

# Chapter 5 – The Periodic Table

**Periodic Table of the Elements**

1																	2		
1	H																	He	
2	3	4																	10
2	Li	Be																	Ne
3	11	12	13	14	15	16	17	18											18
3	Na	Mg	Al	Si	P	S	Cl	Ar											
4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
5	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
6	55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	
6	Cs	Ba	*La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
7	87	88	89	104	105	106	107	108	109	110									
7	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

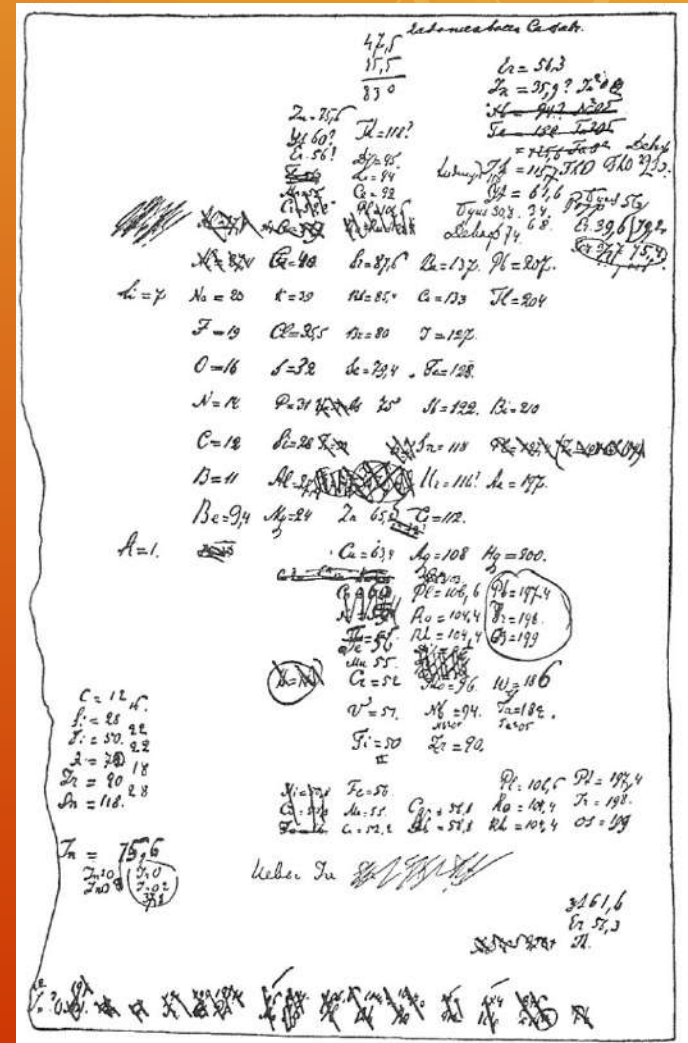
Jennie L. Borders

# Warm-Up Mar. 4

1. Who created the first useful periodic table?
2. What is a column on the periodic table called?
3. What is a valence electron?

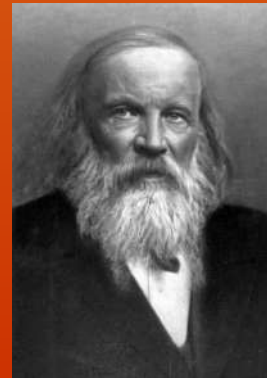
# Section 5.1 – Organizing the Elements

- A periodic table is an arrangement of elements in columns, based on a set of properties that repeat from row to row.
- Dmitri Mendeleev is credited with creating the first useful periodic table.
- Mendeleev arranged the elements into rows in order of increasing mass so that elements with similar properties were in the same column.



# Mendeleev's Periodic Table

- Mendeleev could not make a complete periodic table of the elements because many elements had not yet been discovered.
- He had to leave spaces in his table for those elements.
- He used the properties of elements located near the blank spaces in his table to predict properties for undiscovered elements.



# Mendeleev's Periodic Table

- The close matches between Mendeleev's predictions and the actual properties of new elements showed how useful his periodic table could be.

			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 = 106,6	Os = 199
H = 1			Cu = 63,4	Ag = 108	Hg = 200
	Be = 9,4	Mg = 24	Zn = 65,2	Cd = 112	
	B = 11	Al = 27,4	? = 68	Ur = 116	Au = 197?
	C = 12	Si = 28	? = 70	Sn = 118	
	N = 14	P = 31	As = 75	Sb = 122	Bi = 210?
	O = 16	S = 32	Se = 79,4	Te = 128?	
	F = 19	Cl = 35,5	Br = 80	J = 127	
Li = 7	Na = 23	K = 39	Rb = 85,4	Cs = 133	Tl = 204
		Ca = 40	Sr = 87,6	Ba = 137	Pb = 207
		? = 45	Ce = 92		
		?Er = 56	La = 94		
		?Yt = 60	Di = 95		
		?In = 75,6	Th = 118?		

## Section 5.1 Assessment

1. Describe how Mendeleev organized the elements into rows and columns in his periodic table.
2. How did the discovery of new elements such as gallium demonstrate the usefulness of Mendeleev's table?
3. Why did Mendeleev leave spaces in his table?
4. How was Mendeleev able to predict the properties of elements that had not yet been discovered?

# Section 5.2 – The Modern Periodic Table

- Mendeleev developed his periodic table before the discovery of protons.
- In the modern periodic table, elements are arranged by increasing atomic number (number of protons).

hydrogen 1 H 1.008																	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											aluminum 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 65.38	gallium 31 Ga 69.723	germanium 32 Ge 72.64	arsenic 33 As 74.922	selecnium 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 101.07	paladium 46 Pd 106.92	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	
cesium 55 Cs 132.91	barium 56 Ba 137.33	* 57-70	lanthanum 57 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	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]		
		* 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		
		* * 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]		

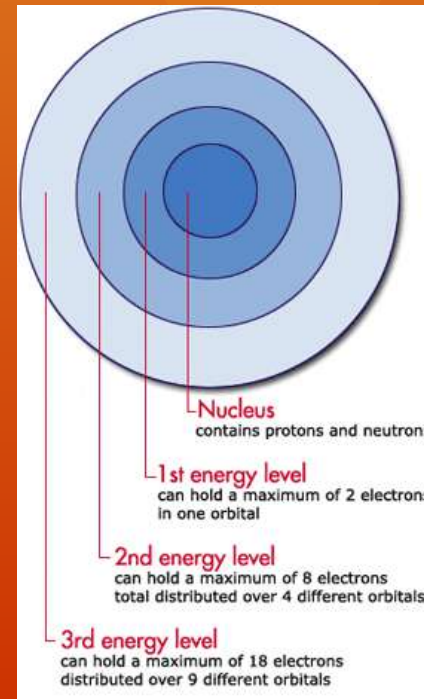


# Periods

- Each row in the table of elements is a period.
- The number of elements per period varies because the maximum number of electrons increases from energy level to energy level.

LONG FORM OF PERIODIC TABLE

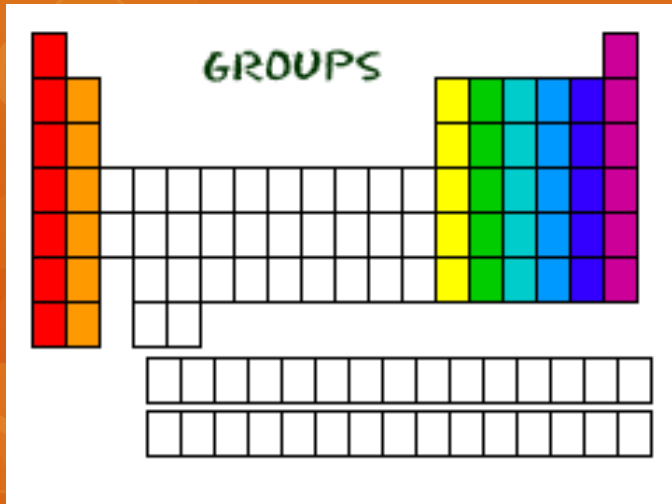
	Light Metals																Non-Metals						VIA or 0
Period 1	1											2	He										
	IA											IIA											
Period 2	3	4	Heavy Metals (Transition Metals)										5	6	7	8	9	10					
	Li	Be											B	C	N	O	F	Ne					
Period 3	11	12	VIIB										13	14	15	16	17	18					
	Na	Mg	IIIB	IVB	VB	VIB	VIIIB	IB			IIB	Al	Si	P	S	Cl	Ar						
Period 4	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					
Period 5	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					
Period 6	55	56	57 to 71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86					
	Cs	Ba	Lanthanide series	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn					
Period 7	87	88	89 to 103	104	105	106	107	108	109														
	Fr	Ra	Actinide series	Rf	Ha	Sg	Ns	Hs	Mt														
Lanthanide series	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71								
	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu								
Actinide series	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103								
	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr								





# Groups

- Each column on the periodic table is called a group.
- The elements within a group have similar properties.



s block		d block										p block																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																		
1A	2A	3B	4B	5B	6B	7B	8B	8B	8B	1B	2B	3A	4A	5A	6A	7A	8A																		
2s	3	4											1s	1																					
3s	11	12											2p	5	6	7	8	9	10																
4s	19	20	3d	21	22	23	24	25	26	27	28	29	30	4p	13	14	15	16	17	18															
5s	37	38	4d	39	40	41	42	43	44	45	46	47	48	5p	31	32	33	34	35	36															
6s	55	56	5d	71	72	73	74	75	76	77	78	79	80	6p	49	50	51	52	53	54															
7s	87	88	6d	103	104	105	106	107	108	109	110	111	112	7p	81	82	83	84	85	86															
																		f block																	
																		4f	57	58	59	60	61	62	63	64	65	66	67	68	69	70			
																		5f	89	90	91	92	93	94	95	96	97	98	99	100	101	102			

# Periodic Law

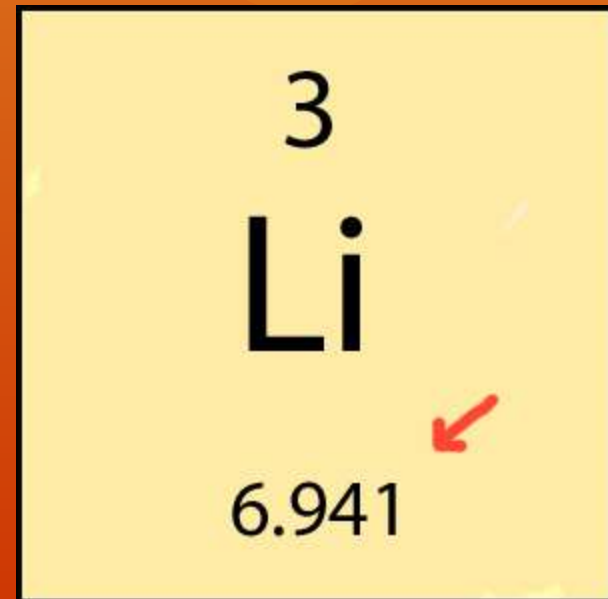
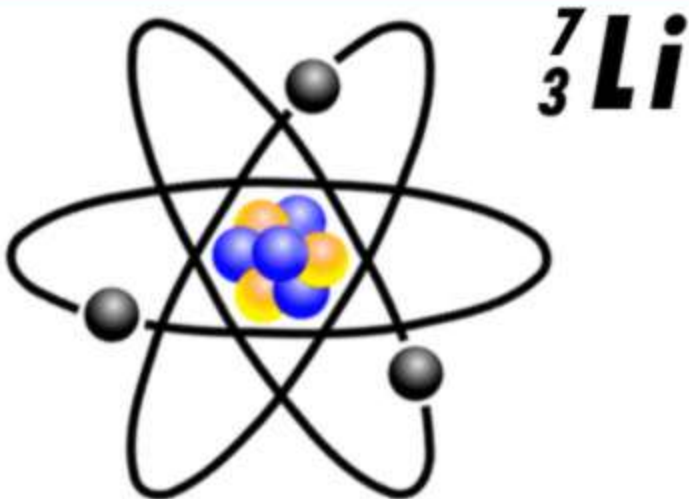
- The pattern of repeating properties across a period when the elements are arranged in order of increasing atomic number is called the periodic law.

The image shows a screenshot of a periodic table application. The table is color-coded by groups, with a legend at the top. The legend includes: hydrogen (white), alkali metals (yellow), alkaline earth metals (light green), transition metals (green), lanthanides (purple), actinides (blue), boron group (teal), carbon group (light blue), nitrogen group (orange), chalcogens (red), halogens (dark red), and noble gases (pink). The table displays elements from Hydrogen (H) to Oganesson (Og), with atomic numbers and symbols. The legend also includes buttons for 'View Options...' and 'Line Graph...'. The bottom of the image shows the lanthanide and actinide series.

Periodic Table																					
1																	18				
H 1.0079																	He 4.0026				
2																	10				
Li 6.941	Be 9.0122															B 10.811	C 12.011	N 14.007	O 15.999	F 18.998	Ne 20.18
3	4															5	6	7	8	9	10
Na 22.99	Mg 24.305															Al 26.982	Si 28.085	P 30.974	S 32.065	Cl 35.453	Ar 39.948
11	12															13	14	15	16	17	18
K 39.098	Ca 40.078	Sc 44.956	Ti 47.867	V 50.941	Cr 51.996	Mn 54.938	Fe 55.845	Co 58.933	Ni 58.693	Cu 63.546	Zn 65.409	Ga 69.723	Ge 72.64	As 74.922	Se 78.96	Br 79.904	Kr 81.798				
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36				
Rb 85.468	Sr 87.62	Y 88.906	Zr 91.224	Nb 92.906	Mo 95.94	Tc 98	Ru 101.07	Rh 102.91	Pd 106.42	Ag 107.87	Cd 112.41	In 114.82	Sn 118.71	Sb 121.76	Te 127.60	I 126.9	Xe 131.29				
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54				
Cs 132.91	Ba 137.33	La 138.91	Hf 178.49	Ta 180.95	W 183.84	Re 186.21	Os 190.23	Ir 192.22	Pt 195.08	Au 196.97	Hg 200.59	Tl 204.38	Pb 207.2	Bi 208.98	Po 209	At 210	Rn 222				
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86				
Fr 223	Ra 226	Ac 227	Rf 261	Db 262	Sg 266	Bh 264	Hs 277	Mt 268	Ds 271	Rg 272	Uub 277	Uut --	Uuq --	Uup --	Uuh --	Uus --	Uuo --				
87	88	89	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118				
Lanthanide and Actinide Series																					
Ce 140.12	Pr 140.91	Nd 144.24	Pm 145	Sm 150.36	Eu 151.96	Gd 157.25	Tb 158.93	Dy 162.5	Ho 164.93	Er 167.26	Tm 168.93	Yb 173.04	Lu 174.97								
58	59	60	61	62	63	64	65	66	67	68	69	70	71								
Th 232.04	Pa 231.04	U 238.03	Np 237.05	Pu 244	Am 243	Cm 247	Bk 247	Cf 251	Es 252	Fm 257	Md 258	No 259	Lr 262								
90	91	92	93	94	95	96	97	98	99	100	101	102	103								

# Mass Number vs. Atomic Mass

- Mass number is the number of protons and neutrons in the nucleus of an atom.
- Atomic mass is a value that depends on the distribution of an element's isotopes in nature and the masses of those isotopes.



# Classes of Elements

- Elements are classified as metals, nonmetals, and metalloids.

**Metals, Nonmetals, and Metalloids**

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
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	—	Uuq	—	—	—	—
		Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		
		Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		

**metals**

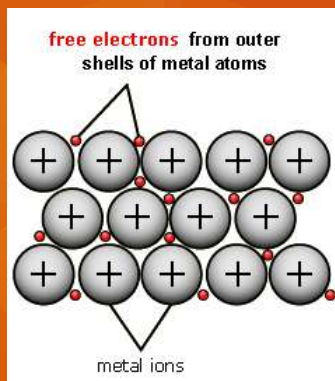
**metalloids**

**nonmetals**



# Metals

- The majority of the elements on the periodic table are classified as metals.
- Metals are elements that are good conductors of electric current and heat.
- Most metals are solid at room temperature except mercury.
- Most metals are malleable and ductile (they can be drawn into wires).



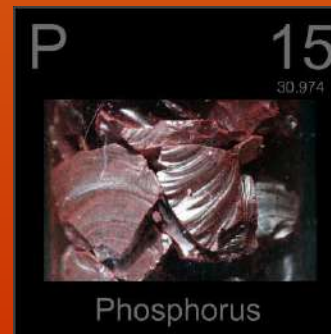
# Transition Metals

- Metals in groups 3 through 12 are called transition metals.
- Transition metals are elements that form a bridge between the elements on the left and right sides of the periodic table.
- One property of transition metals is their ability to form compounds with distinctive colors.



# Nonmetals

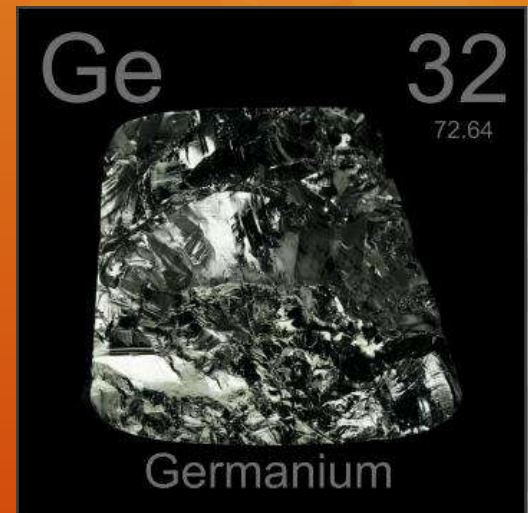
- Nonmetals are elements that are poor conductors of heat and electric current.
- Because nonmetals have low boiling points, many nonmetals are gases at room temperature.
- The nonmetals that are solids at room temperature tend to be brittle.
- Nonmetals vary in their chemical and physical properties.





# Metalloids

- Metalloids are elements with properties that fall between those of metals and nonmetals.



# Variation Across a Period

- Across a period from left to right, the elements become less metallic and more nonmetallic in their properties.



## Section 5.2 Assessment

1. What determines the order of the elements in the modern periodic table?
2. Describe the periodic law.
3. What two factors determine the atomic mass of an element?
4. Name three categories that are used to classify the elements in the periodic table.

## Section 5.2 Assessment

5. What major change occurs as you move from left to right across the periodic table?
6. The atomic mass of iodine (I) is less than the atomic mass of tellurium (Te). But an iodine atom has one more proton than a tellurium atom. Explain how this situation is possible.
7. Explain how you know that no new element with an atomic number of less than 100 will be discovered.

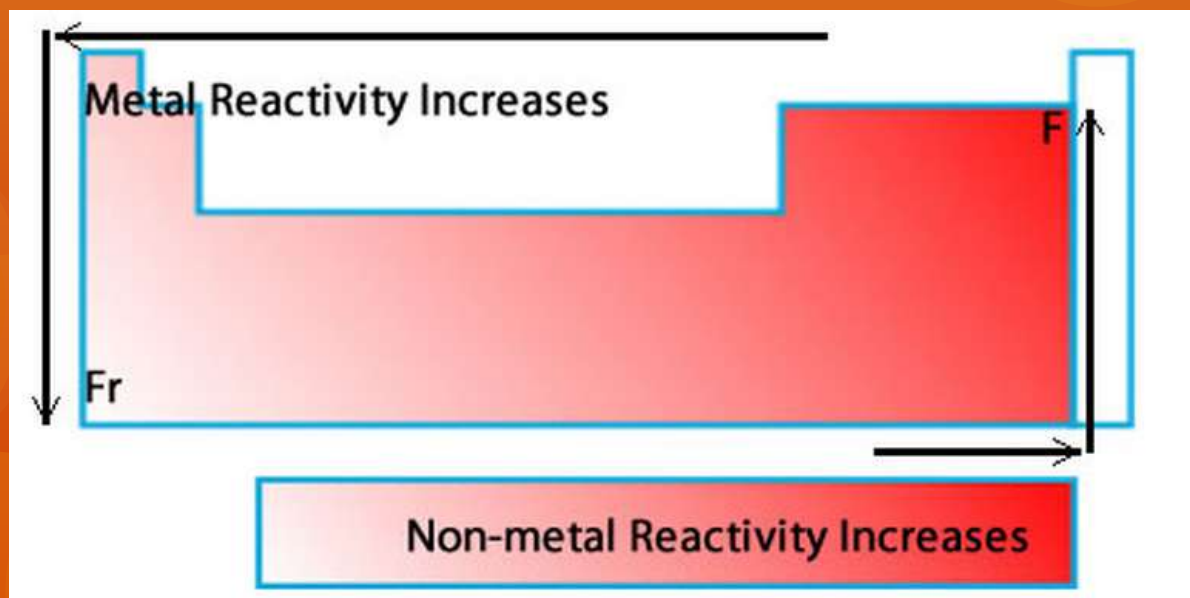
# Warm-Up Mar. 5

1. How did Mendeleev arrange his periodic table?
2. Name one element that would have properties similar to chlorine (Cl).
3. What does the periodic law state?



# Reactivity and the Periodic Table

- Reactivity increases to the left in a row across the metals and increases down in a group of the metals.
- Reactivity increases to the right in a row across the nonmetals (except the noble gases are unreactive) and decreases down a group in the nonmetals.





## Section 5.3 Assessment

1. Explain why elements in a group have similar properties.
2. What is the most reactive metal in group 2?
3. What is the most reactive nonmetal in period 3?

- Alkali Metal
- Alkaline earth metal
- Lanthanide
- Actinide
- Transition Metal
- Other Metals
- Metalloids
- Non Metals
- Halogen
- Noble Gas

1	1	IA											18	VIIA																																								
1	H	1.0079											2	He	4.0026																																							
2	3	Li	6.941	4	Be	9.0122											10	Ne	20.180																																			
3	11	Na	22.990	12	Mg	24.305											16	Ar	39.948																																			
4	19	K	39.098	20	Ca	40.078	21	Sc	44.956	22	Ti	47.887	23	V	50.942	24	Cr	51.996	25	Mn	54.938	26	Fe	55.845	27	Co	58.933	28	Ni	58.693	29	Cu	63.546	30	Zn	65.38	31	Ga	69.723	32	Ge	72.64	33	As	74.922	34	Se	78.96	35	Br	79.904	36	Kr	83.798
5	37	Rb	85.468	38	Sr	87.62	39	Y	88.906	40	Zr	91.224	41	Nb	92.906	42	Mo	95.96	43	Te	98.00	44	Ru	101.07	45	Rh	102.91	46	Pd	106.42	47	Ag	107.87	48	Cd	112.41	49	In	114.82	50	Sn	118.71	51	Sb	121.76	52	Te	127.60	53	I	126.90	54	Xe	131.29
6	55	Cs	132.91	56	Ba	137.33		72	Hf	178.49	73	Ta	180.95	74	W	183.84	75	Re	186.21	76	Os	190.23	77	Ir	192.22	78	Pt	195.08	79	Au	196.97	80	Hg	200.59	81	Tl	204.38	82	Pb	207.2	83	Bi	208.98	84	Po	209	85	At	210	86	Rn	222		
7	87	Fr	223	88	Ra	226		104	Rf	261	105	Db	268	106	Sg	271	107	Bh	272	108	Hs	277	109	Mt	278	110	Ds	281	111	Rg	280	112	Cn	285	113	Uut	—	114	F1	287	115	Uup	—	116	Lv	291	117	Uus	—	118	Uuo	—		

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
138.91	140.12	140.91	144.24	145	150.36	151.96	157.25	158.93	162.50	164.93	167.26	168.93	173.05	174.97
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
227	232.04	231.04	238.03	237	244	243	247	247	251	252	257	258	259	262