

# Rare Earth Elements

By. Zachary Thammavongsy

The 'Rare Earth Elements' game is a memory card game introducing players to the importance of rare earth elements in our society. Players are tasked to find rare earth elements used in our daily lives. Players will learn the 17 rare earth elements, their elemental symbols, and the incorporation of them into cell phones, flat screens, lasers, and other technological devices. Ultimately, players will learn how common these rare earth elements are in our society, making them not so rare.

This file is released under the  
United States Copyright Office  
You have our permission to...

- Print as much as you want for personal use
- Share this file with friends and family

You may not...

- Mass produce this game for events
- Sell this pdf file or the art within this pdf file
- Modify any of the art within this pdf file

Instructions: Print all pages double sided (the pages are layed out for you to print in one go). After printing, cut the cards along the dash lines. Use a paper trimmer and cut directly on the dash line. We reccommend using glossy white paper between 150 gsm and 300 gsm.

**Instructions: Print all pages double sided (the pages are layed out for you to print in one go). After printing, cut the cards along the dash lines. Use a paper trimmer and cut directly on the dash line. We reccommend using glossy white paper between 150 gsm and 300 gsm.**



**Copyright 2019 d-ORBITAL GAMES**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**

**57**

**La**

**Lanthanum**

**57**

**La**

**Lanthanum**

**58**

**Ce**

**Cerium**

**58**

**Ce**

**Cerium**

**59**

**Pr**

**Praseodymium**

**59**

**Pr**

**Praseodymium**





**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**

**60**

**Nd**

**Neodymium**

**60**

**Nd**

**Neodymium**

**62**

**Sm**

**Samarium**

**62**

**Sm**

**Samarium**

**63**

**Eu**

**Europium**

**63**

**Eu**

**Europium**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**

64

**Gd**

Gadolinium

64

**Gd**

Gadolinium

65

**Tb**

Terbium

65

**Tb**

Terbium

66

**Dy**

Dysprosium

66

**Dy**

Dysprosium



**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



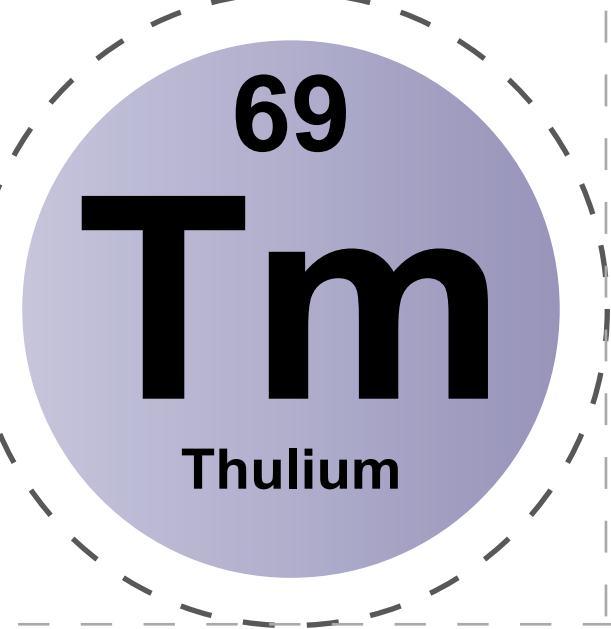
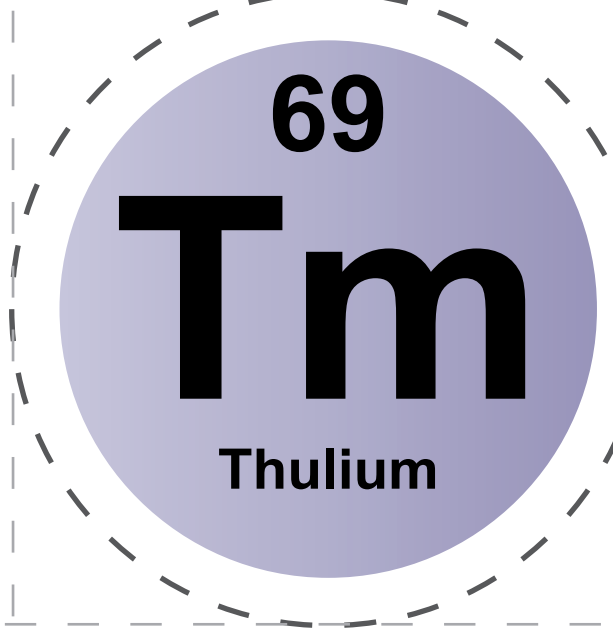
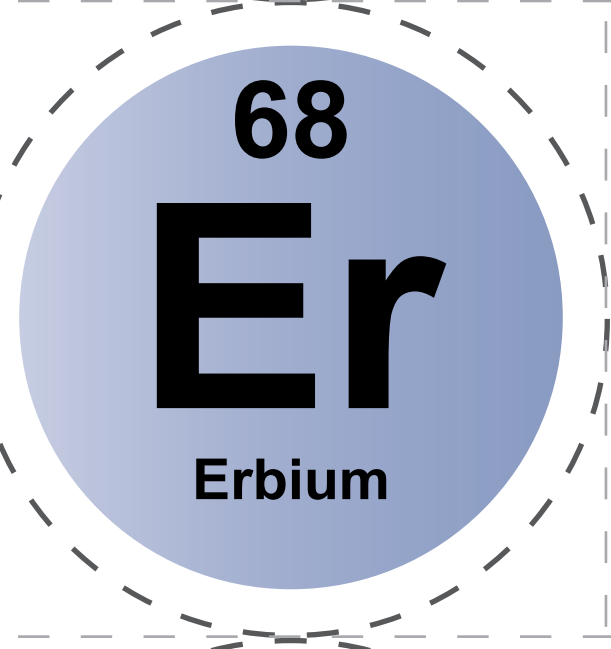
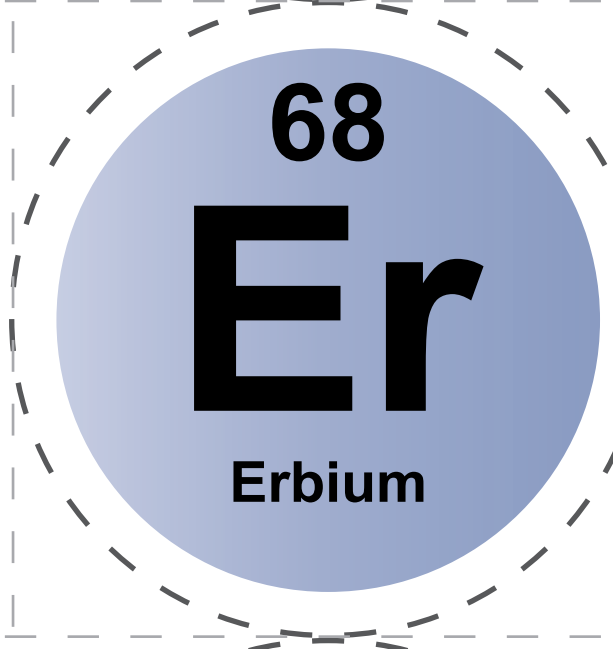
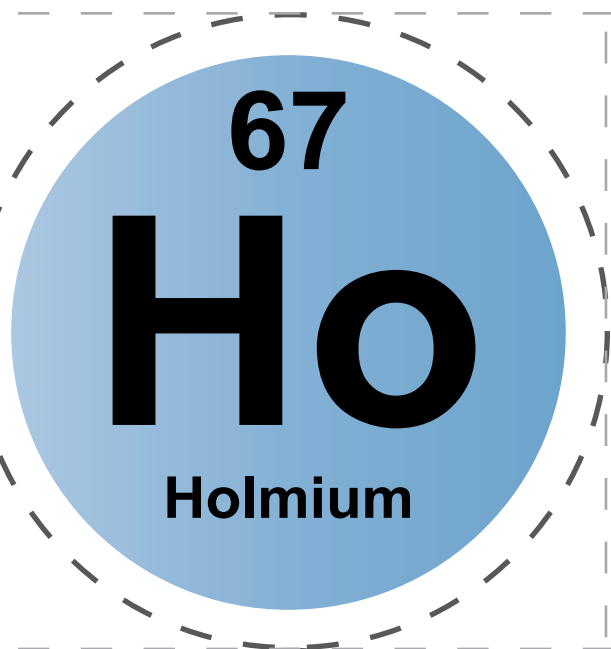
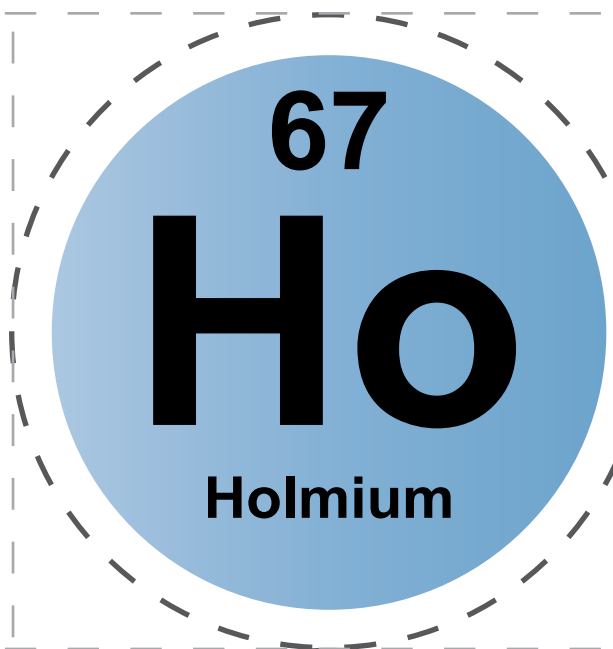
**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**





**Rare Earth  
Elements**



**Rare Earth  
Elements**



**Rare Earth  
Elements**



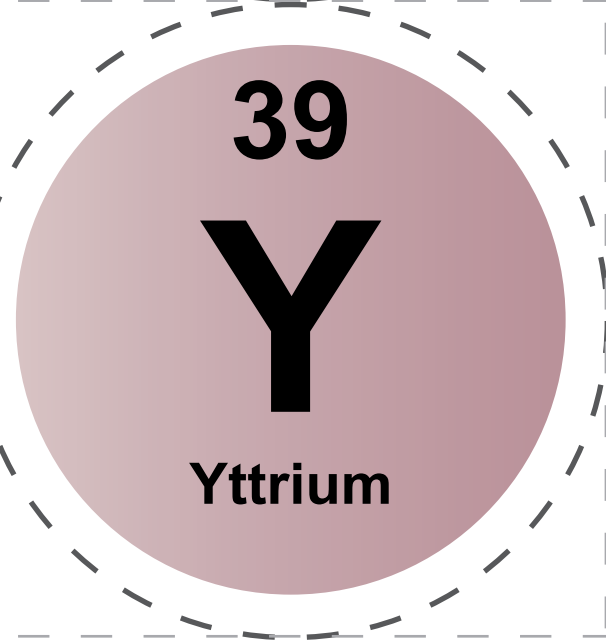
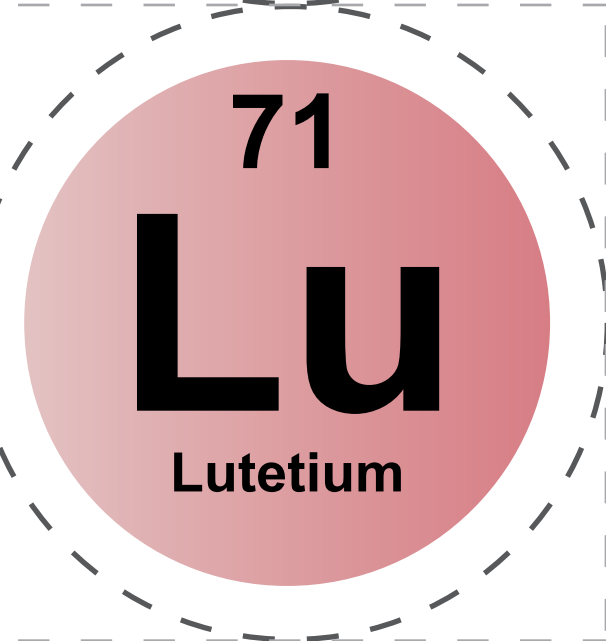
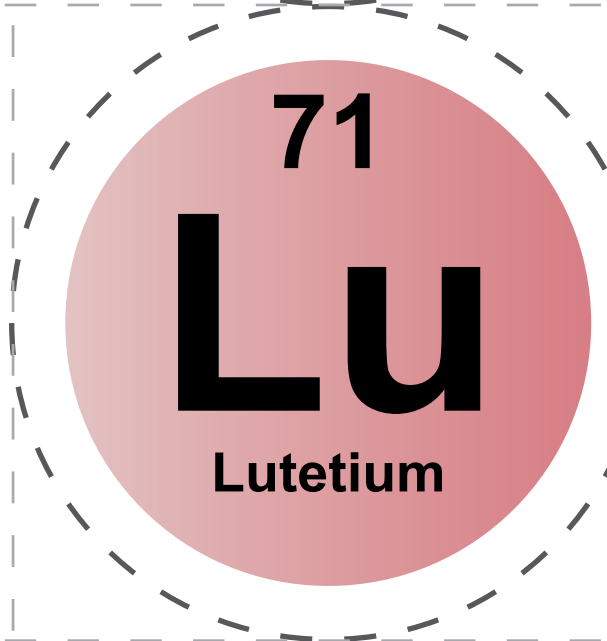
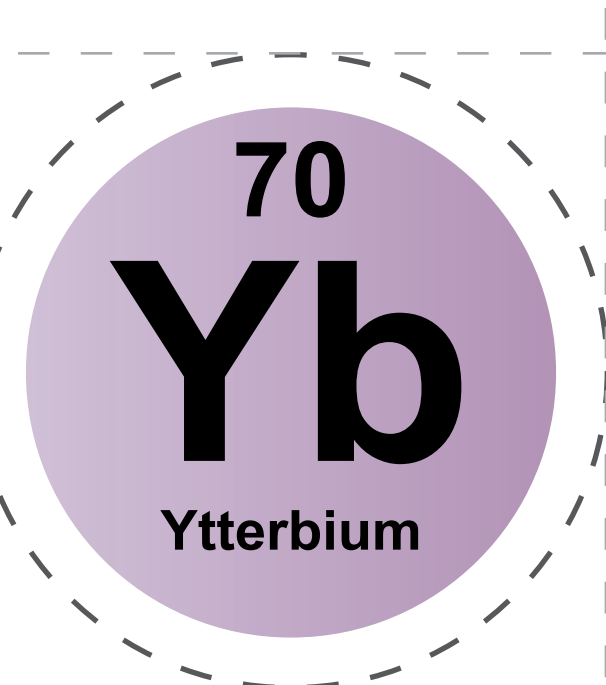
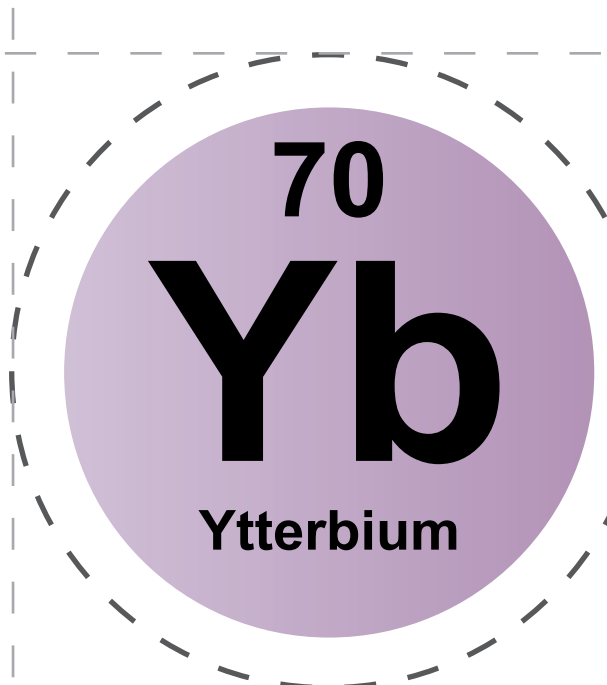
**Rare Earth  
Elements**



**Rare Earth  
Elements**

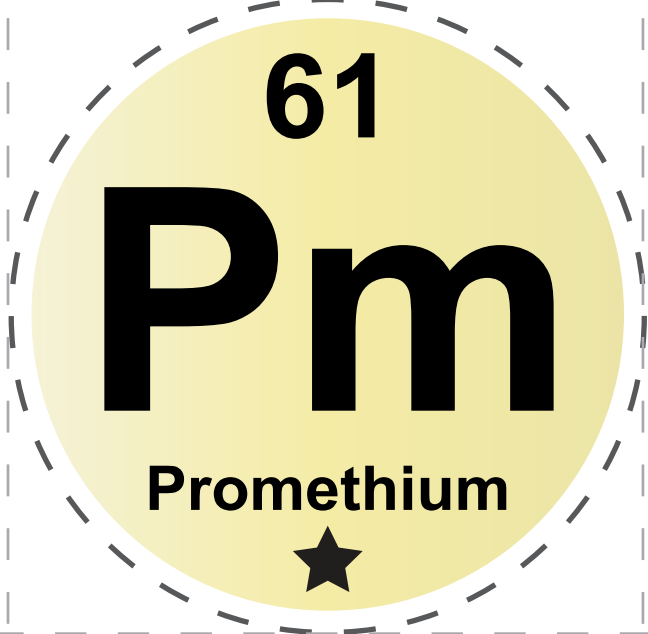
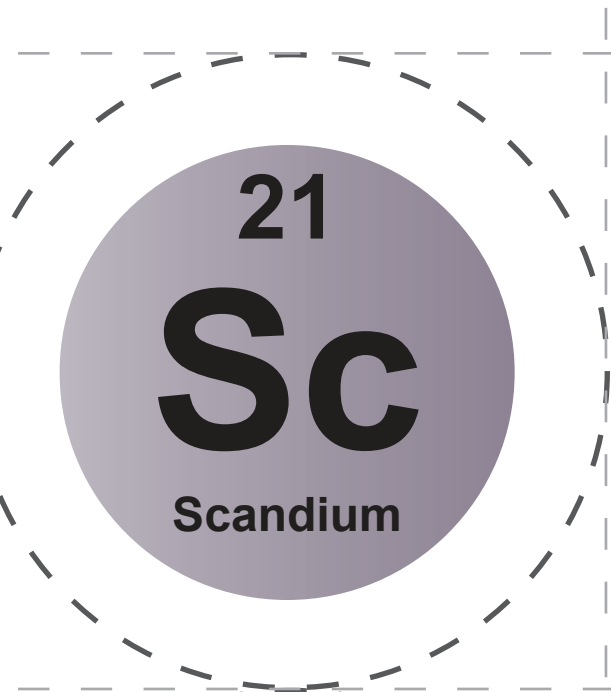
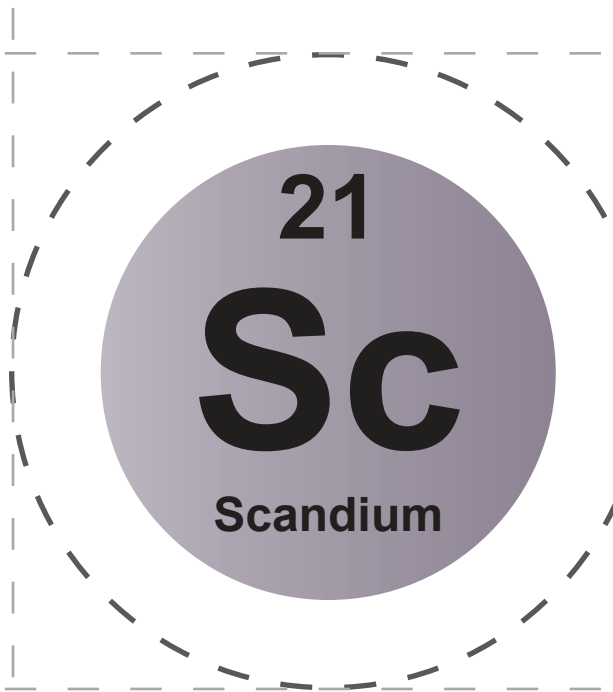


**Rare Earth  
Elements**









Periodic Table of the Elements																	
Rare Earth																	
1 H Hydrogen	2 He Helium	3 Li Lithium	4 Be Beryllium	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon	11 Na Sodium	12 Mg Magnesium	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Cesium	56 Ba Barium	57 - 71	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89 - 103	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson
57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium			
89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium			

Ionic radii of the 17 Rare Earth elements in the +3 oxidation are drawn to relative size. Data taken from "Electronic Table of Shannon Ionic Radii, J. D. Van Horn, 2001. Other elements are not drawn to relative size.

Copyright © d-ORBITAL GAMES, LLC. All Rights Reserved.

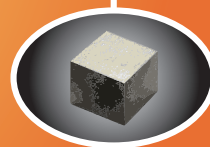
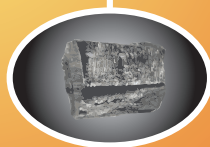
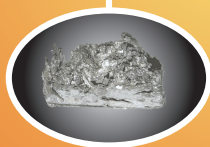
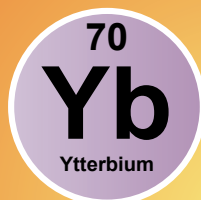
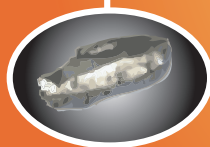
Periodic Table of the Elements																																					
Rare Earth																																					
1 H Hydrogen	2 He Helium																																				
3 Li Lithium	4 Be Beryllium																	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon														
11 Na Sodium	12 Mg Magnesium																	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon														
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton	37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon		
55 Cs Cesium	56 Ba Barium	57 - 71	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon	87 Fr Francium	88 Ra Radium	89 - 103	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson		
57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium									89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

Ionic radii of the 17 Rare Earth elements in the +3 oxidation are drawn to relative size. Data taken from "Electronic Table of Shannon Ionic Radii, J. D. Van Horn, 2001. Other elements are not drawn to relative size.

Copyright © d-ORBITAL GAMES, LLC. All Rights Reserved.

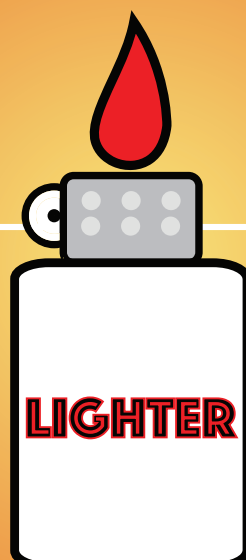
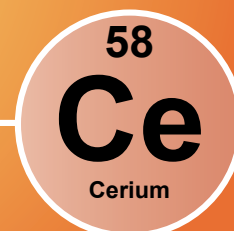
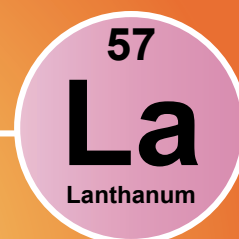
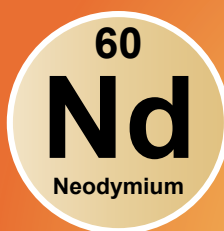
# Smallest Rare Earths

(Based on the ionic radius in the +3 oxidation state)



*Images above are of the actual Rare Earth elements with artistic rendering.*

# Mischmetal



*Used as striker flints*

1 H Hydrogen		Periodic Table of the Elements																2 He Helium																	
3 Li Lithium		4 Be Beryllium		Rare Earth														5 B Boron		6 C Carbon		7 N Nitrogen		8 O Oxygen		9 F Fluorine		10 Ne Neon							
11 Na Sodium		12 Mg Magnesium																13 Al Aluminum		14 Si Silicon		15 P Phosphorus		16 S Sulfur		17 Cl Chlorine		18 Ar Argon							
19 K Potassium		20 Ca Calcium		21 Sc Scandium		22 Ti Titanium		23 V Vanadium		24 Cr Chromium		25 Mn Manganese		26 Fe Iron		27 Co Cobalt		28 Ni Nickel		29 Cu Copper		30 Zn Zinc		31 Ga Gallium		32 Ge Germanium		33 As Arsenic		34 Se Selenium		35 Br Bromine		36 Kr Krypton	
37 Rb Rubidium		38 Sr Strontium		39 Y Yttrium		40 Zr Zirconium		41 Nb Niobium		42 Mo Molybdenum		43 Tc Technetium		44 Ru Ruthenium		45 Rh Rhodium		46 Pd Palladium		47 Ag Silver		48 Cd Cadmium		49 In Indium		50 Sn Tin		51 Sb Antimony		52 Te Tellurium		53 I Iodine		54 Xe Xenon	
55 Cs Cesium		56 Ba Barium		57 - 71		72 Hf Hafnium		73 Ta Tantalum		74 W Tungsten		75 Re Rhenium		76 Os Osmium		77 Ir Iridium		78 Pt Platinum		79 Au Gold		80 Hg Mercury		81 Tl Thallium		82 Pb Lead		83 Bi Bismuth		84 Po Polonium		85 At Astatine		86 Rn Radon	
87 Fr Francium		88 Ra Radium		89 - 103		104 Rf Rutherfordium		105 Db Dubnium		106 Sg Seaborgium		107 Bh Bohrium		108 Hs Hassium		109 Mt Meitnerium		110 Ds Darmstadtium		111 Rg Roentgenium		112 Cn Copernicium		113 Nh Nihonium		114 Fl Flerovium		115 Mc Moscovium		116 Lv Livermorium		117 Ts Tennessine		118 Og Oganesson	
				57 La Lanthanum		58 Ce Cerium		59 Pr Praseodymium		60 Nd Neodymium		61 Pm Promethium		62 Sm Samarium		63 Eu Europium		64 Gd Gadolinium		65 Tb Terbium		66 Dy Dysprosium		67 Ho Holmium		68 Er Erbium		69 Tm Thulium		70 Yb Ytterbium		71 Lu Lutetium			
				89 Ac Actinium		90 Th Thorium		91 Pa Protactinium		92 U Uranium		93 Np Neptunium		94 Pu Plutonium		95 Am Americium		96 Cm Curium		97 Bk Berkelium		98 Cf Californium		99 Es Einsteinium		100 Fm Fermium		101 Md Mendelevium		102 No Nobelium		103 Lr Lawrencium			

Ionic radii of the 17 Rare Earth elements in the +3 oxidation are drawn to relative size. Data taken from "Electronic Table of Shannon Ionic Radii, J. D. Van Horn, 2001. Other elements are not drawn to relative size.

Copyright © d-ORBITAL GAMES, LLC. All Rights Reserved.

1

H

Hydrogen

3

Li

Lithium

11

Na

Sodium

19

K

Potassium

37

Rb

Rubidium

55

Cs

Cesium

87

Fr

Francium

4

Be

Beryllium

12

Mg

Magnesium

20

Ca

Calcium

38

Sr

Strontium

56

Ba

Barium

88

Ra

Radium

21

Sc

Scandium

39

Y

Yttrium

57-71

89-103

22

Ti

Titanium

40

Zr

Zirconium

72

Hf

Hafnium

104

Rf

Rutherfordium

23

V

Vanadium

41

Nb

Niobium

73

Ta

Tantalum

105

Db

Dubnium

24

Cr

Chromium

42

Mo

Molybdenum

74

W

Tungsten

106

Sg

Seaborgium

25

Mn

Manganese

43

Tc

Technetium

75

Re

Rhenium

107

Bh

Bohrium

26

Fe

Iron

44

Ru

Ruthenium

76

Os

Osmium

108

Hs

Hassium

27

Co

Cobalt

45

Rh

Rhodium

77

Ir

Iridium

109

Mt

Meitnerium

28

Ni

Nickel

46

Pd

Palladium

78

Pt

Platinum

110

Ds

Darmstadtium

29

Cu

Copper

47

Ag

Silver

79

Au

Gold

111

Rg

Roentgenium

30

Zn

Zinc

48

Cd

Cadmium

80

Hg

Mercury

112

Cn

Copernicium

31

Ga

Gallium

49

In

Indium

81

Tl

Thallium

113

Nh

Nihonium

32

Ge

Germanium

50

Sn

Tin

82

Pb

Lead

114

Fl

Flerovium

33

As

Arsenic

51

Sb

Antimony

83

Bi

Bismuth

115

Mc

Moscovium

34

Se

Selenium

52

Te

Tellurium

84

Po

Polonium

116

Lv

Livermorium

35

Br

Bromine

53

I

Iodine

85

At

Astatine

117

Ts

Tennessine

36

Kr

Krypton

54

Xe

Xenon

86

Rn

Radon

118

Og

Oganesson

71

Lu

Lutetium

57

La

Lanthanum

89

Ac

Actinium

61

Pm

Promethium

62

Sm

Samarium

94

Pu

Plutonium

63

Eu

Europium

64

Gd

Gadolinium

95

Am

Americium

65

Tb

Terbium

66

Dy

Dysprosium

96

Cm

Curium

67

Ho

Holmium

68

Er

Erbium

97

Bk

Berkelium

69

Tm

Thulium

70

Yb

Ytterbium

98

Cf

Californium

71

Lu

Lutetium

72

Hf

Hafnium

99

Es

Einsteinium

73

Ta

Tantalum

74

W

Tungsten

100

Fm

Fermium

75

Re

Rhenium

76

Os

Osmium

101

Md

Mendelevium

77

Ir

Iridium

78

Pt

Platinum

102

No

Nobelium

79

Au

Gold

80

Hg

Mercury

103

Lr

Lawrencium

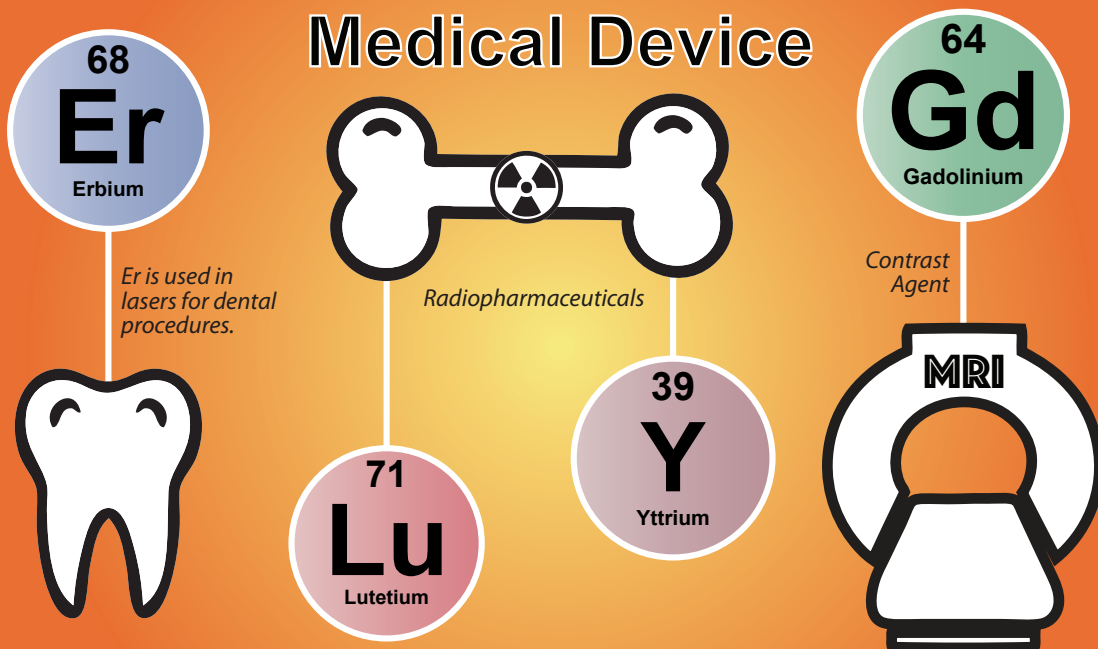
Periodic Table of the Elements

Rare Earth

Ionic radii of the 17 Rare Earth elements in the +3 oxidation are drawn to relative size. Data taken from "Electronic Table of Shannon Ionic Radii, J. D. Van Horn, 2001. Other elements are not drawn to relative size.

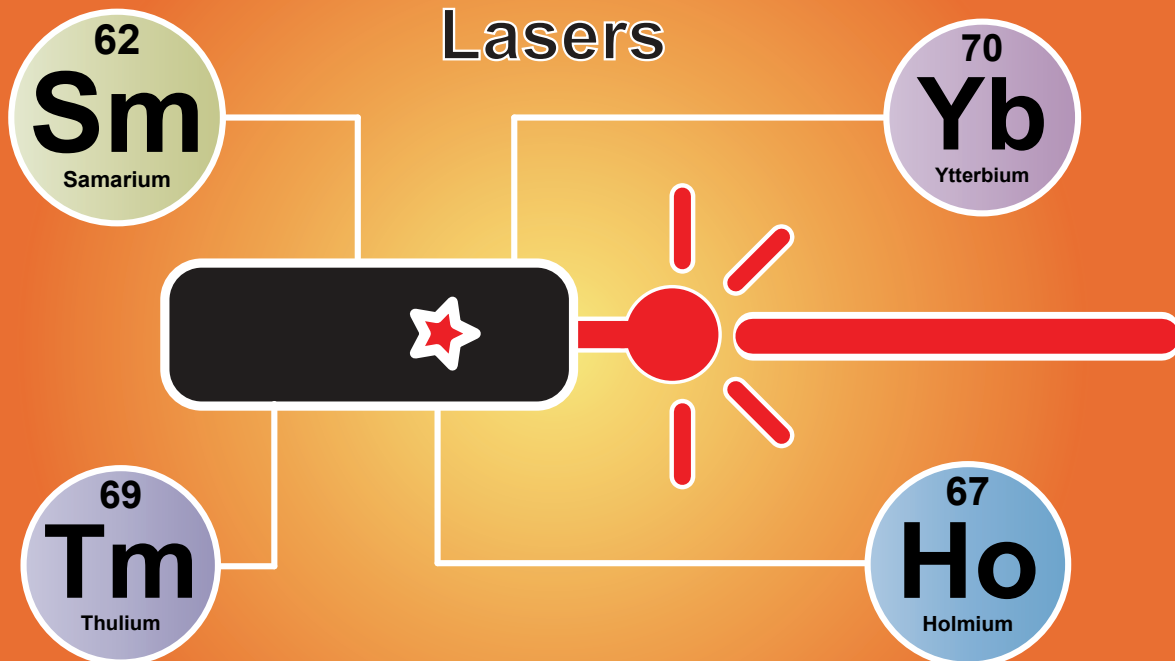
Copyright © d-ORBITAL GAMES, LLC. All Rights Reserved.

## Medical Device



*Other Rare Earth elements used in radiopharmaceuticals are Er and Sm.*

## Lasers



*Other Rare Earth elements found in lasers are Y, Pr, Nd, Er, Eu, Gd and Dy.*



Periodic Table of the Elements																	
Rare Earth																	
1 H Hydrogen	2 He Helium	3 Li Lithium	4 Be Beryllium	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon	11 Na Sodium	12 Mg Magnesium	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Cesium	56 Ba Barium	57 - 71	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89 - 103	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson
57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium			
89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium			

Ionic radii of the 17 Rare Earth elements in the +3 oxidation are drawn to relative size. Data taken from "Electronic Table of Shannon Ionic Radii, J. D. Van Horn, 2001. Other elements are not drawn to relative size.

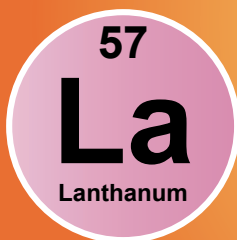
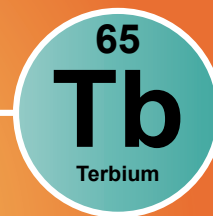
Copyright © d-ORBITAL GAMES, LLC. All Rights Reserved.

Periodic Table of the Elements																																			
Rare Earth																																			
1 H Hydrogen	2 He Helium																																		
3 Li Lithium	4 Be Beryllium																	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon												
11 Na Sodium	12 Mg Magnesium																	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon												
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton	37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Cesium	56 Ba Barium	57 - 71	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon	87 Fr Francium	88 Ra Radium	89 - 103	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson
57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium					89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium		

Ionic radii of the 17 Rare Earth elements in the +3 oxidation are drawn to relative size. Data taken from "Electronic Table of Shannon Ionic Radii, J. D. Van Horn, 2001. Other elements are not drawn to relative size.

Copyright © d-ORBITAL GAMES, LLC. All Rights Reserved.

## Flat Screen

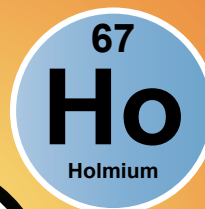
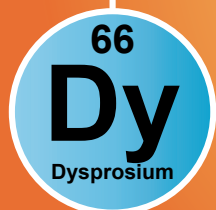


*Other Rare Earth elements found in flat screen TVs are Pr, Dy and Gd.  
The ones selected above are mainly found in the screen component of a TV.*

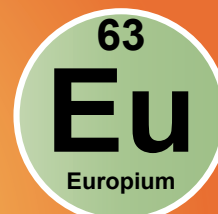
## Computing Technology



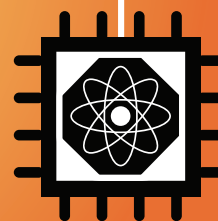
Hard Drive



Optic Fiber



Quantum Memory Chip



*Other Rare Earth elements found in optic fibers are Nd, Yb, Tm and Pr.*



1 H Hydrogen		Periodic Table of the Elements																2 He Helium																			
3 Li Lithium		4 Be Beryllium		Rare Earth																5 B Boron		6 C Carbon		7 N Nitrogen		8 O Oxygen		9 F Fluorine		10 Ne Neon							
11 Na Sodium		12 Mg Magnesium																		13 Al Aluminum		14 Si Silicon		15 P Phosphorus		16 S Sulfur		17 Cl Chlorine		18 Ar Argon							
19 K Potassium		20 Ca Calcium		21 Sc Scandium		22 Ti Titanium		23 V Vanadium		24 Cr Chromium		25 Mn Manganese		26 Fe Iron		27 Co Cobalt		28 Ni Nickel		29 Cu Copper		30 Zn Zinc		31 Ga Gallium		32 Ge Germanium		33 As Arsenic		34 Se Selenium		35 Br Bromine		36 Kr Krypton			
37 Rb Rubidium		38 Sr Strontium		39 Y Yttrium		40 Zr Zirconium		41 Nb Niobium		42 Mo Molybdenum		43 Tc Technetium		44 Ru Ruthenium		45 Rh Rhodium		46 Pd Palladium		47 Ag Silver		48 Cd Cadmium		49 In Indium		50 Sn Tin		51 Sb Antimony		52 Te Tellurium		53 I Iodine		54 Xe Xenon			
55 Cs Cesium		56 Ba Barium		57 - 71		72 Hf Hafnium		73 Ta Tantalum		74 W Tungsten		75 Re Rhenium		76 Os Osmium		77 Ir Iridium		78 Pt Platinum		79 Au Gold		80 Hg Mercury		81 Tl Thallium		82 Pb Lead		83 Bi Bismuth		84 Po Polonium		85 At Astatine		86 Rn Radon			
87 Fr Francium		88 Ra Radium		89 - 103		104 Rf Rutherfordium		105 Db Dubnium		106 Sg Seaborgium		107 Bh Bohrium		108 Hs Hassium		109 Mt Meitnerium		110 Ds Darmstadtium		111 Rg Roentgenium		112 Cn Copernicium		113 Nh Nihonium		114 Fl Flerovium		115 Mc Moscovium		116 Lv Livermorium		117 Ts Tennessine		118 Og Oganesson			
57 La Lanthanum		58 Ce Cerium		59 Pr Praseodymium		60 Nd Neodymium		61 Pm Promethium		62 Sm Samarium		63 Eu Europium		64 Gd Gadolinium		65 Tb Terbium		66 Dy Dysprosium		67 Ho Holmium		68 Er Erbium		69 Tm Thulium		70 Yb Ytterbium		71 Lu Lutetium									
89 Ac Actinium		90 Th Thorium		91 Pa Protactinium		92 U Uranium		93 Np Neptunium		94 Pu Plutonium		95 Am Americium		96 Cm Curium		97 Bk Berkelium		98 Cf Californium		99 Es Einsteinium		100 Fm Fermium		101 Md Mendelevium		102 No Nobelium		103 Lr Lawrencium									

Ionic radii of the 17 Rare Earth elements in the +3 oxidation are drawn to relative size. Data taken from "Electronic Table of Shannon Ionic Radii, J. D. Van Horn, 2001. Other elements are not drawn to relative size.

Copyright © d-ORBITAL GAMES, LLC. All Rights Reserved.

1

H

Hydrogen

2

He

Helium

3

Li

Lithium

4

Be

Beryllium

5

B

Boron

6

C

Carbon

7

N

Nitrogen

8

O

Oxygen

9

F

Fluorine

10

Ne

Neon

11

Na

Sodium

12

Mg

Magnesium

13

Al

Aluminum

14

Si

Silicon

15

P

Phosphorus

16

S

Sulfur

17

Cl

Chlorine

18

Ar

Argon

19

K

Potassium

20

Ca

Calcium

21

Sc

Scandium

22

Ti

Titanium

23

V

Vanadium

24

Cr

Chromium

25

Mn

Manganese

26

Fe

Iron

27

Co

Cobalt

28

Ni

Nickel

29

Cu

Copper

30

Zn

Zinc

31

Ga

Gallium

32

Ge

Germanium

33

As

Arsenic

34

Se

Selenium

35

Br

Bromine

36

Kr

Krypton

37

Rb

Rubidium

38

Sr

Strontium

39

Y

Yttrium

40

Zr

Zirconium

41

Nb

Niobium

42

Mo

Molybdenum

43

Tc

Technetium

44

Ru

Ruthenium

45

Rh

Rhodium

46

Pd

Palladium

47

Ag

Silver

48

Cd

Cadmium

49

In

Indium

50

Sn

Tin

51

Sb

Antimony

52

Te

Tellurium

53

I

Iodine

54

Xe

Xenon

55

Cs

Cesium

56

Ba

Barium

57 - 71

72

Hf

Hafnium

73

Ta

Tantalum

74

W

Tungsten

75

Re

Rhenium

76

Os

Osmium

77

Ir

Iridium

78

Pt

Platinum

79

Au

Gold

80

Hg

Mercury

81

Tl

Thallium

82

Pb

Lead

83

Bi

Bismuth

84

Po

Polonium

85

At

Astatine

86

Rn

Radon

87

Fr

Francium

88

Ra

Radium

89 - 103

104

Rf

Rutherfordium

105

Db

Dubnium

106

Sg

Seaborgium

107

Bh

Bohrium

108

Hs

Hassium

109

Mt

Meitnerium

110

Ds

Darmstadtium

111

Rg

Roentgenium

112

Cn

Copernicium

113

Nh

Nihonium

114

Fl

Flerovium

115

Mc

Moscovium

116

Lv

Livermorium

117

Ts

Tennessine

118

Og

Oganesson

57

La

Lanthanum

58

Ce

Cerium

59

Pr

Praseodymium

60

Nd

Neodymium

61

Pm

Promethium

62

Sm

Samarium

63

Eu

Europium

64

Gd

Gadolinium

65

Tb

Terbium

66

Dy

Dysprosium

67

Ho

Holmium

68

Er

Erbium

69

Tm

Thulium

70

Yb

Ytterbium

71

Lu

Lutetium

89

Ac

Actinium

90

Th

Thorium

91

Pa

Protactinium

92

U

Uranium

93

Np

Neptunium

94

Pu

Plutonium

95

Am

Americium

96

Cm

Curium

97

Bk

Berkelium

98

Cf

Californium

99

Es

Einsteinium

100

Fm

Fermium

101

Md

Mendelevium

102

No

Nobelium

103

Lr

Lawrencium

Periodic Table of the Elements

Rare Earth

Ionic radii of the 17 Rare Earth elements in the +3 oxidation are drawn to relative size. Data taken from "Electronic Table of Shannon Ionic Radii, J. D. Van Horn, 2001. Other elements are not drawn to relative size.

Copyright © d-ORBITAL GAMES, LLC. All Rights Reserved.

# Catalysts and Magnets

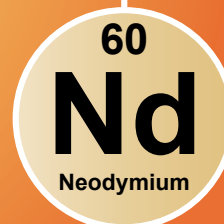
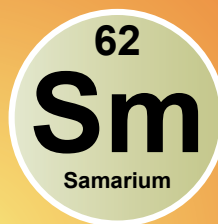
(A substance that accelerates a reaction.)



*Ce is used in catalytic converters found in cars.*

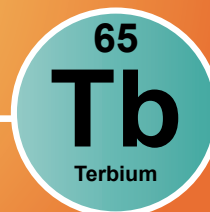
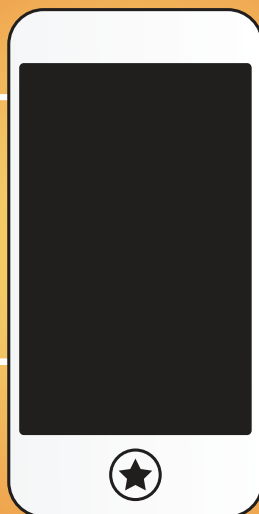


*Sc is used as a Lewis acid catalyst in organic reactions.*



*Other Rare Earth elements found in magnets are Pr, Tb, Dy and Ho.*

# Cell Phone



*Other Rare Earth elements found in cell phones are Y, La, Eu, and Nd.  
The ones selected above are mainly found in the electronic component of a cell phone.*