

Classification And Interactions Of Matter



Auburn Mountainview

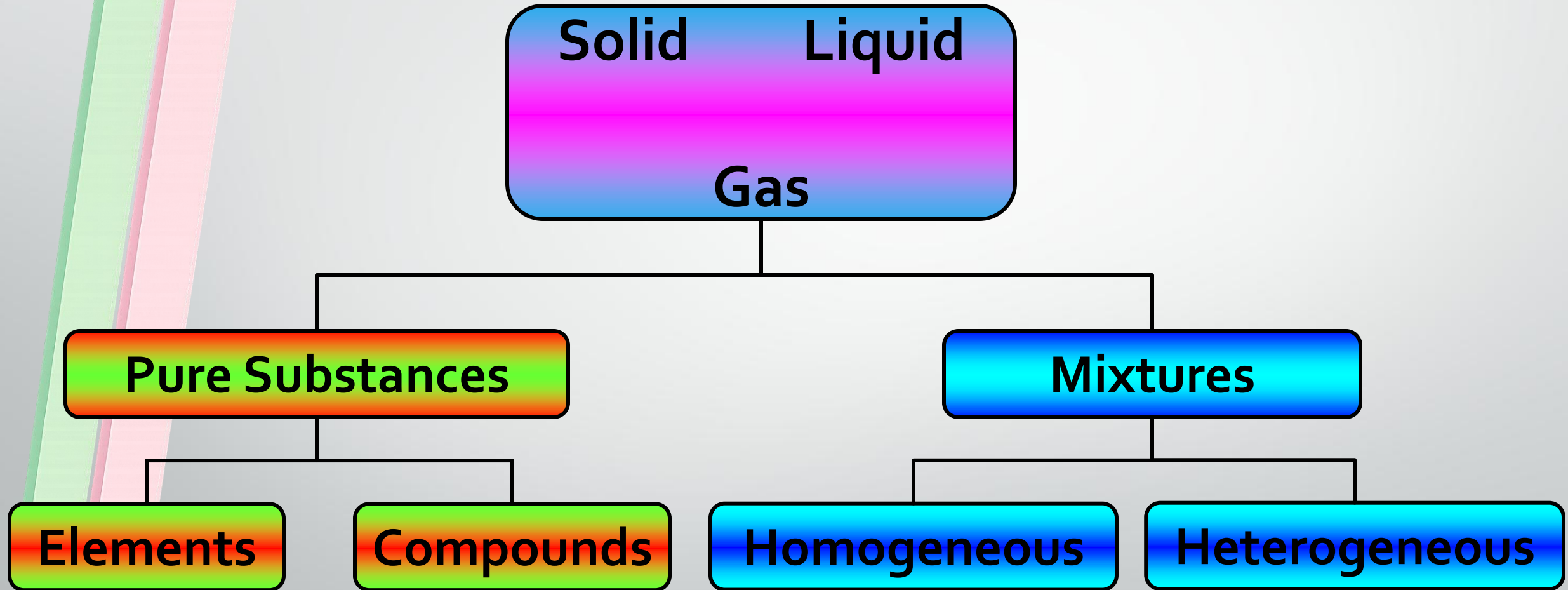
Karl Steffin, 2001

7/29/2026

By end of this unit I can...

- **A.1 Distinguish between atoms, molecules, and compounds at the particle level.**
- **A.2 Create and/or evaluate models of pure substances.**
- **B.1 Create and/or evaluate models of mixtures.**
- **B.2 Interpret the results of an experiment involving the separation of a mixture.**
- **C.1 Relate the total and partial pressure of a gas mixture to the number of particles and their proportions.**
- **D.1 Create and/or evaluate a claim about the types of forces that are overcome during the melting, boiling, and/or dissolving of substances.**

Classifications of Matter





400 BCE



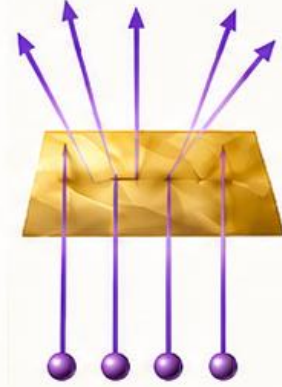
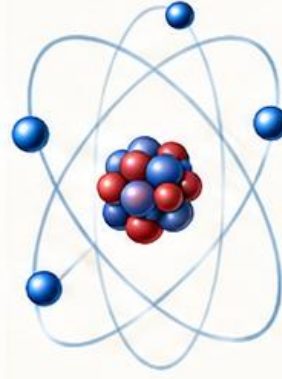
1803



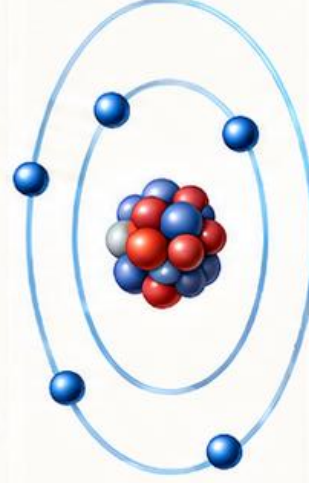
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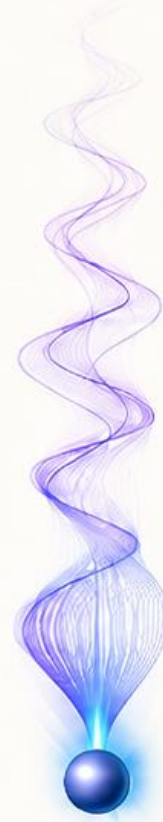
1909



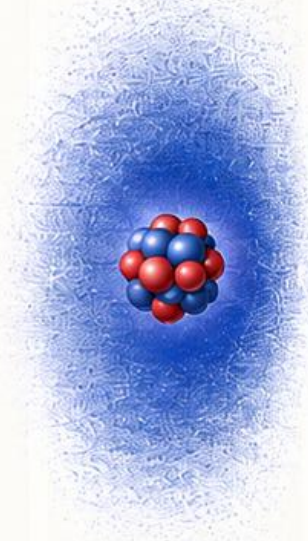
1911



1913



1924



1926



1932

The Subatomic Particles

- 'All' elements contain the same three particles:

Particle	Charge (q)	Mass (amu)
Proton (p^+)	1	1
Electron (e^-)	-1	1/1900
Neutron (n^0)	0	1

Navigating the Periodic Table

- Rows ($\leftrightarrow$) are called **periods** (7 total).
- Columns ($\updownarrow$) are called **families** or **groups**.
- Electrons tell us when to start a new period.
- Elements are given a one or two letter symbol.
 - Ex: Li, He, Ne, C, V, W, Ti.
- Most of the time the name and symbol are the same
 - Li is Lithium, O is Oxygen

Trivial: Names that do not follow set rules

Name	Symbol	Derivative	Meaning
Antimony	Sb	Stibium	Arabic/Egyptian: Eye Paint
Copper	Cu	Cuprum	Latin: From Cyprus
Gold	Au	Aurum	Latin: Glowing Dawn
Iron	Fe	Ferrum	Latin: Holy/Strong Metal (Sword)
Lead	Pb	Plumbum	Latin: Soft Metals
Mercury	Hg	Hydrargyros	Greek: Liquid Silver
Potassium	K	Kalium	Arabic: Plant Ashes
Silver	Ag	Argentum	Indo-European: White, Shining, Money
Sodium	Na	Natrium	Arabic/Egyptian: Soda
Tin	Sn	Stannum	Indo-European: Dripping
Tungsten	W	Wolfram	German: Wolf froth (Tin stealer)

Protons

- Elements are assigned an Atomic Number (Z) according to the number of protons in their nucleus.
 - Example: All Hydrogen atoms (H) have only 1 p⁺.
 - Example: All Carbon atoms (C) have only 6 p⁺.
- Elements are placed on the periodic table according to ascending proton number.
 - Example: Helium (He) has 2 p⁺ so it is the second element to appear on the periodic table.

Families/Groups

- Columns share similar properties, and most are given a trivial name.

1: Alkali Metals

2: Alkaline Earth Metals

3: Boron

4: Carbon

5: Pnictogen

6: Chalcogens

7: Halogens

8: Noble Gasses

S: Coinage

11.00794 20.28 13.81 0.0899 1s¹ Hydrogen																	24.00260 4.216 0.95 0.1786 1s² Helium				
36.941 3243 1615 453.7 0.53 1s²2s¹ Lithium	49.01218 3243 1560 1.85 1s²2s² Beryllium															1010.811 4275 2365 2.34 1s²2s²2p¹ Boron	1212.011 5100 3825 2.26 1s²2s²2p² Carbon	714.0067 77.344 63.15 1.251 1s²2s²2p³ Nitrogen	815.9994 90.188 54.8 1.429 1s²2s²2p⁴ Oxygen	918.99840 85.0 53.55 1.696 1s²2s²2p⁵ Fluorine	1020.1797 27.10 24.55 0.900 1s²2s²2p⁶ Neon
11122.98977 1156 371.0 0.97 [Ne]3s¹ Sodium	1224.305 1380 922 1.74 [Ne]3s² Magnesium															1326.98154 2740 933.5 2.70 [Ne]3s²3p¹ Aluminum	1428.0855 2630 1683 2.33 [Ne]3s²3p² Silicon	1530.97376 553 317.3 1.82 [Ne]3s²3p³ Phosphorus	1632.066 717.82 392.2 2.07 [Ne]3s²3p⁴ Sulfur	1735.4527 239.18 172.17 3.214 [Ne]3s²3p⁵ Chlorine	1839.948 87.45 33.95 1.784 [Ne]3s²3p⁶ Argon
1939.0983 1033 336.8 0.86 [Ar]4s¹ Potassium	2040.078 1757 1112 1.55 [Ar]4s² Calcium	2144.9559 3109 1814 2.99 [Ar]3d¹4s² Scandium	2247.88 3560 1935 4.54 [Ar]3d²4s² Titanium	2350.9415 3650 2163 6.11 [Ar]3d³4s² Vanadium	2451.996 3650 2130 7.19 [Ar]3d⁴4s² Chromium	2554.9380 2235 1518 7.44 [Ar]3d⁵4s² Manganese	2655.847 3023 1808 7.874 [Ar]3d⁶4s² Iron	2758.9332 3143 1768 8.90 [Ar]3d⁷4s² Cobalt	2858.6934 3005 1726 8.90 [Ar]3d⁸4s² Nickel	2963.546 2840 1356.6 6.96 [Ar]3d⁹4s¹ Copper	3065.39 1180 692.73 7.13 [Ar]3d¹⁰4s² Zinc	3169.723 2478 302.92 5.91 [Ar]3d¹⁰4s² Gallium	3272.61 2107 211.5 5.32 [Ar]3d¹⁰4s²4p² Germanium	3374.9216 76 76 5.78 [Ar]3d¹⁰4s²4p³ Arsenic	3478.96 958 494 4.79 [Ar]3d¹⁰4s²4p⁴ Selenium	3579.904 331.85 265.95 3.12 [Ar]3d¹⁰4s²4p⁵ Bromine	3683.80 120.85 116 3.75 [Ar]3d¹⁰4s²4p⁶ Krypton				

Out of Place

- Most of the columns in the middle don't have family names.
- Due to spacing some elements have been moved from their middle spot to the bottom.

11.00794 1 H Hydrogen																24.00260 2 He Helium																																																																																																																																																																																																																																																																																																																																																															
36.941 3 Li Lithium								9.01218 4 Be Beryllium								10.811 5 B Boron								12.011 6 C Carbon								14.0067 7 N Nitrogen								15.9994 8 O Oxygen								18.99840 9 F Fluorine								20.1797 10 Ne Neon																																																																																																																																																																																																																																																																																																																							
22.98977 11 Na Sodium																24.305 12 Mg Magnesium																26.98154 13 Al Aluminum																28.0855 14 Si Silicon																30.97376 15 P Phosphorus																32.066 16 S Sulfur																35.4527 17 Cl Chlorine																39.948 18 Ar Argon																																																																																																																																																																																																																																																															
39.0983 19 K Potassium								40.078 20 Ca Calcium								44.9559 21 Sc Scandium								63.546 29 Cu Copper								65.39 30 Zn Zinc								69.723 31 Ga Gallium								72.61 32 Ge Germanium								74.9216 33 As Arsenic								78.96 34 Se Selenium								79.904 35 Br Bromine								83.80 36 Kr Krypton																																																																																																																																																																																																																																																																																															
85.4678 37 Rb Rubidium								87.62 38 Sr Strontium								88.9059 39 Y Yttrium								106.42 46 Pd Palladium								107.868 47 Ag Silver								112.41 48 Cd Cadmium								114.82 49 In Indium								118.710 50 Sn Tin								121.757 51 Sb Antimony								127.60 52 Te Tellurium								126.9045 53 I Iodine								131.29 54 Xe Xenon																																																																																																																																																																																																																																																																																							
132.9054 55 Cs Cesium																137.33 56 Ba Barium																138.9055 57 La Lanthanum																140.12 58 Ce Cerium																140.9077 59 Pr Praseodymium																144.24 60 Nd Neodymium																145 61 Pm Promethium																150.36 62 Sm Samarium																151.965 63 Eu Europium																157.25 64 Gd Gadolinium																158.9253 65 Tb Terbium																162.50 66 Dy Dysprosium																164.9303 67 Ho Holmium																167.26 68 Er Erbium																168.9342 69 Tm Thulium																173.04 70 Yb Ytterbium																174.967 71 Lu Lutetium																																																																																																															
178.49 72 Hf Hafnium																180.9479 73 Ta Tantalum																183.85 74 W Tungsten																186.207 75 Re Rhenium																186.209 76 Os Osmium																192.22 77 Ir Iridium																195.08 78 Pt Platinum																196.9665 79 Au Gold																200.59 80 Hg Mercury																204.383 81 Tl Thallium																207.2 82 Pb Lead																208.9804 83 Bi Bismuth																209 84 Po Polonium																210 85 At Astatine																210 86 Rn Radon																																																																																																																																															
223 87 Fr Francium																226.0254 88 Ra Radium																227 89 Ac Actinium																232.0381 90 Th Thorium																231.0359 91 Pa Protactinium																238.029 92 U Uranium																237.0482 93 Np Neptunium																244 94 Pu Plutonium																243 95 Am Americium																247 96 Cm Curium																247 97 Bk Berkelium																251 98 Cf Californium																252 99 Es Einsteinium																257 100 Fm Fermium																258 101 Md Mendelevium																259 102 No Nobelium																261 103 Lr Lawrencium																261 104 Rf Rutherfordium																262 105 Ha Hahnium																263 106 Sg Seaborgium																263 107 Uns Unnilseptium																265 108 Uno Unniloctium																266 109 Une Unnilennium															

General Trends

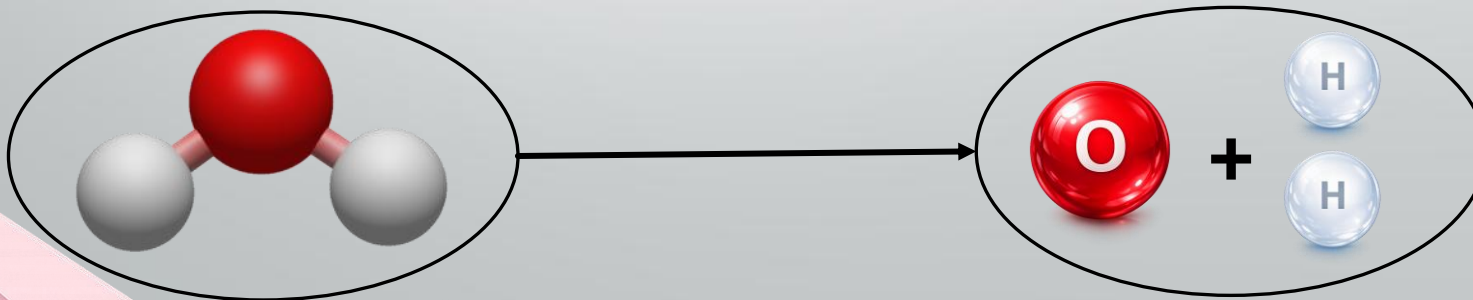
Elements have three main groups: Metal, Metalloids, and Nonmetals.

1																		8	
1 1.00794 1, -1 20.28 13.61 0.0999 1s ¹ H Hydrogen																		2 4.00260 2 4.216 0.95 0.000549 1s ² He Helium	
3 (6.941) 3 1615 453.7 0.534 [He]2s ¹ Li Lithium	4 9.012182 4 2744 1500 1.85 [He]2s ² Be Beryllium																	10 20.1797 10 27.07 24.56 [He]2s ² 2p ⁶ Ne Neon	
11 11.009108 11 371.0 923 0.97 [Ne]3s ¹ Na Sodium	12 24.3050 12 1383 371.0 923 1.74 [Ne]3s ² Mg Magnesium																	18 39.948 18 39.87 87.8 1.784 [Ne]3s ² 3p ⁶ Ar Argon	
19 39.0983 19 1033 396 0.86 [Ar]4s ¹ K Potassium	20 40.078 20 1115 110 0.75 [Ar]4s ² Ca Calcium	21 44.95591 21 3109 1814 2.99 [Ar]3d ¹ 4s ² Sc Scandium	22 47.867 22 3580 1941 4.54 [Ar]3d ² 4s ² Ti Titanium	23 50.9415 23 3680 2183 6.11 [Ar]3d ³ 4s ² V Vanadium	24 51.996 24 3680 2180 7.19 [Ar]3d ⁴ 4s ² Cr Chromium	25 54.9380 25 2234 1619 7.44 [Ar]3d ⁵ 4s ¹ Mn Manganese	26 55.845 26 3134 1811 7.674 [Ar]3d ⁶ 4s ² Fe Iron	27 58.9332 27 3134 1728 8.90 [Ar]3d ⁶ 4s ² Co Cobalt	28 58.9332 28 3134 1728 8.90 [Ar]3d ⁷ 4s ² Ni Nickel	29 63.546 29 3134 1728 8.96 [Ar]3d ⁹ 4s ¹ Cu Copper	30 65.409 30 3134 1728 8.96 [Ar]3d ¹⁰ 4s ¹ Zn Zinc	31 69.723 31 3106 302.91 6.095 [Ar]3d ¹⁰ 4s ² 4p ¹ Ga Gallium	32 72.64 32 3106 302.91 5.32 [Ar]3d ¹⁰ 4s ² 4p ² Ge Germanium	33 74.9216 33 3106 302.91 5.73 [Ar]3d ¹⁰ 4s ² 4p ³ As Arsenic	34 78.96 34 3106 302.91 4.79 [Ar]3d ¹⁰ 4s ² 4p ⁴ Se Selenium	35 78.96 35 3106 302.91 3.12 [Ar]3d ¹⁰ 4s ² 4p ⁵ Br Bromine	36 83.80 36 3106 302.91 0.2 [Ar]3d ¹⁰ 4s ² 4p ⁶ Kr Krypton		
37 39.0983 37 961 312.4 1.53 [Kr]4s ¹ Rb Rubidium	38 85.468 38 1686 105 0.72 [Kr]4s ² Sr Strontium	39 88.9059 39 3618 1795 4.47 [Kr]4d ¹ 5s ² Y Yttrium	40 91.224 40 4082 2128 6.51 [Kr]4d ² 5s ² Zr Zirconium	41 92.906 41 5017 2730 8.57 [Kr]4d ³ 5s ² Nb Niobium	42 92.906 42 5017 2730 8.57 [Kr]4d ⁴ 5s ² Mo Molybdenum	43 95.94 43 5675 2838 7.4 [Kr]4d ⁵ 5s ¹ Tc Technetium	44 95.94 44 5675 2838 7.4 [Kr]4d ⁶ 5s ¹ Ru Ruthenium	45 101.07 45 5675 2838 7.4 [Kr]4d ⁷ 5s ¹ Rh Rhodium	46 101.07 46 5675 2838 7.4 [Kr]4d ⁸ 5s ¹ Pd Palladium	47 106.9056 47 5675 2838 7.4 [Kr]4d ⁹ 5s ¹ Ag Silver	48 112.41 48 5675 2838 7.4 [Kr]4d ¹⁰ 5s ¹ Cd Cadmium	49 112.41 49 5675 2838 7.4 [Kr]4d ¹⁰ 5s ² In Indium	50 114.82 50 5675 2838 7.4 [Kr]4d ¹⁰ 5s ² 5p ² Sn Tin	51 121.760 51 5675 2838 7.4 [Kr]4d ¹⁰ 5s ² 5p ³ Sb Antimony	52 127.60 52 5675 2838 7.4 [Kr]4d ¹⁰ 5s ² 5p ⁴ Te Tellurium	53 126.90447 53 5675 2838 7.4 [Kr]4d ¹⁰ 5s ² 5p ⁵ I Iodine	54 131.29 54 5675 2838 7.4 [Kr]4d ¹⁰ 5s ² 5p ⁶ Xe Xenon		
55 87.62 55 944 301.5 1.87 [Xe]6s ¹ Cs Cesium	56 137.327 56 2170 1000 3.5 [Xe]6s ² Ba Barium	57 138.9055 57 3737 1191 6.15 [Xe]5d ¹ 6s ² La Lanthanum	72 178.49 72 4876 2506 13.31 [Xe]4f ¹⁴ 5d ² 6s ² Hf Hafnium	73 180.9479 73 5730 3290 16.65 [Xe]4f ¹⁴ 5d ³ 6s ² Ta Tantalum	74 183.84 74 5828 3290 19.3 [Xe]4f ¹⁴ 5d ⁴ 6s ² Ta Tantalum	75 186.207 75 5828 3290 19.3 [Xe]4f ¹⁴ 5d ⁵ 6s ¹ W Tungsten	76 190.23 76 5828 3290 19.3 [Xe]4f ¹⁴ 5d ⁶ 6s ² Ir Iridium	77 192.227 77 5828 3290 19.3 [Xe]4f ¹⁴ 5d ⁷ 6s ² Pt Platinum	78 195.08 78 5828 3290 19.3 [Xe]4f ¹⁴ 5d ⁹ 6s ¹ Au Gold	79 196.96655 79 5828 3290 19.3 [Xe]4f ¹⁴ 5d ¹⁰ 6s ¹ Hg Mercury	80 200.59 80 5828 3290 19.3 [Xe]4f ¹⁴ 5d ¹⁰ 6s ² Tl Thallium	81 204.3833 81 5828 3290 19.3 [Xe]4f ¹⁴ 5d ¹⁰ 6s ² 6p ¹ Pb Lead	82 207.2 82 5828 3290 19.3 [Xe]4f ¹⁴ 5d ¹⁰ 6s ² 6p ² Bi Bismuth	83 208.9804 83 5828 3290 19.3 [Xe]4f ¹⁴ 5d ¹⁰ 6s ² 6p ³ Po Polonium	84 (209) 84 5828 3290 19.3 [Xe]4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁴ At Astatine	85 (210) 85 5828 3290 19.3 [Xe]4f ¹⁴ 5d ¹⁰ 6s ² 6p ⁵ Rn Radon			
87 (223) 87 950 300 — [Rn]7s ¹ Fr Francium	88 (226) 88 1413 973 5.0 [Rn]7s ² Ra Radium	89 (227) 89 3470 1324 10.07 [Rn]5f ¹⁴ 6d ¹ 7s ² Ac Actinium	104 (261) 104 [Rn]5f ¹⁴ 6d ² 7s ² Rf Rutherfordium	105 (262) 105 [Rn]5f ¹⁴ 6d ³ 7s ² Db Dubnium	106 (266) 106 [Rn]5f ¹⁴ 6d ⁴ 7s ² Sg Seaborgium	107 (264) 107 [Rn]5f ¹⁴ 6d ⁵ 7s ² Bh Bohrium	108 (277) 108 [Rn]5f ¹⁴ 6d ⁶ 7s ² Hs Hassium	109 (268) 109 [Rn]5f ¹⁴ 6d ⁷ 7s ² Mt Meitnerium	110 (269) 110 [Rn]5f ¹⁴ 6d ⁸ 7s ² Ds Darmstadtium	111 (272) 111 [Rn]5f ¹⁴ 6d ⁹ 7s ² Rg Roentgenium	112 (285) 112 [Rn]5f ¹⁴ 6d ¹⁰ 7s ² Uub Ununbium	113 (284) 113 [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ¹ Uut Ununtrium	114 (289) 114 [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ² Uuq Ununquadium	115 (288) 115 [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ³ Uup Ununpentium	116 (289) 116 [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ⁴ Uuh Ununhexium	117 (294) 117 [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ⁵ Uus Ununseptium	118 (294) 118 [Rn]5f ¹⁴ 6d ¹⁰ 7s ² 7p ⁶ Uuo Ununoctium		

★ 58 140.116 3716 1071 6.77 [Xe]4f ¹⁴ 5d ¹ 6s ² Ce Cerium	★ 59 140.90765 3785 1204 6.77 [Xe]4f ¹³ 6s ² Pr Praseodymium	60 144.24 3947 1294 7.01 [Xe]4f ¹⁴ 6s ² Nd Neodymium	61 (145) 3273 1315 7.26 [Xe]4f ¹³ 6s ² Pm Promethium	62 150.36 2067 1347 7.52 [Xe]4f ¹⁴ 6s ² Sm Samarium	63 151.964 1969 1095 5.24 [Xe]4f ⁶ 6s ² Eu Europium	64 157.25 3548 1586 7.90 [Xe]4f ⁷ 6s ² Gd Gadolinium	65 158.92534 3503 1629 8.23 [Xe]4f ⁷ 6s ² Tb Terbium	66 162.50 2840 1685 8.55 [Xe]4f ⁹ 6s ² Dy Dysprosium	67 164.9303 2973 1747 8.55 [Xe]4f ¹⁰ 6s ² Ho Holmium	68 167.26 3140 1802 9.07 [Xe]4f ¹¹ 6s ² Er Erbium	69 168.9342 2223 1818 9.32 [Xe]4f ¹² 6s ² Tm Thulium	70 173.04 1460 1092 6.903 [Xe]4f ¹³ 6s ² Yb Ytterbium	71 174.967 3675 1936 8.941 [Xe]4f ¹⁴ 6s ² Lu Lutetium
★ 90 232.0381 5061 2023 11.72 [Rn]5d ⁴ 7s ² Th Thorium	91 231.0359 4300* 1845 15.4* [Rn]5f ¹ 6d ¹ 7s ² Pa Protactinium	92 238.02891 4406 1409 18.95 [Rn]5f ² 6d ¹ 7s ² U Uranium	93 237.04372 4175* 913 20.2 [Rn]5f ³ 6d ¹ 7s ² Np Neptunium	94 239.04543 3505 913 19.84 [Rn]5f ⁴ 6d ¹ 7s ² Pu Plutonium	95 244.06422 2294 1449 13.7 [Rn]5f ⁶ 6d ¹ 7s ² Am Americium	96 247.07715 1020 13.5* 14* [Rn]5f ⁷ 6d ¹ 7s ² Cm Curium	97 247.07715 1170* 13.5* 14* [Rn]5f ⁷ 6d ¹ 7s ² Bk Berkelium	98 247.07715 1170* 13.5* 14* [Rn]5f ⁷ 6d ¹ 7s ² Cf Californium	99 247.07715 1170* 13.5* 14* [Rn]5f ⁷ 6d ¹ 7s ² Es Einsteinium	100 247.07715 1170* 13.5* 14* [Rn]5f ⁷ 6d ¹ 7s ² Fm Fermium	101 247.07715 1170* 13.5* 14* [Rn]5f ⁷ 6d ¹ 7s ² Md Mendelevium	102 (259) 1100* 13.5* 14* [Rn]5f ⁷ 6d ¹ 7s ² No Nobelium	103 (262) 1900* 13.5* 14* [Rn]5f ⁷ 6d ¹ 7s ² Lr Lawrencium

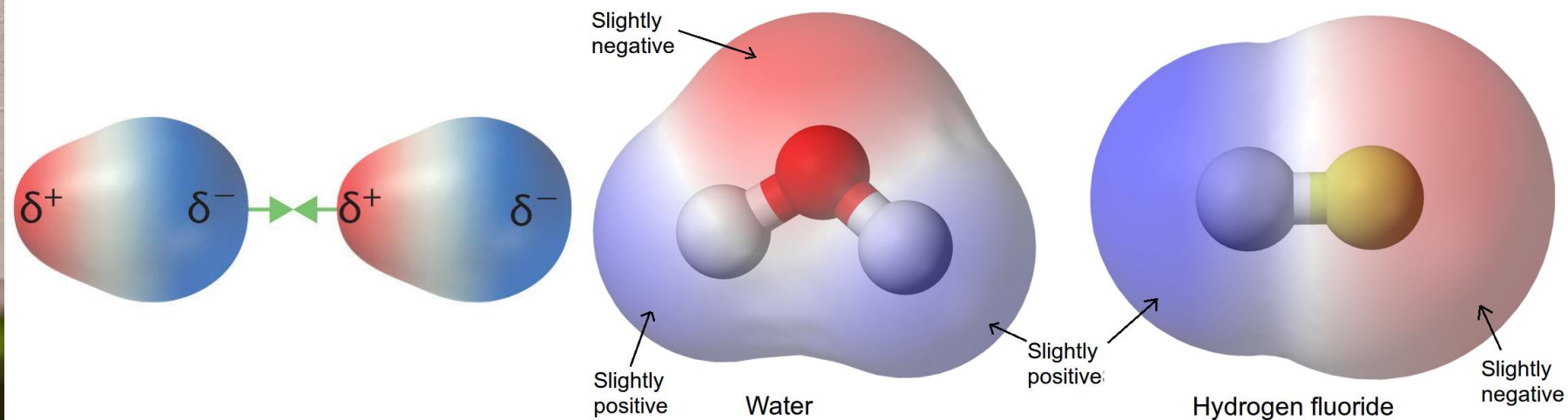
Compounds

- **Atoms combine on the atomic level to form compounds. In Nature:**
 - Metals can be separated easily and found in pure form.
 - Non-metals are found compounded, with themselves or another element.
 - Only the heaviest Nobel Gasses form compounds (very rarely).
- **Compounds and atoms are both single particles.**
 - One particle of water (H_2O) contains three atoms (2 Hydrogen, 1 Oxygen).



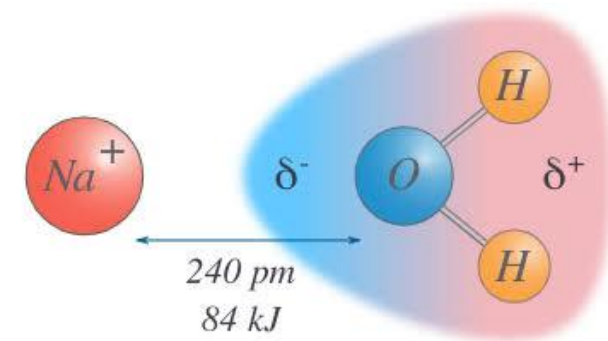
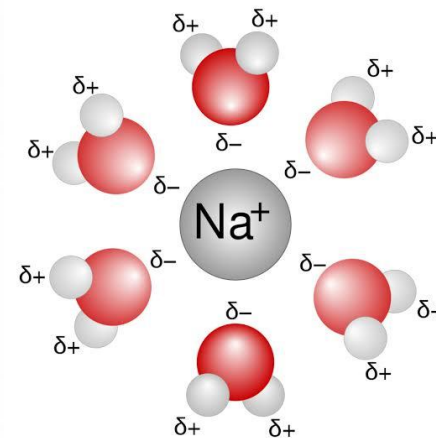
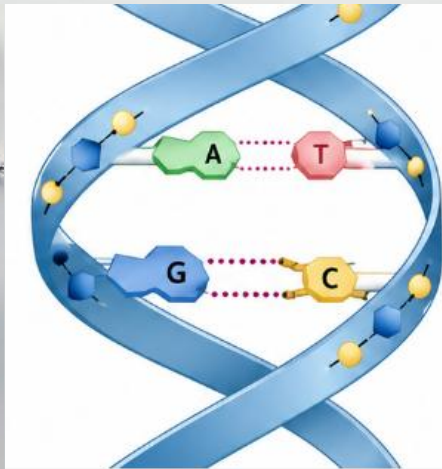
Revisiting IMF (Weak to Strong)

- London Dispersion: Attraction between all atoms because of moving e^- .
 - Increases with **more electrons** or **greater surface area contact**.
 - F_2 is a gas while I_2 is a liquid. Geckos and Insects use London Dispersion to climb walls.
- Dipole: Polar molecules create partially charged positive/negative ends.
 - Opposite's Attract.



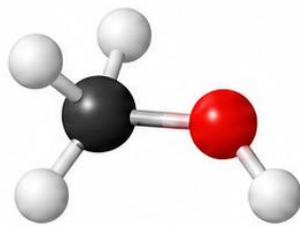
Revisiting IMF (Weak to Strong)

- **Hydrogen Bonds:** Hydrogen bonded with Nitrogen, Oxygen, Fluorine.
 - Responsible for water's high surface tension and DNA's ability to hold together.
- **Ion-Dipole:** Positive and negative ions, fully charged ends.
 - Salt (NaCl) dissociates in water. Sodium attracts the Oxygen side of water.



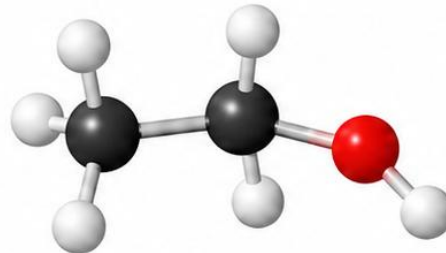
IMF: What Does This Mean?

- The stronger the Intermolecular Force the higher the boiling point.
 - Water (Dipole) has a lower boiling point than Sodium Chloride (Ionic)
- Molecular Weight can also play a part in boiling point if the molecules are similar.
 - Methanol (CH_3OH) and Butanol ($\text{C}_4\text{H}_9\text{OH}$) have similar structures. Since methanol is smaller it has less London dispersion force and a lower boiling point.



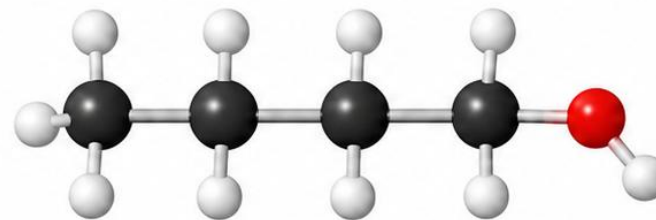
Methanol

Boiling point: 64.7 °C



Ethanol

Boiling point: 78.4 °C

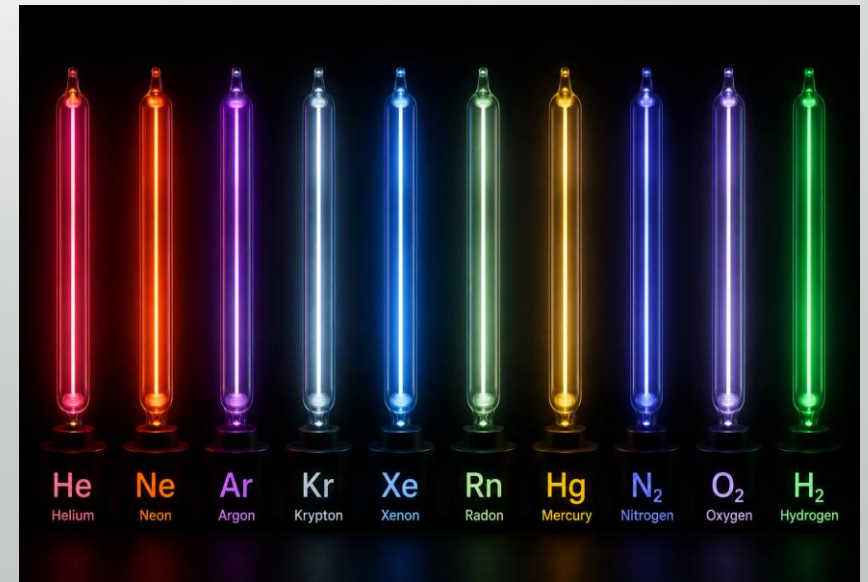


Butanol

Boiling point: 117.7 °C

Making Ions: Electrons

- On the periodic table or unless specifically told, protons equal electrons.
 - Ion: when an element's $p^+ \neq e^-$.
- An ion is considered electrically charged.



Ionic Example: Is Al with 16 e⁻ an ion?

- Al always has 13 p⁺.
- Solve by subtracting the number of e⁻ from p⁺.

$$13 - 16 = -3$$

there is a charge

- If charge < 0 it is called an Anion.
- If charge > 0 it would be called a Cation.
- If e⁻ = p⁺ then it would not be an Ion (Neutral).

Neutral Ions

- On the Periodic Table elements have equal number of protons and electrons.
- Elements will try to add/remove electrons to complete their outer energy level (get to the end of a period).
 - Metals will lose to become +
 - Non-metals will gain to become -



Ions: Written

- To write an ion two pieces of information are needed:
 - The element's symbol
 - The charge (both mag and then a + or -)
- Write the element and then the charge in the upper right-hand corner.
 - For 1+ or 1-: you may drop the '1'
 - Examples: Al^{3+} , Li^+ , Mg^{2+} , Cl^- , O^{2-} .

Write Symbolically

- Uranium of charge +3.
- Oxygen with 10 electrons.
- Iron with 29 electrons.
- The most common form of element 9.
 - Hint: What would it take to get to end of its period.

Metals

- Metals have a few (1-4) extra electrons in their outer layer.
 - These are held loosely and free to travel to any other metal atom.
- This causes metal atoms to be more positive.
 - These positive charged metals are attracted to the electrons and bond together.

