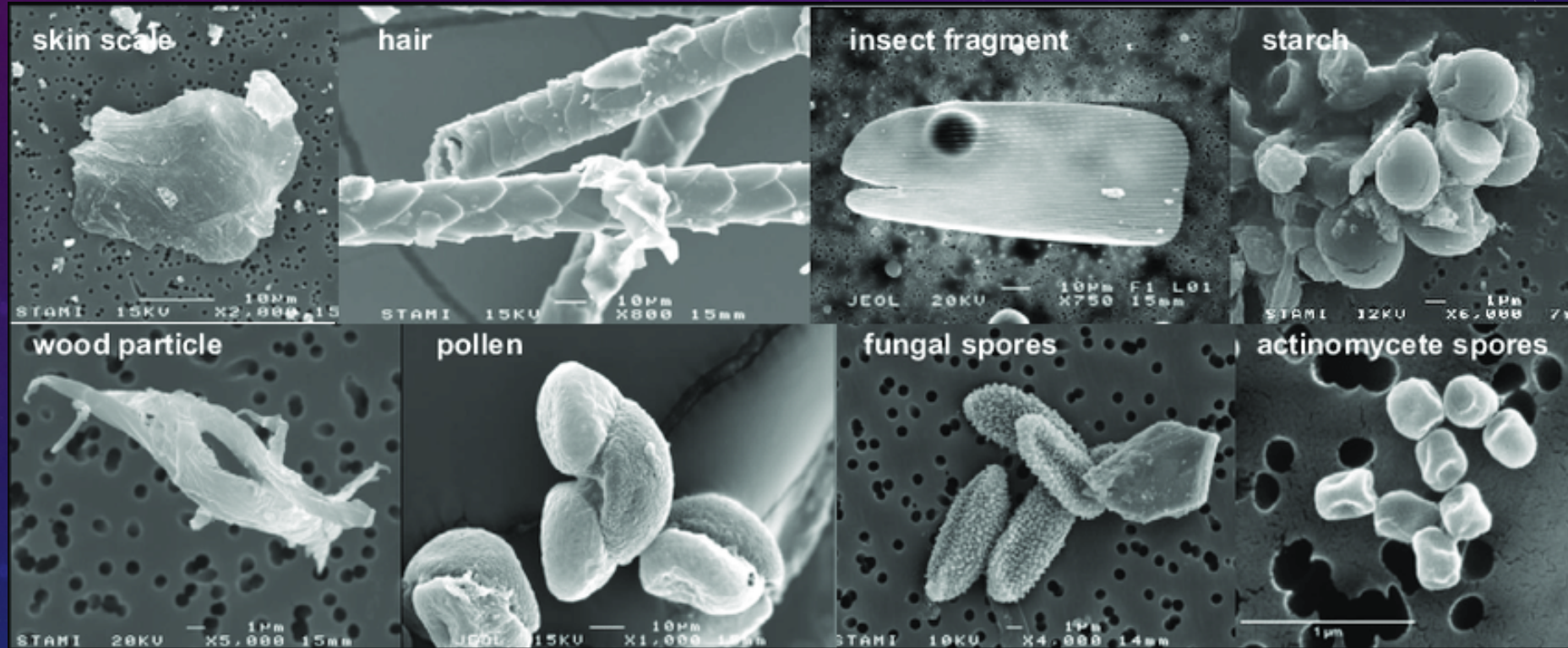


# MICROSCOPIC DUST PARTICLES



HOW MANY CARBON ATOMS MAKE UP THE WIDTH OF A SINGLE HUMAN HAIR?

- 1) 5,000
- 2) 50,000
- 3) 500,000
- 4) 5,000,000

# HOW MANY CARBON ATOMS MAKE UP THE WIDTH OF A SINGLE HUMAN HAIR?

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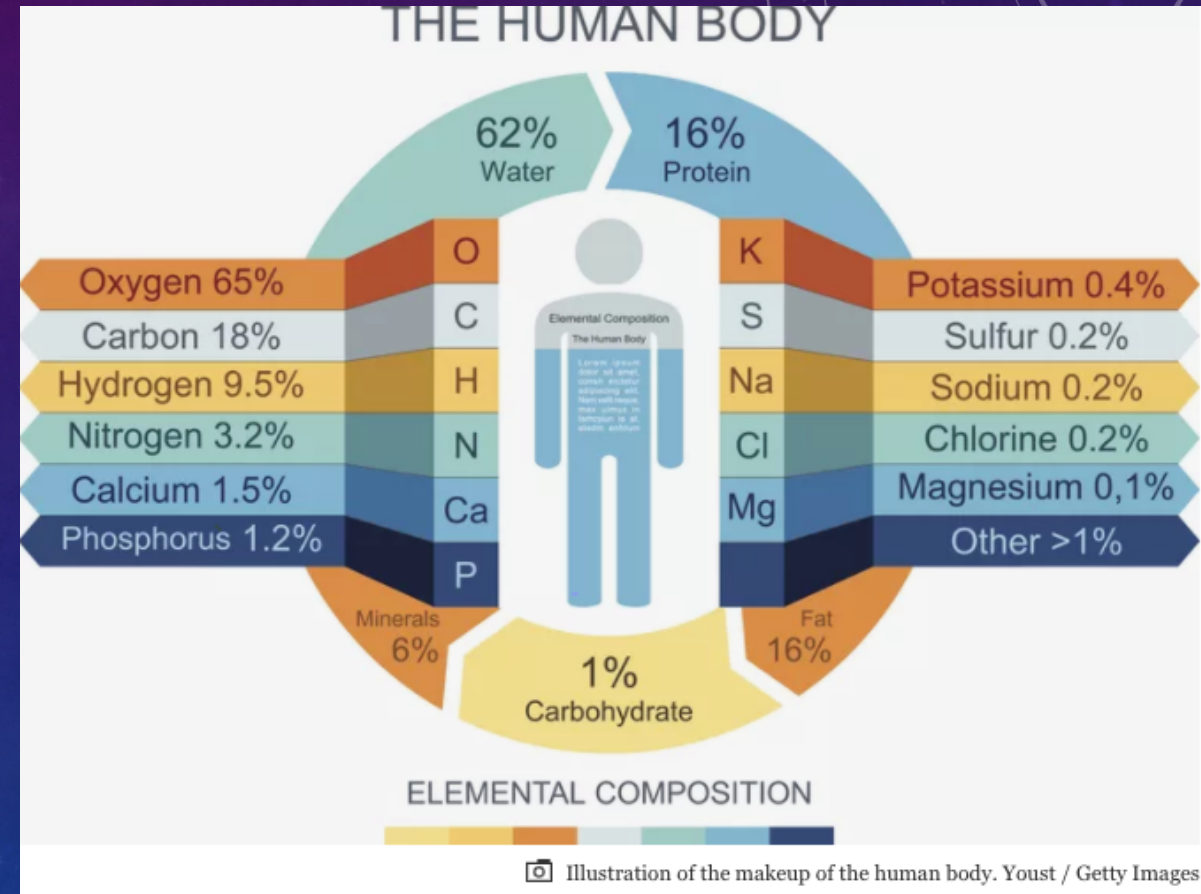
# CHEMISTRY II

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1. ELEMENTS
2. PERIODIC TABLE
3. PROPERTIES OF ELEMENTS

# ELEMENTS

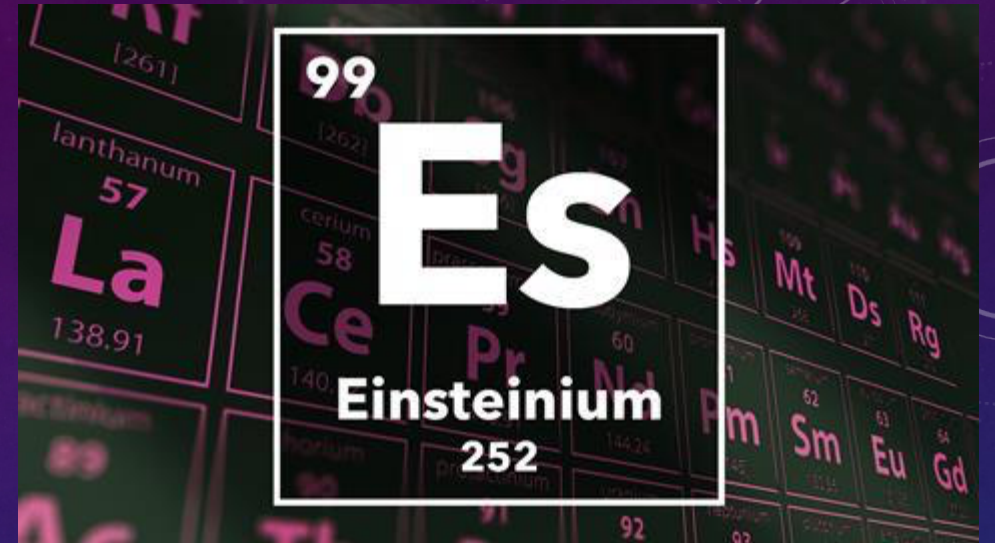
- The basic building blocks of matter
- Made up of one type of atom (cannot be broken down further)
- About 90 elements occur naturally (carbon, silver, oxygen)
- Some elements are synthesized in labs
- Have varying properties



# ELEMENTS

Each element has a

- **Chemical name**
  - Based on Latin words, countries, names of famous scientists
- **Chemical symbol**
  - One or two letters (first letter is capitalized)
  - Synthetic or unnamed elements have placeholder names or three-letter symbols



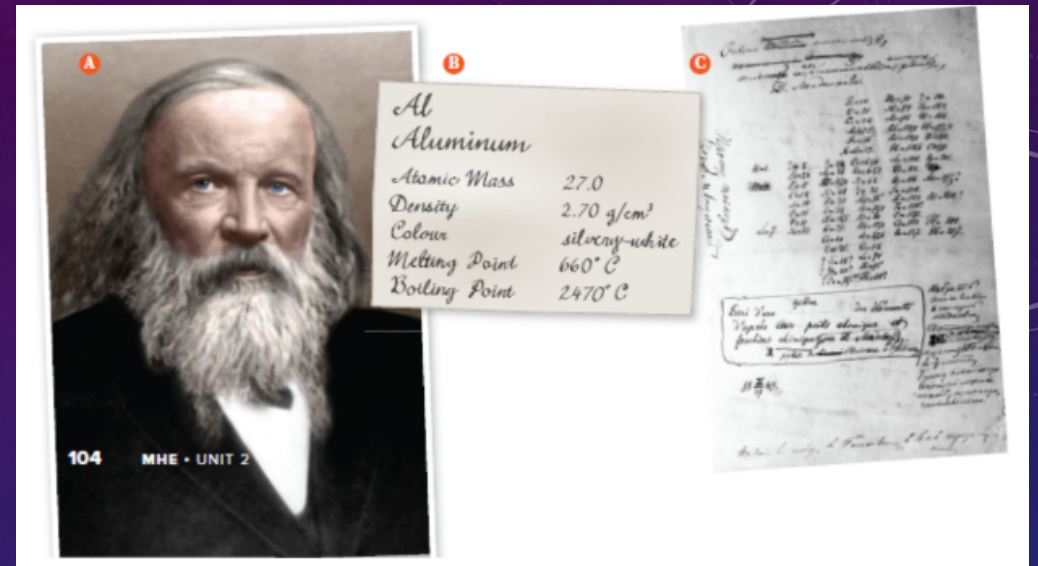
# MENDELEEV'S PERIODIC TABLE

**Video:** [https://www.youtube.com/watch?v=fPnwBITSmgU&ab\\_channel=TED-Ed](https://www.youtube.com/watch?v=fPnwBITSmgU&ab_channel=TED-Ed)

# MENDELEEV'S PERIODIC TABLE

1860s: Dmitri Mendeleev

- Looked at different ways to organize the elements
- Wrote properties of elements on cards so that he could rearrange them and compare properties (“chemical solitaire”)
- Properties included atomic mass (average mass of an atom of an element), density, and melting point.

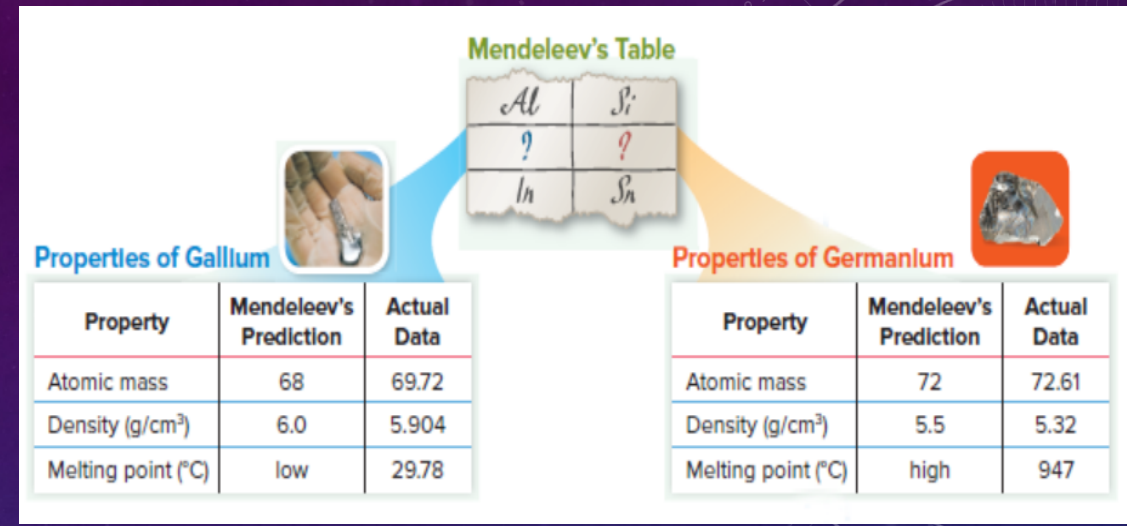




# MENDELEEV'S PERIODIC TABLE

Mendeleev's periodic table:

- Ordered the elements by increasing atomic mass.
- Grouped elements into "families" based on similar properties (density, melting point)
- Left gaps in his periodic table to predict the existence of elements not yet found yet
  - These missing elements would have properties similar to other elements in the same families.



# MENDELEEV'S PERIODIC TABLE

Mendeleev's periodic table was ordered by increasing atomic mass:

- Did not work perfectly – some elements were out of order so they would fit in a family that had similar properties

Mendeleev's Periodic Table

Series	Group I	Group II	Group III	Group IV	Group V	Group VI	Group VII	Group VIII
1	H=1							
2	Li=7	Be=9.1	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24.4	Al=27	Si=28	P=31	S=32	Cl=35.5	
4	K=39.1	Ca=40	--=44	Ti=48.1	V=51.2	Cr=52.3	Mn=55	{ Fe=56, Ni=58.5, Co 59.1, Cu 63.3.
5	(Cu)=63.3	Zn=65.4	--=68	--=72	As=75	Se=79	Br=80	
6	Rb=85.4	Sr=87.5	Y=89	Zr=90.7	Nb=94.2	Mo=95.9	--=100	{ Rh=103, Ru=103.8, Pd=106, Ag=107.9.
7	[Ag]=107.9	Cd=112	In=113.7	Sn=119	Sb=120.3	Te=125.2	I=126.9	
8	Cs=132.9	Ba=137	La=138.5	Ce=141.5	Di=145	--	--	-- -- --
9	(--)	--	--	--	--	--	--	
10	--	--	Yb=173.2	--	Ta=182.8	W=184	--	{ Ir=193.1, Pt=194.8, Os=200, Au=196.7.
11	[Au]=196.7	Hg=200.4	Tl=204.1	Pb=208.9	Bi=208	--	--	
12	--	--	--	Tb=203.4	--	U=239	--	-- -- --

# MODERN PERIODIC TABLE

Modern periodic table is ordered by increasing atomic number.

- Henry Moseley: scientist that determined an element's atomic number (the number of protons in an atom)
- When elements are arranged according to increasing atomic number, the elements fit perfectly and do not require re-ordering

## The Blindingly Brilliant but Heartbreakingly Short Career of Henry Moseley

Moseley discovered atomic numbers at the age of 26 and was dead at 27.



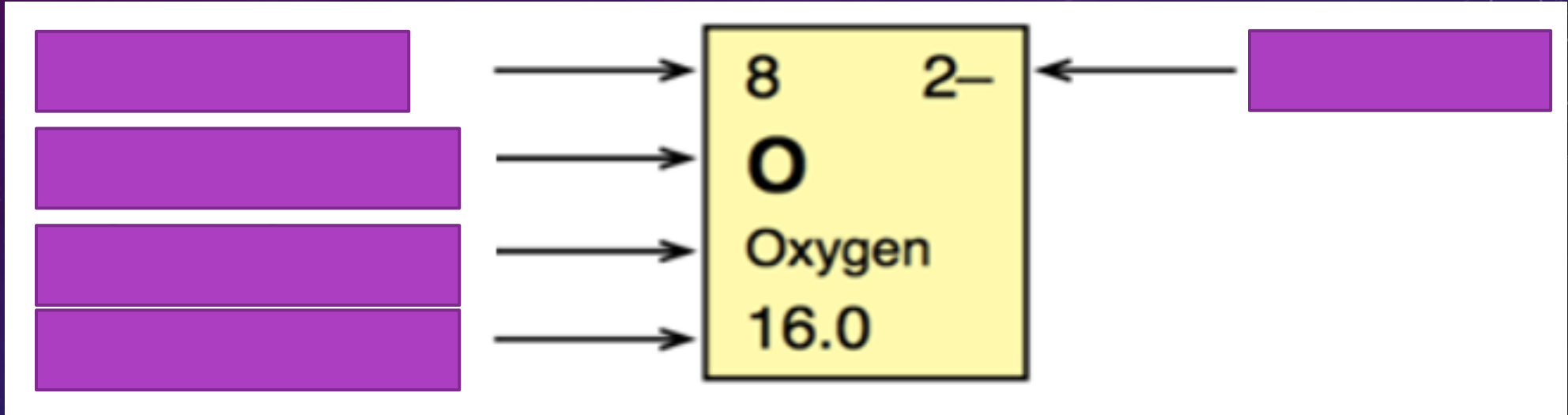
Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Period 1	1 H																	2 He
Period 2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
Period 3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
Period 4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	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	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
Period 7	87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og
				* 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	
				* 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	

<https://interestingengineering.com/the-blindingly-brilliant-but-heartbreakingly-short-career-of-henry-moseley>

# MODERN PERIODIC TABLE

Video:

[https://www.youtube.com/watch?v=rz4Dd1I\\_fX0&ab\\_channel=AsapSCIENCE](https://www.youtube.com/watch?v=rz4Dd1I_fX0&ab_channel=AsapSCIENCE)



# MODERN PERIODIC TABLE

We can use the information from the periodic table in order to find information about subatomic particles.

Name	Charge	Location	To find the number of particles for each elements, look at the...
<b>Proton</b>	<u>Positive</u>	<u>Nucleus</u>	<u>Atomic number</u>
<b>Neutron</b>	<u>Neutral</u>	<u>Nucleus</u>	<u>Atomic mass – atomic number</u>
<b>Electron</b>	<u>Negative</u>	<u>Electron shells/rings</u>	<u>Atomic number</u>

# METALS

On the periodic table, there are three categories shown on the periodic table:

## Metal:

- Shiny and hard (typically)
- Malleable and ductile
- Conducts electricity and heat
- Found to the left of the zigzag line on the periodic table

Periodic Table of the Elements

Periodic Table of the Elements																											
1																	18										
1 H Hydrogen 1.0																	2 He Helium 4.0										
3 Li Lithium 6.9	4 Be Beryllium 9.0											5 B Boron 10.8	6 C Carbon 12.0	7 N Nitrogen 14.0	8 O Oxygen 16.0	9 F Fluorine 19.0	10 Ne Neon 20.2										
11 Na Sodium 23.0	12 Mg Magnesium 24.3											13 Al Aluminum 27.0	14 Si Silicon 28.1	15 P Phosphorus 31.0	16 S Sulfur 32.1	17 Cl Chlorine 35.5	18 Ar Argon 39.9										
19 K Potassium 39.1	20 Ca Calcium 40.1	21 Sc Scandium 45.0	22 Ti Titanium 47.9	23 V Vanadium 50.9	24 Cr Chromium 52.0	25 Mn Manganese 54.9	26 Fe Iron 55.8	27 Co Cobalt 58.9	28 Ni Nickel 58.7	29 Cu Copper 63.5	30 Zn Zinc 65.4	31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0	35 Br Bromine 79.9	36 Kr Krypton 83.8										
37 Rb Rubidium 85.5	38 Sr Strontium 87.6	39 Y Yttrium 88.9	40 Zr Zirconium 91.2	41 Nb Niobium 92.9	42 Mo Molybdenum 95.9	43 Tc Technetium (98)	44 Ru Ruthenium 101.1	45 Rh Rhodium 101.1	46 Pd Palladium 106.4	47 Ag Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.8	52 Te Tellurium 127.6	53 I Iodine 126.9	54 Xe Xenon 131.3										
55 Cs Cesium 132.9	56 Ba Barium 137.3	57 La Lanthanum 138.9	72 Hf Hafnium 178.5	73 Ta Tantalum 180.9	74 W Tungsten 183.8	75 Re Rhenium 186.2	76 Os Osmium 190.2	77 Ir Iridium 192.2	78 Pt Platinum 195.1	79 Au Gold 197.0	80 Hg Mercury 200.6	81 Tl Thallium 204.4	82 Pb Lead 207.2	83 Bi Bismuth 208.0	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)										
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (268)	106 Sg Seaborgium (266)	107 Bh Bohrium (270)	108 Hs Hassium (285)	109 Mt Meitnerium (278)	110 Ds Darmstadtium (281)	111 Rg Roentgenium (286)	112 Cn Copernicium (285)	113 Nh Nihonium (286)	114 Fl Flerovium (289)	115 Mc Moscovium (288)	116 Lv Livermorium (293)	117 Ts Tennessine (294)	118 Og Oganesson (294)										
Based on mass of C-12 at 12.00.																											
Any value in parentheses is the mass of the most stable or best known isotope for elements that do not occur naturally.																											
58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Nd Neodymium 144.2	61 Pm Promethium (145)	62 Sm Samarium 150.4	63 Eu Europium 152.0	64 Gd Gadolinium 157.3	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Holmium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Ytterbium 173.0	71 Lu Lutetium 175.0	90 Th Thorium 232.0	91 Pa Protactinium 231.0	92 U Uranium 238.0	93 Np Neptunium (237)	94 Pu Plutonium (244)	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 (288)	102 No Nobelium (289)	103 Lr Lawrencium (262)

# NON-METALS

## Non-metal:

- Not shiny, malleable, or ductile
- Poor conductor of electricity and heat
- Found to the right of the zigzag line on the periodic table
- Generally gases or brittle, dull solids.

Periodic Table of the Elements

Legend:

- metal (blue)
- semi-metal (green)
- non-metal (yellow)
- natural
- Db synthetic

Callout for Titanium (Ti):

- Atomic Number: 22
- Symbol: Ti
- Name: Titanium
- Atomic Mass: 47.88
- Ion charge(s): 3+

Callout for Rutherfordium (Rf):

- Atomic Number: 104
- Symbol: Rf
- Name: Rutherfordium
- Atomic Mass: 261

Based on mass of C-12 at 12.00.

Any value in parentheses is the mass of the most stable or best known isotope for elements that do not occur naturally.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H Hydrogen 1.0																	2 He Helium 4.0
3 Li Lithium 6.9	4 Be Beryllium 9.0											5 B Boron 10.8	6 C Carbon 12.0	7 N Nitrogen 14.0	8 O Oxygen 16.0	9 F Fluorine 18.0	10 Ne Neon 20.2
11 Na Sodium 23.0	12 Mg Magnesium 24.3											13 Al Aluminum 27.0	14 Si Silicon 28.1	15 P Phosphorus 31.0	16 S Sulfur 32.1	17 Cl Chlorine 35.5	18 Ar Argon 39.9
19 K Potassium 39.1	20 Ca Calcium 40.1	21 Sc Scandium 45.0	22 Ti Titanium 47.9	23 V Vanadium 50.9	24 Cr Chromium 52.0	25 Mn Manganese 54.9	26 Fe Iron 55.8	27 Co Cobalt 58.9	28 Ni Nickel 58.7	29 Cu Copper 63.5	30 Zn Zinc 65.4	31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0	35 Br Bromine 79.9	36 Kr Krypton 83.8
37 Rb Rubidium 85.5	38 Sr Strontium 87.6	39 Y Yttrium 88.9	40 Zr Zirconium 91.2	41 Nb Niobium 92.9	42 Mo Molybdenum 95.9	43 Tc Technetium (98)	44 Ru Ruthenium 101.1	45 Rh Rhodium 101.1	46 Pd Palladium 106.4	47 Ag Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.8	52 Te Tellurium 127.6	53 I Iodine 126.9	54 Xe Xenon 131.3
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87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (266)	106 Sg Seaborgium (269)	107 Bh Bohrium (270)	108 Hs Hassium (269)	109 Mt Meitnerium (278)	110 Ds Darmstadtium (281)	111 Rg Roentgenium (280)	112 Cn Copernicium (285)	113 Nh Nihonium (286)	114 Fl Flerovium (289)	115 Mc Moscovium (289)	116 Lv Livermorium (293)	117 Ts Tennessine (294)	118 Og Oganesson (294)
58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Nd Neodymium 144.2	61 Pm Promethium (145)	62 Sm Samarium 150.4	63 Eu Europium 152.0	64 Gd Gadolinium 157.3	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Holmium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Ytterbium 173.0	71 Lu Lutetium 175.0				
80 Th Thorium 232.0	81 Pa Protactinium 231.0	82 U Uranium 238.0	83 Np Neptunium (237)	84 Pu Plutonium (244)	85 Am Americium (243)	86 Cm Curium (247)	87 Bk Berkelium (247)	88 Cf Californium (251)	89 Es Einsteinium (252)	90 Fm Fermium (257)	91 Md Mendelevium (258)	92 No Nobelium (259)	93 Lr Lawrencium (262)				



Periodic Table of the Elements

Legend:

- metal (blue)
- semi-metal (green)
- non-metal (yellow)
- O natural
- Db synthetic

Key:

- Atomic Number
- Symbol
- Name
- Atomic Mass
- Ion charge(s)

Based on mass of C-12 at 12.00.

Any value in parentheses is the mass of the most stable or best known isotope for elements that do not occur naturally.

# SEMI-METALS (METALLOIDS)

## Semi-metals (Metalloids):

- Have physical and chemical properties of both metals and non-metals
  - Shiny (like metals)
  - Brittle and *not* ductile (like non-metals)
  - Poor conductors of heat and electricity (like non-metals)

# MODERN PERIODIC TABLE

The modern periodic table can also be organized into:

- **Groups (Family) (1-18)**: A vertical column of elements



- **Periods (1-7)**: A horizontal row of elements





# ALKALINE EARTH METALS (GROUP 2)

- Shiny and soft (but not as soft as alkali metals)
- Highly reactive (but not as reactive as alkali metals)

Alkaline earth metals

Hydrogen 1 H 1.01	Helium 2 He 4.00	Lithium 3 Li 6.94	Beryllium 4 Be 9.01	Boron 5 B 10.81	Carbon 6 C 12.01	Nitrogen 7 N 14.01	Oxygen 8 O 16.00	Fluorine 9 F 18.99	Neon 10 Ne 20.18
Sodium 11 Na 22.99	Magnesium 12 Mg 24.31	Aluminum 13 Al 26.98	Silicon 14 Si 28.09	Phosphorus 15 P 30.97	Sulfur 16 S 32.07	Chlorine 17 Cl 35.45	Argon 18 Ar 39.95	Potassium 19 K 39.10	Calcium 20 Ca 40.08
Rubidium 37 Rb 85.47	Strontium 38 Sr 87.62	Yttrium 39 Y 88.91	Zirconium 40 Zr 91.22	Niobium 41 Nb 92.91	Molybdenum 42 Mo 95.94	Technetium 43 Tc [98]	Ruthenium 44 Ru 101.07	Rhodium 45 Rh 102.91	Palladium 46 Pd 106.42
Cesium 55 Cs 132.91	Barium 56 Ba 137.33	Lanthanum 57 La* 138.91	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 223.22	Platinum 78 Pt 223.02
Francium 87 Fr [223]	Radium 88 Ra [226]	Actinium 89 Ac~ [227]	Rutherfordium 104 Rf [261]	Dubnium 105 Db [262]	Seaborgium 106 Sg [266]	Bhassium 107 Bh [264]	Hassium 108 Hs [277]	Moscovium 109 Mc [288]	Livermorium 110 Lv [293]
Lanthanide and Actinide Series									
Cerium 58 Ce 140.12	Praseodymium 59 Pr 140.90	Niodymium 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 Tm 158.93	Dysprosium 66 Dy 162.50	Homium 67 Ho 164.93
Thorium 90 Th 232.04	Protactinium 91 Pa 231.04	Uranium 92 U 238.03	Nepthulium 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]

Video:

[https://www.youtube.com/watch?v=O6DaCYKh77E&ab\\_channel=DavidRead](https://www.youtube.com/watch?v=O6DaCYKh77E&ab_channel=DavidRead)

# HALOGENS (GROUP 17)

Periodic table highlighting the Halogen family (Group 17) in red. The elements in this group are Fluorine (F), Chlorine (Cl), Bromine (Br), Iodine (I), and Astatine (At). An arrow points from the label 'Halogen family' to this group.

1	2	13	14	15	16	17	18												
H	He	B	C	N	O	F	Ne												
Li	Be	Al	Si	P	S	Cl	Ar												
Na	Mg	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	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn			
Fr	Ra	Rf	Db	Sg	Bh	Hs	Mt												
La Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb Lu																			
Ac Th Pa U Np Pu Am Cm Bk Cf Es Fm Md No Lr																			

- Highly reactive (therefore usually found in nature as part of compounds)

Video:

[https://www.youtube.com/watch?v=u2ogMUDBaf4&ab\\_channel=OpenLearnfromTheOpenUniversity](https://www.youtube.com/watch?v=u2ogMUDBaf4&ab_channel=OpenLearnfromTheOpenUniversity)



# ADOPT AN ELEMENT!

1. Using the attached fact sheet, complete the handout for your given element
2. Using the card stock given, create a fun advertisement for your element! Include:
  - Element name, symbol, atomic mass, ion charge(s)
  - A catchy, fun slogan
  - Cost to “buy” your element
  - Relevant diagrams/pictures

Due: Thursday, Feb. 17