

Section 1: Organizing the Elements

Preview

- Key Ideas
- Bellringer
- Recognizing a Pattern
- Changing the Arrangement

Key Ideas

- › How did Mendeleev arrange the elements in his periodic table?
- › How are elements arranged in the modern periodic table?

Bellringer

One way to organize a large group of objects is to arrange them into groups of similar objects. This is how scientists organize all of the many elements. Practice the skill of categorizing by arranging the magazines listed below into similar groups.

Calling All Girls

Computer World

Beautiful Homes

Auto Racing

The Healthy Man

Sporting Times

Child's Play

Family Computing

Beautiful Homes

Car Trends

Homeopathic Medicine

Sports and Scores

Calling All Boys

All About Computing

Home Decorating

Classic Cars

The Healthy Woman

Golf for Everyone

Nursery Rhymes

How to Use the Internet

Modern Housekeeping

Easy Car Repairs

The Health Newsletter

Football Stories

Read Aloud Stories

Building a Web Site

Home Makers Magazine

The Sports Car Story

Good Nutrition

Tennis Tips

Bellringer, *continued*

1. Arrange the magazines into similar groups.
2. What criteria did you use for grouping the magazines?
3. Once you arrange the magazines into groups, could you sort the material further to make it even more organized?

Calling All Girls
Computer World
Beautiful Homes
Auto Racing
The Healthy Man
Sporting Times
Child's Play
Family Computing
Beautiful Homes
Car Trends

Homeopathic Medicine
Sports and Scores
Calling All Boys
All About Computing
Home Decorating
Classic Cars
The Healthy Woman
Golf for Everyone
Nursery Rhymes
How to Use the Internet

Modern Housekeeping
Easy Car Repairs
The Health Newsletter
Football Stories
Read Aloud Stories
Building a Web Site
Home Makers Magazine
The Sports Car Story
Good Nutrition
Tennis Tips

Recognizing a Pattern

- › How did Mendeleev arrange the elements in his periodic table?
- › In his periodic table, Mendeleev arranged elements in rows by increasing atomic mass.

Recognizing a Pattern, *continued*

- Mendeleev was able to predict new elements.
 - Mendeleev left spaces in his table to make the pattern fit.
 - He used the spaces to successfully predict the existence and properties of elements not yet discovered.
- A few elements did not fit the pattern.

Properties of Germanium

	Mendeleev's prediction	Actual property
Atomic mass	70	72.6
Density*	5.5 g/cm ³	5.3 g/cm ³
Appearance	Dark gray metal	Gray metalloid
Melting point*	High	937 °C

**at room temperature and pressure*

Changing the Arrangement

- › How are elements arranged in the modern periodic table?
- › The modern periodic table organizes elements by atomic number. When the elements are arranged in this way, elements that have similar properties appear at regular intervals.

Changing the Arrangement, *continued*

- As scientists learned more about the structure of the atom, they improved Mendeleev's table.
- Arranging the table by atomic number (number of protons) rather than by atomic mass fixed the discrepancies in Mendeleev's table.
- **periodic law:** the law that states that the repeating chemical and physical properties of elements change periodically with the atomic numbers of the elements

The Periodic Table of the Elements

1
H
Hydrogen
1.007 94

Group 1

3
Li
Lithium
6.941

Group 2

11
Na
Sodium
22.989 769 28

12
Mg
Magnesium
24.3050

19
K
Potassium
39.0983

20
Ca
Calcium
40.078

21
Sc
Scandium
44.955 912

22
Ti
Titanium
47.867

23
V
Vanadium
50.9415

24
Cr
Chromium
51.9961

25
Mn
Manganese
54.938 045

26
Fe
Iron
55.845

27
Co
Cobalt
58.933 195

37
Rb
Rubidium
85.4678

38
Sr
Strontium
87.62

39
Y
Yttrium
88.905 85

40
Zr
Zirconium
91.224

41
Nb
Niobium
92.906 38

42
Mo
Molybdenum
95.94

43
Tc
Technetium
(98)

44
Ru
Ruthenium
101.07

45
Rh
Rhodium
102.905 50

55
Cs
Cesium
132.905 4519

56
Ba
Barium
137.327

57
La
Lanthanum
138.905 47

72
Hf
Hafnium
178.49

73
Ta
Tantalum
180.947 88

74
W
Tungsten
183.84

75
Re
Rhenium
186.207

76
Os
Osmium
190.23

77
Ir
Iridium
192.227

87
Fr
Francium
(223)

88
Ra
Radium
(226)

89
Ac
Actinium
(227)

104
Rf
Rutherfordium
(261)

105
Db
Dubnium
(262)

106
Sg
Seaborgium
(266)

107
Bh
Bohrium
(264)

108
Hs
Hassium
(277)

109
Mt
Meitnerium
(268)

Key:

Atomic number: 6

Symbol: C

Name: Carbon

Average atomic mass: 12.0107

Hydrogen

Semiconductors
(also known as metalloids)

Metals

Alkali metals

Alkaline-earth metals

Transition metals

Other metals

Nonmetals

Halogens

Noble gases

Other nonmetals

Group 13

5
B
Boron
10.811

Group 14

6
C
Carbon
12.0107

Group 15

7
N
Nitrogen
14.0067

Group 16

8
O
Oxygen
15.9994

Group 17

9
F
Fluorine
18.998 4032

Group 18

10
Ne
Neon
20.1797

Group 13

13
Al
Aluminum
26.981 5386

Group 14

14
Si
Silicon
28.0855

Group 15

15
P
Phosphorus
30.973 762

Group 16

16
S
Sulfur
32.065

Group 17

17
Cl
Chlorine
35.453

Group 18

18
Ar
Argon
39.948

Group 10

28
Ni
Nickel
58.6934

Group 11

29
Cu
Copper
63.546

Group 12

30
Zn
Zinc
65.409

Group 13

31
Ga
Gallium
69.723

Group 14

32
Ge
Germanium
72.64

Group 15

33
As
Arsenic
74.921 60

Group 16

34
Se
Selenium
78.96

Group 17

35
Br
Bromine
79.904

Group 18

36
Kr
Krypton
83.798

Group 10

46
Pd
Palladium
106.42

Group 11

47
Ag
Silver
107.8682

Group 12

48
Cd
Cadmium
112.411

Group 13

49
In
Indium
114.818

Group 14

50
Sn
Tin
118.710

Group 15

51
Sb
Antimony
121.760

Group 16

52
Te
Tellurium
127.60

Group 17

53
I
Iodine
126.904 47

Group 18

54
Xe
Xenon
131.293

Group 10

78
Pt
Platinum
195.084

Group 11

79
Au
Gold
196.966 569

Group 12

80
Hg
Mercury
200.59

Group 13

81
Tl
Thallium
204.3833

Group 14

82
Pb
Lead
207.2

Group 15

83
Bi
Bismuth
208.980 40

Group 16

84
Po
Polonium
(209)

Group 17

85
At
Astatine
(210)

Group 18

86
Rn
Radon
(222)

Group 10

110
Ds
Darmstadtium
(271)

Group 11

111
Rg
Roentgenium
(272)

Group 12

112
Uub*
Ununbium
(269)

Group 13

114
Uuq*
Ununquadium
(279)

Group 15

116
Uuh*
Ununhexium
(292)

Group 16

118
Uuo
Ununoctium
(294)

63
Eu
Europium
151.964

64
Gd
Gadolinium
157.25

65
Tb
Terbium
158.925 35

66
Dy
Dysprosium
162.500

67
Ho
Holmium
164.930 32

68
Er
Erbium
167.259

69
Tm
Thulium
168.934 21

70
Yb
Ytterbium
173.04

71
Lu
Lutetium
174.967

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)

* The systematic names and symbols for elements greater than 111 will be used until the approval of trivial names by IUPAC.

58
Ce
Cerium
140.116

59
Pr
Praseodymium
140.907 65

60
Nd
Neodymium
144.242

61
Pm
Promethium
(145)

62
Sm
Samarium
150.36

90
Th
Thorium
232.038 06

91
Pa
Protactinium
231.036 88

92
U
Uranium
238.028 91

93
Np
Neptunium
(237)

94
Pu
Plutonium
(244)

The discoveries of elements with atomic numbers 112, 114, and 116 have been reported but not fully confirmed.

The atomic masses listed in this table reflect the precision of current measurements. (Each value listed in accordance to the mass number of that element is rounded to the nearest whole number.)

Changing the Arrangement, *continued*

- Elements become less metallic across each period.
 - **period**: a horizontal row of elements in the periodic table
- Elements in a group have similar properties.
 - **group**: a vertical column of elements in the periodic table; elements in a group share chemical properties

Visual Concept: Periodic Table Overview

