

# NOTES ON CHAPTER 4: ELEMENTS AND THE PERIODIC TABLE

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## 4.3 Metals

# Metals

The physical properties of metals include:

➤ shininess- ability to reflect light

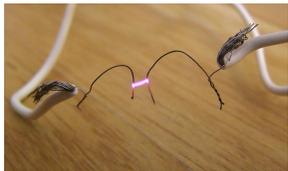


➤ malleability – ability to be hammered or rolled into flat sheets and other shapes

➤ ductility- ability to be pulled out, or drawn, into a long wire



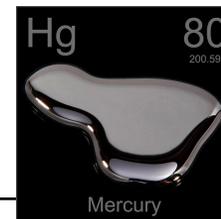
➤ conductivity- ability of an object to transfer heat or electricity to another object



Some are even magnetic! iron (Fe), cobalt (Co), and nickel (Ni) are attracted to magnets and can be made into magnets. 

Most metals are solids at room temperature. There is one exception: **mercury (Hg)**

It is a liquid at room temperature.





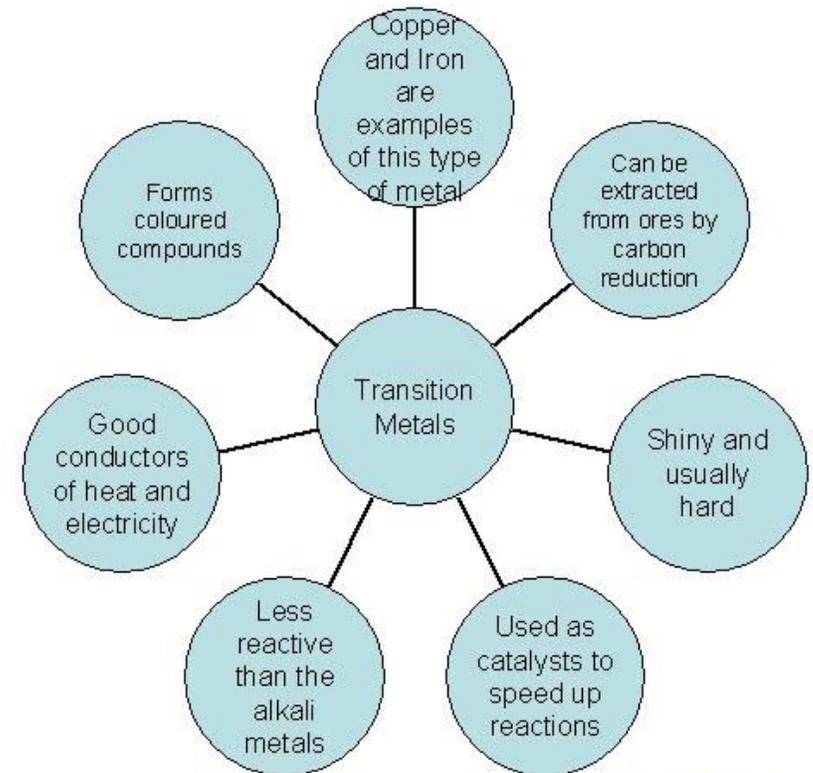


INTRODUCTION

PERIODIC TABLE OF THE ELEMENTS

**transition metals**  
groups 3 through 12

H																	He	
Li	Be											B	C	N	O	F	Ne	
Na	Mg	3	4	5	6	7	8	9	10	11	12	Al	Si	P	S	Cl	Ar	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Uub	Uuu	Uub	Uut	Uuq	Uup	Uuh	Uus	Uuc	
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		



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The transition metals include the familiar metals of iron, copper, nickel, silver, and gold.

Iron forms the core of a large molecule called hemoglobin, which carries oxygen in your bloodstream.

They are less reactive, which is why items made from these elements are long-lasting.



# Lanthanides

1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31							13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95				
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.71	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0	
87 Fr (223)	88 Ra (226.0)	89 Ac (227)	104 Rf	105 Ha	106 Unh	107 Uns	108	109 Uue									

Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
	90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

These are placed below the main part of the periodic table to make it more compact.

Lanthanides are soft, malleable, shiny metals with high conductivity.

They are mixed with other metals to make alloys. An alloy is a mixture of a metal with at least one other element, usually another metal.

Lanthanides are difficult to separate from one another because they all share similar properties.

60  
Nd  
Neodymium  
144



Neodymium magnets are powerful!

# Actinides

The elements from actinium (element 89) to lawrencium (element 103) form a distinct group—the actinides—within the periodic table.

1 H																	2 He		
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne		
11 Na	12 Mg							VIII						13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr		
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe		
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn		
87 Fr	88 Ra	89 Ac															114	116	118
		Actinides																	
		Thorium	Protactinium	Uranium	Neptunium	Plutonium	Americium	Curium	Berkelium	Californium	Einsteinium	Fermium	Mendelevium	Nobelium	Lawrencium				
90 Th (232)	91 Pa (231)	92 U (238)	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)						

Of these, only actinium, thorium, protactinium, and uranium occur naturally on Earth. The others were created artificially in labs.

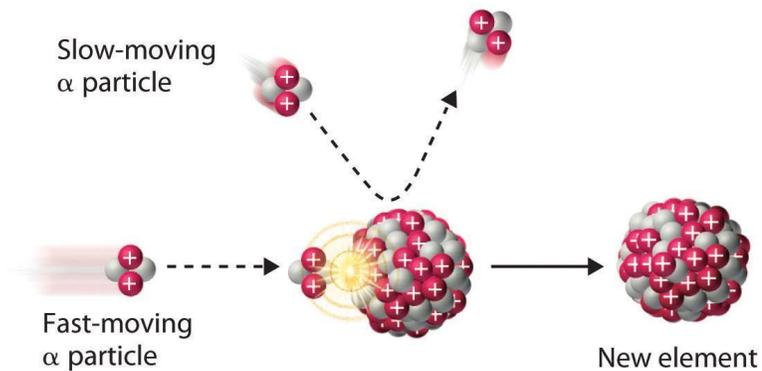
**U = atomic number 92**

The nuclei of these elements are very unstable (they break apart quickly into smaller nuclei) and only last for a fraction of a second after they are made.

The actinides are located right below the lanthanides.

## Synthetic Elements

Elements with atomic numbers higher than 92 are described as synthetic elements because they are not found naturally on Earth. They are made when nuclear particles are forced to crash into one another.



Plutonium is made by bombarding nuclei of uranium-238 with neutrons in a nuclear reactor.

To make heavier elements, having atomic numbers higher than 95, scientists use machines called particle accelerators.

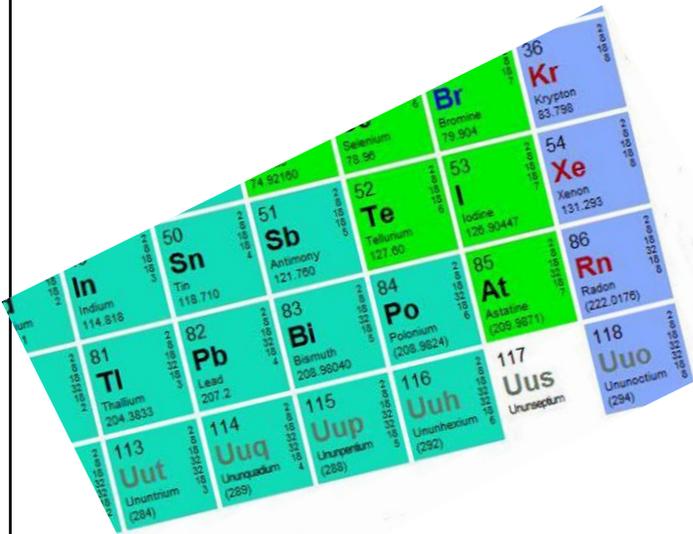
These move nuclei faster and faster until they reach high speeds. These crash into other nuclei with so much energy that they can sometime combine into a single nuclei.

Curium was the first synthetic element to be made (1940) by colliding the nuclei of helium with a plutonium nuclei. Curium is used as an energy source for the Mars Exploration Rover.



The higher the atomic number, the more difficulty in synthesizing new elements. As the particle accelerators become more powerfully built, new elements have been synthesized.

If you see elements on the periodic table that have three-letter symbols, it means they are synthetic elements. Their permanent name and symbol have not yet been agreed on by scientists around the world.



Group #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Period 1	1 H																	2 He
Period 2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
Period 3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
Period 4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
Period 5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
Period 6	55 Cs	56 Ba	+	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
Period 7	87 Fr	88 Ra	**	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo
* Lanthanides (Lanthanoids)			57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
** Actinides (Actinoids)			89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

ELEMENT 112, 114, 116, 118

Latest ELEMENT 120

Ubn 120