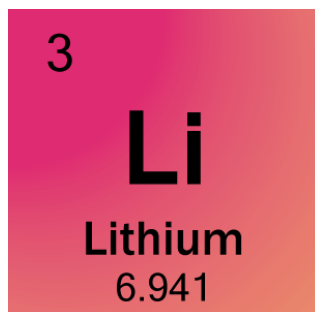
Average atomic
mass



Elements and the Periodic Table

- **Atomic number** (# of protons) defines an element.
- **Average atomic mass:** weighted average of all the atomic masses of all naturally occurring isotopes
 - > Different # of neutrons = isotopes.
 - > Isotopes don't occur in equal abundance. There are more of some isotopes than others.
 - > Example:

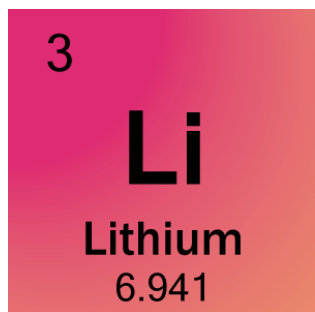
Isotope	Atomic Mass (u)	Abundance (%)
Li-6	6.015	7.5
Li-7	7.016	92.5



Elements and the Periodic Table

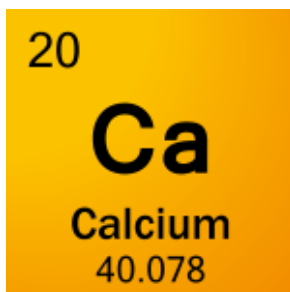
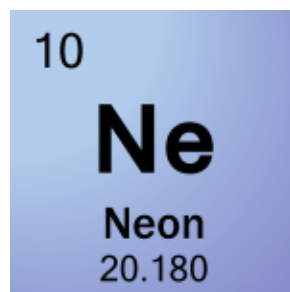
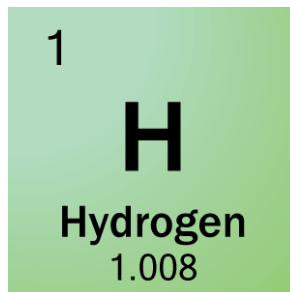
- Average atomic mass does not equal the mass number!
- Mass number = # of protons + # of neutrons for a particular isotope
- For lithium, what do you notice about the average atomic mass and the mass number for each isotope?

Isotope	Atomic Mass (u)	Abundance (%)
Li-6	6.015	7.5
Li-7	7.016	92.5



Elements and the Periodic Table

- What about electrons?
 - > For a neutral atom, the # of protons = # of electrons



How many protons?
Neutrons? Electrons?

Groups/Families and Periods

- Groups/Families: Columns
 - > Elements in the same family share similar properties
- Periods: Rows

1

IA

1A

2

IIA

2A

3

IIIB

3B

4

IVB

4B

5

VB

5B

6

VIB

6B

7

VIIA

7A

8

VIII

8

9

VIII

8

10

VIII

8

11

IB

1B

12

IIB

2B

13

IIIA

3A

14

IVA

4A

15

VA

5A

16

VIA

6A

17

VIIA

7A

18

VIIIA

8A

1

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Hydrogen

1.008

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Lithium

6.941

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Sodium

22.990

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K

Potassium

39.098

37

Rb

Rubidium

84.468

55

Cs

Cesium

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87

Fr

Francium

223.020

4

Be

Beryllium

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Calcium

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Strontium

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Barium

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Ra

Radium

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57-71

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Titanium

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Zirconium

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Rf

Rutherfordium

[261]

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V

Vanadium

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Nb

Niobium

92.906

105

Db

Dubnium

[262]

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Cr

Chromium

51.996

42

Mo

Molybdenum

95.94

106

Sg

Seaborgium

[266]

25

Mn

Manganese

54.938

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Bh

Bohrium

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55.833

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Ru

Ruthenium

101.07

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Hs

Hassium

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Nickel

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Palladium

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Darmstadtium

[269]

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Copper

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Ag

Silver

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Zinc

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Cadmium

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[277]

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In

Indium

114.818

113

Uut

Ununtrium

unknown

32

Si

Silicon

28.086

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Sn

Tin

118.71

114

Fl

Flerovium

[289]

33

Ge

Germanium

72.61

51

Sb

Antimony

121.760

115

Uup

Ununpentium

unknown

34

As

Arsenic

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52

Te

Tellurium

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116

Lv

Livermorium

[293]

35

Se

Selenium

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53

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Iodine

126.904

117

Uus

Ununseptium

unknown

36

Kr

Krypton

83.80

54

Xe

Xenon

131.29

118

Uuo

Ununoctium

unknown

57

La

Lanthanum

138.905

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

Basic Metal

Semimetal

Nonmetal

Halogen

Noble Gas

Lanthanide

Actinide

1

IA

1A

2

IIA

2A

3

IIIB

3B

4

IVB

4B

5

VB

5B

6

VIB

6B

7

VIIA

7A

8

VIII

8

9

VIII

8

10

VIII

8

11

IB

1B

12

IIB

2B

13

IIIA

3A

14

IVA

4A

15

VA

5A

16

VIA

6A

17

VIIA

7A

18

VIIIA

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1

H

Hydrogen

1.008

3

Li

Lithium

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11

Na

Sodium

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V

Vanadium

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Nb

Niobium

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Db

Dubnium

[262]

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Cr

Chromium

51.996

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Mo

Molybdenum

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Livermorium

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Kr

Krypton

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Uuo

Ununoctium

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Europium

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Gadolinium

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Terbium

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Dysprosium

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Ho

Holmium

164.930

68

Er

Erbium

167.26

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Tm

Thulium

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Yb

Ytterbium

173.04

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Lu

Lutetium

174.967

89

Ac

Actinium

227.028

90

Th

Thorium

232.038

91

Pa

Protactinium

231.036

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U

Uranium

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Np

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237.048

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Lr

Lawrencium

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Alkali Metal

Alkaline Earth

Transition Metal

Basic Metal

Semimetal

Nonmetal

Halogen

Noble Gas

Lanthanide

Actinide

Metals, Nonmetals, and Metalloids

- There is a "stair case" that separates the table in half.
- **Metals** are found on the left side of the periodic table
- **Nonmetals** are found on the right side of the periodic table.
- **Metalloids or semimetals** line the stair case.

Example of
how the
periodic table is
organized by
properties!

		← Increasing metallic character																	
Increasing metallic character ↓	1A																	8A	
	1																	2	
	H																	He	
	3	4																	10
	Li	Be																	Ne
	11	12	13	14	15	16	17	18											18
	Na	Mg	Al	Si	P	S	Cl	Ar											Ar
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe		
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86		
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn		
87	88	89	104	105	106	107	108	109	110	111	112								
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt											
	Metals		58	59	60	61	62	63	64	65	66	67	68	69	70	71			
			Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu			
	Metalloids		90	91	92	93	94	95	96	97	98	99	100	101	102	103			
			Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr			
	Nonmetals																		

Metals	Metalloids	Nonmetals
<ul style="list-style-type: none">• Shiny• Malleable• Ductile• Good conductors	<ul style="list-style-type: none">• Inbetween metals and nonmetals!	<ul style="list-style-type: none">• No luster, various colors.• Brittle solids• Poor conductors
Examples:	Examples:	Examples: