

How are elements organized on the Periodic Table?



S8P1e. Develop models (e.g., atomic-level models, including drawings, and computer representations) by analyzing patterns within the periodic table that illustrate the structure, composition, and characteristics of atoms (proton, neutrons, electrons) and simple molecules.



What is the Periodic Table?

- It represents our understanding of the structure and usefulness of the atoms that have been identified in our environment
- Elements are organized on the Periodic Table based on similar properties

H																	He
Li	Be										B	C	N	O	F	Ne	
Na	Mg										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

Picture from www.chem4kids.com



The Periodic Table contains over 100 different Elements

hydrogen 1 H 1.0079																	helium 2 He 4.0026						
lithium 3 Li 6.941	beryllium 4 Be 9.0122																	boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium 12 Mg 24.305																	aluminium 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80						
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29						
caesium 55 Cs 132.91	barium 56 Ba 137.33	57-70 *	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]					
francium 87 Fr [223]	radium 88 Ra [226]	89-102 * *	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	ununilium 110 Uun [271]	unununium 111 Uuu [272]	ununbium 112 Uub [277]		ununquadium 114 Uuq [289]									

* Lanthanide series

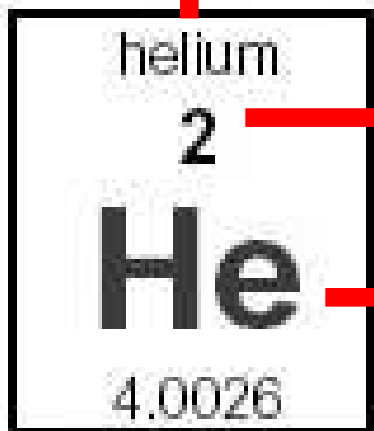
** Actinide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]



What do the numbers and Letters mean?

Element Name



Atomic Number (# protons and electrons in its atom)

Element's Chemical Symbol

**Atomic Mass
(p + n)**

What do you notice about the Atomic Number of Elements as you move Left to Right and Up to Down on the Periodic Table of Elements?

The Atomic Number Increases

hydrogen 1 H 1.0079																			helium 2 He 4.0026	
lithium 3 Li 6.941	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180			
sodium 11 Na 22.990	magnesium 12 Mg 24.305											aluminium 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948			
potassium 19 K 39.098	calcium 20 Ca 40.078											gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80			
rubidium 37 Rb 85.468	strontium 38 Sr 87.62		scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29
caesium 55 Cs 132.91	barium 56 Ba 137.33	57-70 *	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]		
francium 87 Fr [223]	radium 88 Ra [226]	89-102 * *	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	ununnium 110 Uun [271]	ununium 111 Uuu [272]	unubium 112 Uub [277]		ununquadium 114 Uuq [289]						



* Lanthanide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
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** Actinide series

actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]
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So how is the Periodic Table arranged?

- The Periodic Table is organized like a big grid.
- The properties of an element can be predicted from its location in the Periodic Table
- There are rows (left to right) and columns (up and down). Each row and column mean something different.

Periodic Table of the Elements

1	2																	10
H	He																	Ne
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									
Fr	Ra	+Ac	Rf	Ha	106	107	108	109	110									

* Lanthanide Series

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

+ Actinide Series

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

The Periodic Table can also be divided into three main types of Elements: Metals, Metalloids, and Nonmetals

1 H																	18 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											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	71 Lu	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	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub	113	114	115	116	117	118
Lanthanide series		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		
Actinide series		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		

Metals	Metalloids	Nonmetals
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Metals

- Metals are shiny
- Metals are solid at room temperature
- Metals have high conductivity
- Metals can be flattened and not shatter (malleable)

Metals

		2													
3 Li	4 Be											13 Al			
11 Na	12 Mg	3													
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			
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		
55 Cs	56 Ba	71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	
87 Fr	88 Ra	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub				
		Lanthanide series													
		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
		Actinide series													
		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



Nonmetals

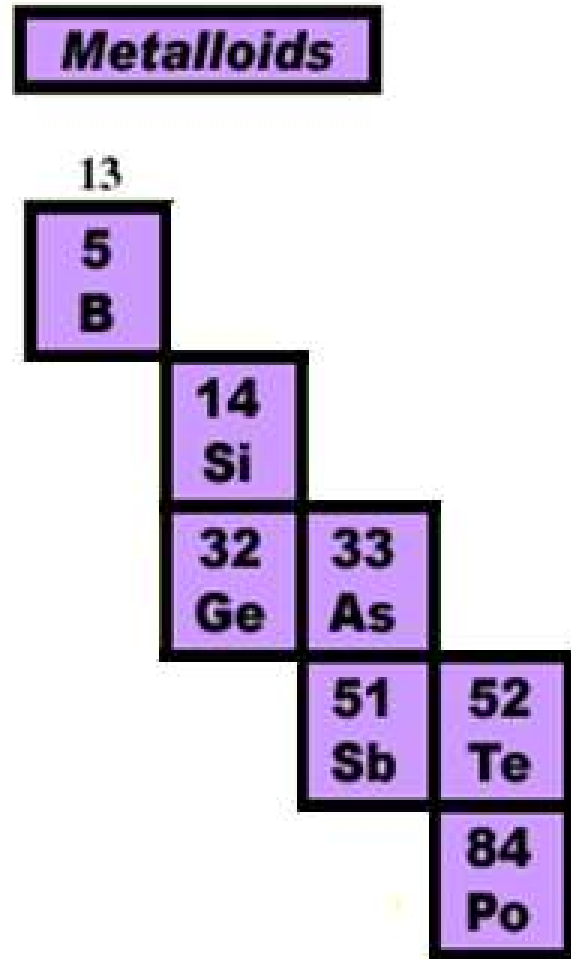
- Nonmetals are not shiny
- Nonmetals are mostly gaseous at room temperature
- Nonmetals are poor conductors
- Nonmetals are brittle and will shatter easily (not malleable or ductile)

Nonmetals				
	1			18
	1 H			2 He
14	15	16	17	10
6 C	7 N	8 O	9 F	Ne
	15 P	16 S	17 Cl	18 Ar
		34 Se	35 Br	36 Kr
			53 I	54 Xe
			85 At	86 Rn



Metalloids

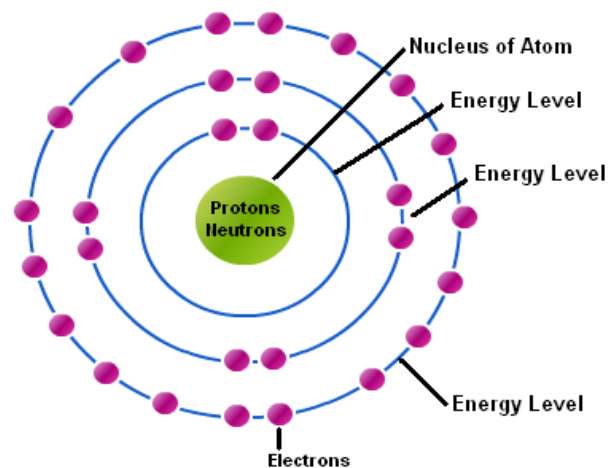
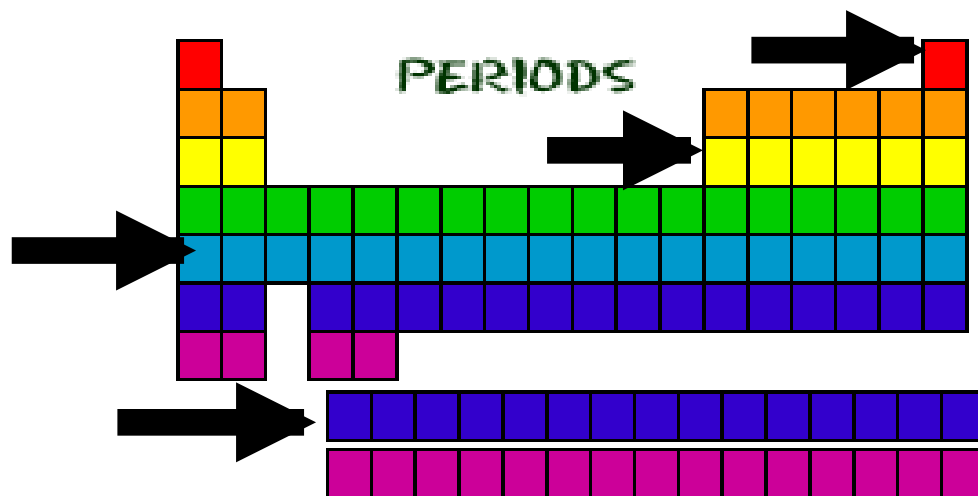
- Metalloids have characteristics between metals and nonmetals
- Metalloids are solid at room temperature
- Metalloids are semi-conductors





Periods

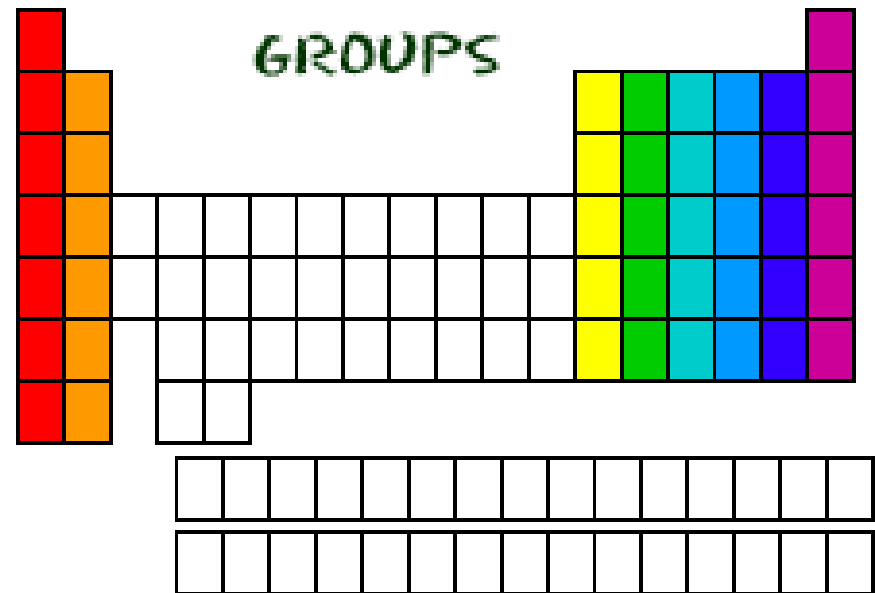
- Each horizontal row of the table is called a period
- Each row represents the number of energy levels present in an atom of the element





Groups (Families)

- The Columns are called Groups
- There are 18 groups
- The Elements in a group have the same number of electrons in their outer energy level
- Groups are often “grouped” together to form Families because of similar properties





Groups (Families)

You probably know a family with several members who look a lot alike.

The Elements in a group or family in the periodic table often-but not always-have similar properties.



use this for #12 on notes

1																	18
1 H	2											5 B	6 C	7 N	8 O	9 F	10 Ne
3 Li	4 Be											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
11 Na	12 Mg	3	4	5	6	7	8	9	10	11	12						
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	71 Lu	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	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub	113	114	115	116	117	118

Lanthanide series

Actinide series

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
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

Metals

Metalloids

Nonmetals



Complete #14 on your Notes

Periodic Table of the Elements

Groups →

Periods ↓

Periods	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
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
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
6	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
7	87 Fr	88 Ra	89 +Ac	104 Rf	105 Ha	106	107	108	109	110								

← groups

58	59	60	61	62	63	64	65	66	67	68	69	70	71	Lanthanides
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
90	91	92	93	94	95	96	97	98	99	100	101	102	103	Actinides
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	



Groups (Families)

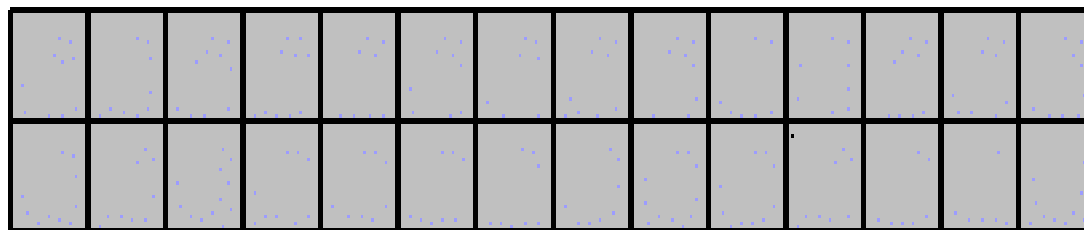
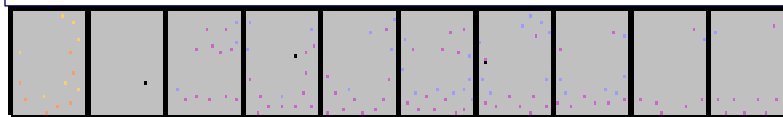
Although you are not expected to know the names of the similar “family (groups)”, here is a quick glance.
[Names vary depending on source]

Hydrogen

Periodic Table of the Elements

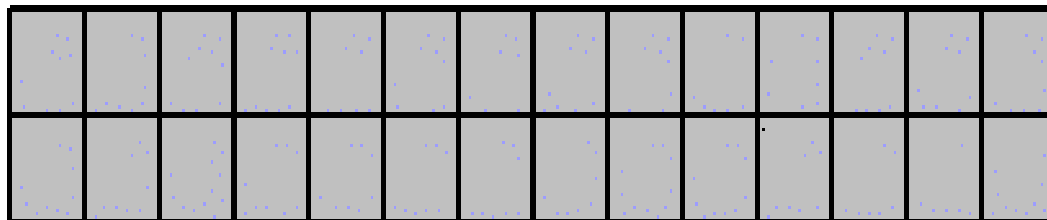
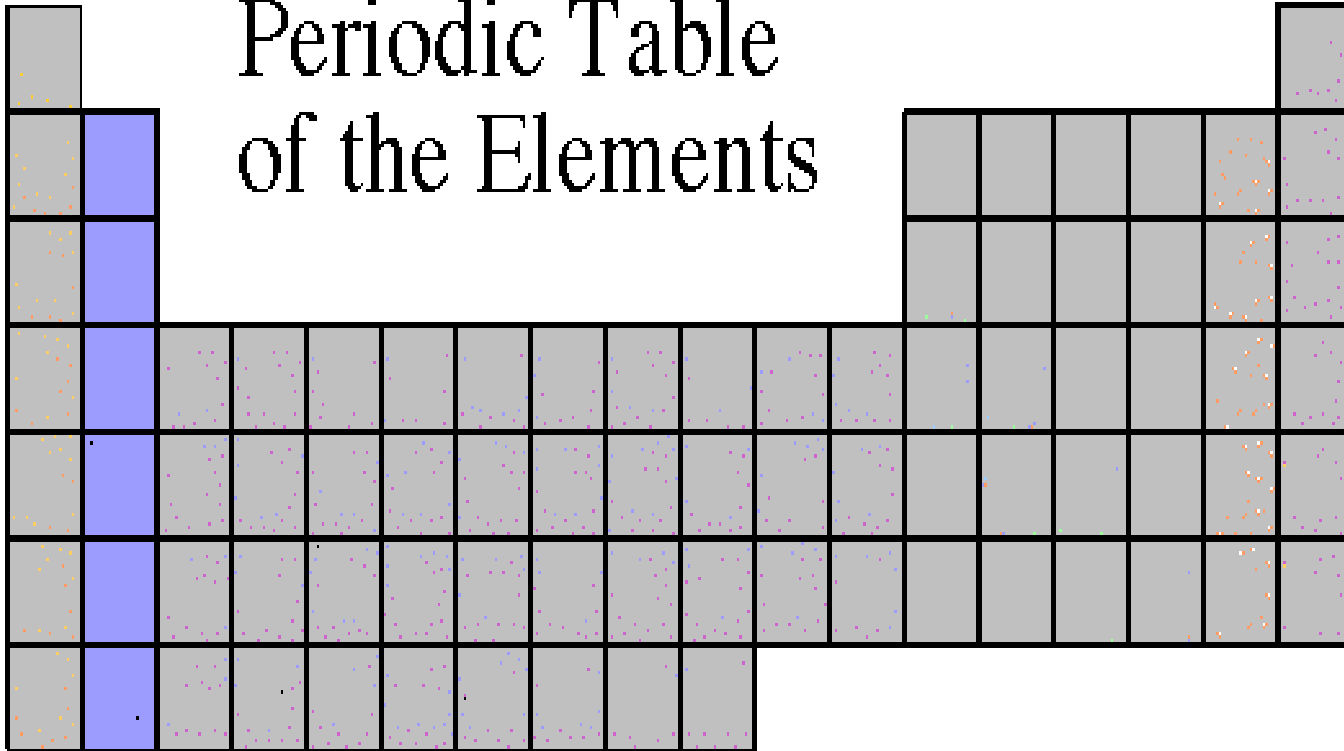


The properties of Hydrogen do not match the properties of any single group, so it is set apart. It is above Group 1 because it has 1 electron in its outer energy level like Group 1.



Alkaline-Earth Metals

Periodic Table
of the Elements



Transition Metals

Periodic Table
of the Elements

The diagram shows a periodic table with the following structure and color-coding:

- Row 1:** 1 grey cell.
- Row 2:** 2 orange cells, 10 grey cells, 2 purple cells.
- Row 3:** 2 orange cells, 10 grey cells, 2 purple cells.
- Row 4:** 2 orange cells, 10 blue cells, 10 grey cells, 2 purple cells.
- Row 5:** 2 orange cells, 10 blue cells, 10 grey cells, 2 purple cells.
- Row 6:** 2 orange cells, 10 blue cells, 10 grey cells, 2 purple cells.
- Row 7:** 2 orange cells, 8 blue cells, 10 grey cells, 2 purple cells.

A separate row of 14 grey cells, representing the lanthanide and actinide series.

Nitrogen Group

Periodic Table
of the Elements

A periodic table of elements where the Nitrogen Group (Group 15) is highlighted in green. The table is composed of gray cells with black borders. The highlighted cells are located in the 15th column, spanning rows 2 through 6. The other cells in the table contain small, scattered dots in various colors (orange, purple, blue).

A separate grid consisting of two rows and fourteen columns of gray cells with black borders. Each cell contains small, scattered blue dots.

Oxygen Group

Periodic Table
of the Elements

A periodic table of elements with the Oxygen Group highlighted in blue. The Oxygen Group consists of elements in Group 16, which includes Oxygen (O), Sulfur (S), Selenium (Se), Tellurium (Te), and Polonium (Po). The rest of the table is shown in gray with black borders. The table is arranged in 7 rows and 18 columns, with the first two rows having gaps at the beginning and end. The Oxygen Group is highlighted in blue in the 16th column.

A separate grid of 14 columns and 2 rows of gray cells, likely representing a simplified or abstract representation of a portion of the periodic table.

Noble Gases

Periodic Table
of the Elements

The image shows a schematic periodic table of elements. The noble gas column is highlighted in orange and consists of the following elements from top to bottom: Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (Xe), and Radon (Rn). The rest of the table is represented by grey cells with black outlines, indicating the positions of other elements.

A separate horizontal row of 14 grey cells, representing the lanthanide and actinide series, positioned below the main periodic table.

Rare Earth Elements

Periodic Table
of the Elements

A periodic table of elements with a grey background and scattered colored dots (orange, purple, blue) representing different element groups. The table is arranged in a standard periodic table layout with 7 rows and 18 columns. The first two columns are on the left, and the last two columns are on the right. The middle 14 columns are split into two groups of 7 columns each, with a gap between them. The dots are scattered across the table, with a higher concentration in the lower right quadrant.

A separate 2x14 grid of blue cells, likely representing the lanthanide and actinide series. The grid consists of two rows and 14 columns of blue cells, each containing a small cluster of colored dots (orange, purple, blue) similar to the main periodic table.



Let's Review the Basics of the Periodic Table

<http://studyjams.scholastic.com/studyjams/jams/science/matter/periodic-table.htm>



Reactivity of Elements

Atoms will often take, give, or share electrons with other atoms in order to have a complete set of electrons in their outer energy level.

Elements whose atoms undergo such processes are called Reactive and can combine to form compounds.

Since “Groups” [columns] are similar because they have the same number of electrons in their outer energy level, the Periodic Table is also organized by degree of reactivity.



Reactivity of Elements

In general, Elements located on the left of the Periodic Table are most reactive metals, least reactive metals in the middle, and least/nonreactive on the right.



Reactivity of Elements (#16 on notes)

High



Low

least

Unreactive

1																	18
1 H	2											13	14	15	16	17	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	3	4	5	6	7	8	9	10	11	12	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr											49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba											81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra											113	114	115	116	117	118
		103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub						

Lanthanide series

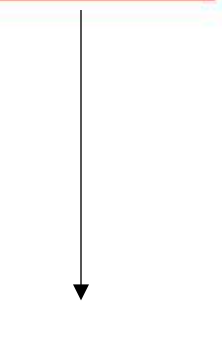
Actinide series

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
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

Metals

Metalloids

Nonmetals





- Complete #13 on notes
- Chose your own 3 colors
- Be sure to make a key!



- Next: “Getting to Know the Periodic Table”
- Students making a periodic table