






THE PERIODIC TABLE NOTES



The Periodic Table Notes




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- I can describe the history of the periodic table.
 - I can explain how the modern periodic table is organized.
 - I can list the properties of a metal.

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- How is the periodic table arranged?
 - What else could be used to arrange the periodic table?




History

- Dmitri Mendeleev was the first person to put the elements into any periodic table.
- He put the elements in order of increasing atomic mass.
- He put elements with similar chemical and physical properties in the same column.

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- Why do you think there are blank spots on the periodic table?





History


- Mendeleev left blank spots for the elements not discovered yet.
 - Henry Mosley put elements in order of increasing atomic number, which is how the periodic table is organized today.
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The Modern Periodic Table


- The horizontal rows are called periods.
 - The periodic law states that when elements are arranged in increasing atomic number, there is a repetition of their chemical and physical properties.
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- Elements with similar properties end up in the same column.
 - Each vertical column is called a group or a family.
 - The first column is designated 1A



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- The elements in this column are highly reactive and react vigorously with water.
 - <http://video.google.com/videoplay?docid=-3103610687149839311#>
 - Group A elements are the tall columns, and they are also known as the representative elements.


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- Prediction: Are most of the elements on the periodic table metals or non-metals?
 - Prediction: Are most of the elements solids, liquids or gases?
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- The representative elements exhibit a wide range of chemical and physical properties.
 - Most of the representative elements are metals.
 - What are some properties of metals?


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- Metals have high electrical conductivity and high luster, and they are ductile.
 - Ductile means they can be drawn into wires.
 - Metals are also malleable, which means they can be pounded into thin sheets.


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- Group B elements are in the middle of the periodic table.
 - They are called the transition metals and they make up the d block.
 - The elements at the bottom of the periodic table in the f block are called the inner transition metals.

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- What is the only liquid metal on the periodic table?
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- The inner transition metals are also called rare earth metals.
 - Approximately 80% of all elements are metals.
 - Only one metal is liquid at room temperature, mercury

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- Predict where you find the non-metals.

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- Non-metals are located in the upper right hand corner of the table.
 - Non-metals are generally lusterless and do not conduct electricity.

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- Most non-metals are gasses at room temperature.
 - Elements that border the stair step line on the table are metalloids.
 - Metalloids have properties of both metals and non-metals.

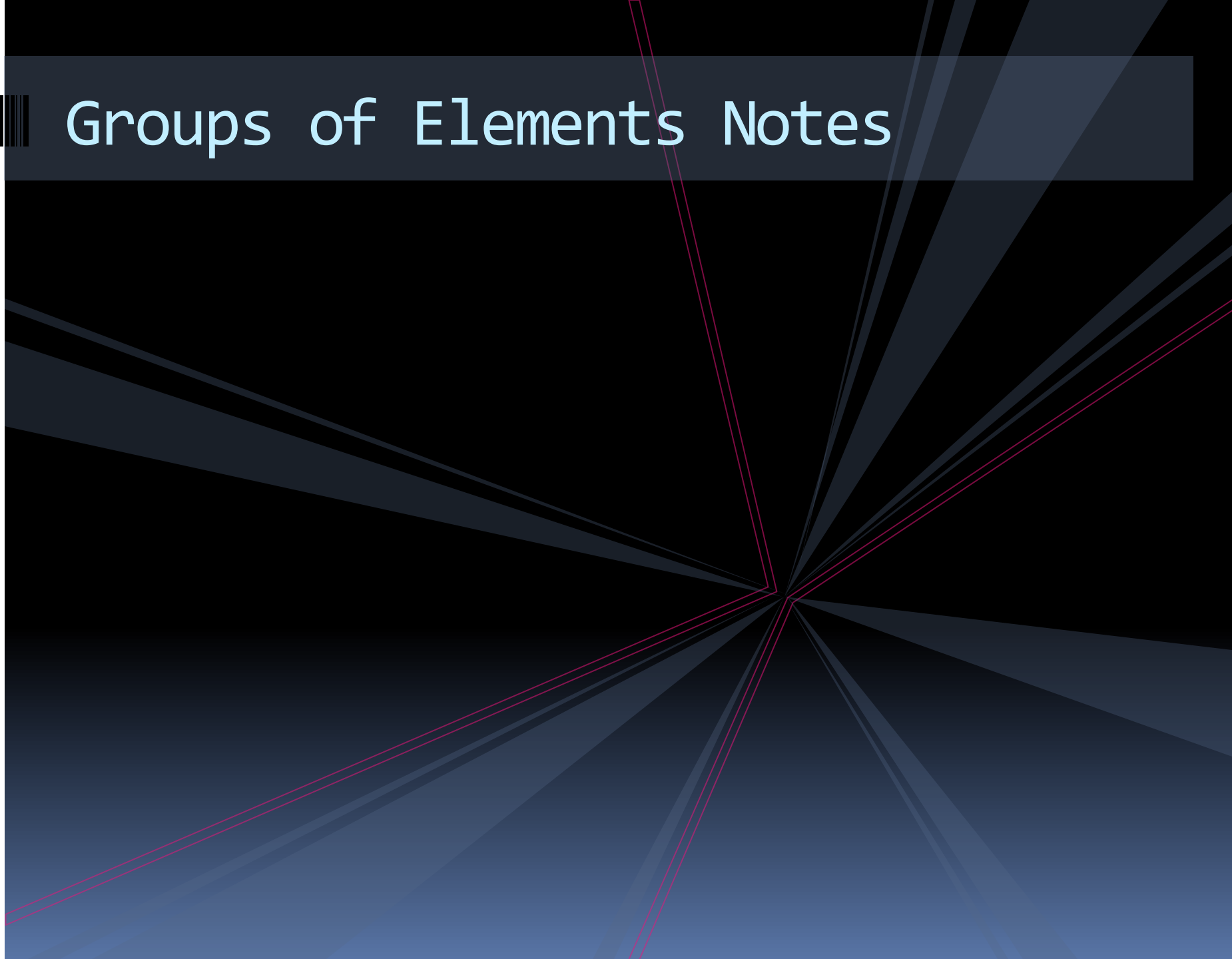




Review Questions

- Who arranged the first periodic table? How did he do it?
- Who arranged the current periodic table? How did he do it?
- What does it mean to be malleable?
- What does ductile mean?
- The majority of the elements on the periodic table are metals or non-metals?
- What are metalloids?





Groups of Elements Notes





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- I can locate the different groups on the periodic table.
 - I can identify what group any element is in.
 - I can give characteristics of the different groups.
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The s-block Elements


- The s-block elements are the most reactive.
- Group 1A is called the alkali metal family.
- These metals are soft, malleable, ductile, and good conductors.
- They are the most reactive elements on the table.


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- *What are ions?*
 - *How do atoms become ions?*
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- The alkali metals are never found as free elements because they are so reactive they are always bonded to something else.
 - These metals form +1 ions.



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- Group 2A is called the alkaline earth metals.
 - These metals are less reactive than the alkali metals and they react with oxygen easily.
 - Like the alkali metals, they are never found as free elements.
 - They form +2 ions.

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- The elements in the d-block are called the transition metals.
 - These elements play an important role in living organisms and are useful in structural materials as well.


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- These metals vary greatly in abundance.
 - Useful transition metals include:
Fe, Cu, Ni, Ag, Au, etc!


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- The 4-f block elements are called the lanthanide series elements after the first element in the series.
 - The 5-f block elements are called the actinide series elements after the first element in the series.


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- Scientists do not agree on where these metals should be placed on the periodic table.
 - The conflict stems because the electron configurations do not form as nice of a pattern.

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- The Lanthanides are soft, silvery metals, and are used in alloys.
 - The actinides are radioactive.
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- Group 3A to 6A are named based on the first element in the group.
- Group 3A or the Boron group, forms +3 ions.
- Group 4aA, or the Carbon group, forms +/-4 ions.

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- Group 5A, or the Nitrogen group, forms -3 ions.
 - Group 6A, or the Oxygen group, forms -2 ions.
 - Group 7A is called the halogens or halides, which means salt former.

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- All of these elements are found in diatomic form, in other words, they are found in pairs in nature.
 - The halogens are the most reactive non-metals and they react with metals to form salts.
 - F is the most reactive halogen.

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- The halogens form -1 ions.
 - The last group on the periodic table is the Noble gases.
 - The Noble gases do not form ions and they do not react.



Review Questions


- What group of elements on the periodic table is the most reactive?
- What is the d block called?
- Why do scientists disagree on where to put the inner transition metals?
- How are groups 3A-7A named?
- What is the most reactive group of non-metals?
- What group on the periodic table does not react or form ions?





Ion Trends in the Periodic Table


Notes





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- I can give the charge of any ion formed on the periodic table.
 - I can draw Lewis Dot Structures for the representative elements.
 - I can explain why all elements want to be like the Noble Gases.


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- What electrons do you think take part in bonding? Those closest to the nucleus or those further away?


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- Valence electrons are the outermost electrons in an atom.
 - They are the s and p electrons of the highest energy level.

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- The goal of an atom is to fill its outer shell.
 - For the outermost shell to be full, an atom must have 8 valence electrons.
 - What group on the periodic table has a full set of valence electrons?

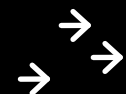
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- Noble gases, with the exception of He, have 8 valence electrons.
 - Every element on the periodic table wants to be like the noble gases. Why?

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- Reason:
 - They are stable!
 - Atoms will gain, lose, or share electrons to become like the Noble gases.
 - What Noble gas would sodium want to be like?
 - In order to be like neon, what does oxygen have to do?

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- Atoms with less than 4 valence electrons will lose electrons to form positive ions.
 - Atoms with more than 4 valence electrons will gain electrons to form negative ions.

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- Atoms with four valence electrons will gain or lose 4 electrons, so they can be +/-4.
 - The transition metals will form many different ions, but they will always be positive.

Label your Periodic Table



THE PERIODIC TABLE																	
1																	18
1 H 1.0079																	2 He 4.0026
2 3 Li 6.941	4 Be 9.0122											5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.18
3 11 Na 22.99	12 Mg 24.305											13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
4 19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.8
5 37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (97.91)	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 127.6	53 I 126.9	54 Xe 131.29
6 55 Cs 132.91	56 Ba 137.33	57 La 138.91	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)	89 Ac (227)	104 Rf (261.1)	105 Ha (262.1)	106 Sg (263.1)	107 Ns (262.1)	108 Hs (265.1)	109 Mt (266.1)	110 Unn (268)	111 Unu (269)							

Lanthanide Series

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (144.9)	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.5	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
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Actinide Series

90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244.1)	95 Am (243.1)	96 Cm (247.1)	97 Bk (247.1)	98 Cf (251.1)	99 Es (252.1)	100 Fm (257.1)	101 Md (258.1)	102 No (259.1)	103 Lr (262.1)
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Lewis Dot Structures


Notes



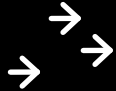
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- If you had to pick the most important electrons, which electrons would they be?

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- Lewis dot structures show only the valence electrons.
 - Valence electrons are the electrons found in the outermost shell.

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- The element symbol goes in the middle.
 - A circle is drawn around the symbol.
 - The electrons are drawn as X's around the circle.


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- Electrons do not pair up until the four “corners” have been filled.
 - The number of valence electrons for representative elements is equal to the group number.
 - So sodium has 1 valence electron because it is in group 1A

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4 19 K 39.098	20 20 Ca 40.078	21 21 Sc 44.956	22 22 Ti 47.88	23 23 V 50.942	24 24 Cr 51.996	25 25 Mn 54.938	26 26 Fe 55.847	27 27 Co 58.933	28 28 Ni 58.693	29 29 Cu 63.546	30 30 Zn 65.39	31 31 Ga 69.723	32 32 Ge 72.61	33 33 As 74.922	34 34 Se 78.96	35 35 Br 79.904	36 36 Kr 83.8
5 37 Rb 85.468	38 38 Sr 87.62	39 39 Y 88.906	40 40 Zr 91.224	41 41 Nb 92.906	42 42 Mo 95.94	43 43 Tc (97.91)	44 44 Ru 101.07	45 45 Rh 102.91	46 46 Pd 106.42	47 47 Ag 107.87	48 48 Cd 112.41	49 49 In 114.82	50 50 Sn 118.71	51 51 Sb 121.76	52 52 Te 127.6	53 53 I 126.9	54 54 Xe 131.29
6 55 Cs 132.91	56 56 Ba 137.33	57 57 La 138.91	72 72 Hf 178.49	73 73 Ta 180.95	74 74 W 183.84	75 75 Re 186.21	76 76 Os 190.23	77 77 Ir 192.22	78 78 Pt 195.08	79 79 Au 196.97	80 80 Hg 200.59	81 81 Tl 204.38	82 82 Pb 207.2	83 83 Bi 208.98	84 84 Po (209)	85 85 At (210)	86 86 Rn (222)
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- Examples:
 - Draw the Lewis Dot Structure for Mg.
 - Draw the Lewis Dot Structure for O.

Review Questions


- What are valence electrons?
- Why do all atoms on the periodic table want to be like the Noble gases?
- How do atoms become like the Noble gases?
- What is the charge of a potassium ion?
- What Noble gas would Sulfur want to be like?
- What electrons are shown in a Lewis Dot Structure?






Periodic Trends


Notes




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- I can explain the trends of electronegativity, ionization energy, and atomic radius.
 - I can use the trends to predict which element will have a larger radius, a higher electronegativity, or a higher ionization energy.

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- What subatomic particle do you think plays the most important role in determining the chemical and physical properties of an element?

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- Electrons play the most significant role in determining the chemical and physical properties of an element.
 - The Noble gases are elements in which the outermost s and p sublevels are full.

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- The representative elements have only partially full s and p sublevels, which are the valence electrons.
 - There is a trend on the periodic table for the number of valence electrons an element has.

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- The group number of representative elements tells you the number of electrons in the outermost energy level.
 - Elements in group 1A have 1 electron in the outermost energy level.
 - Elements in group 2A have 2 electrons in the outermost energy level.



Atomic Size

- What is radius?
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Atomic Size

- The atomic radius is one half the distance between the nuclei of two atoms in a diatomic molecule.
- The atomic radius indicates the relative size of an atom.
- Predict what is going to happen to atomic size as you move down a group.




Atomic Size

- Atomic radius increases as you move down a group.
- This happens because more and more electron orbitals are added to the atoms.
- Predict what happens to atomic radius as you move across a period.

- 
- Atomic radius decreases as you move across a period.
 - What charge does the nucleus have overall?
 - What charge is the electron cloud?
 - What is going to be the end result of these two charges?



Atomic Size


- This happens because you are only adding 1 proton and 1 electron.
 - The protons in the nucleus pull the outermost electrons closer to the nucleus which causes atoms to decrease in size.
- 


A vertical bar on the left side of the slide, consisting of a white top section with three thin black vertical lines, and a bottom section with four colored rectangular segments: pink, grey, yellow, and a longer pink segment.


Draw the Trend

Trends in Ionization Energy

- Ionization energy is the energy required to pull off an electron to form an ion.
- Which elements are going to willingly lose an electron?
- Will these elements have higher or lower ionization energy?

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- The energy required to pull off one electron is called the first ionization energy.
 - The energy required to pull off 2 electrons is called the second ionization energy.
 - Will it take more or less energy to pull off the second electron? Why?

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- The more electrons that are pulled off, the higher the ionization energy.
 - When an electron is removed, the positive nucleus pulls the remaining electrons in, and closer to the nucleus.
 - Therefore, the ion gets smaller, and the nucleus holds on tighter to the remaining electrons.

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- As you move down a group, ionization energy decreases because the electrons are farther from the nucleus because the atoms are bigger.
 - As you move across a period, ionization energy increases because the electrons are closer to the nucleus and harder to pull off.



Draw the Trend






Ions

- Predict what will happen to the size of an atom when it becomes a positive ion.
- Predict what will happen to the size of an atom when it becomes a negative ion.
- Based on the trend on the periodic table, are metals positive or negative ions?

Ionic Size

- When atoms gain or lose electrons, they become ions.
- Metallic elements form positive ions easily.
- Positive ions are smaller than neutral atoms because the nucleus pulls harder on the remaining electrons.



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- Non-metals form negative ions easily.
 - Negative ions are bigger than neutral atoms because the nuclear attraction is less with more electrons.


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- As you go down a group, the ion radius decreases.
 - As you go across a period from left to right, the ion radius increases.




Electronegativity Trends

- Electronegativity is the ability of an atom to attract electrons to itself when chemically combined with another element.
- Noble gases don't have electronegativities because they don't react.

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- Who wants an electron more, metals or non-metals?
 - Who is going to have a higher electronegativity, metals or non-metals?
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- Electronegativity decreases as you move down a group and increases as you go across a period.
 - The element with the lowest electronegativity is Cs and the element with the highest is F.

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- Electronegativity helps predict whether elements form ionic or covalent bonds.



Draw the Trend



Review Questions

- What is atomic radius?
- Why does atomic radius increase when you move down a group?
- What is ionization energy?
- Why does ionization energy increase when you pull off an electron?
- Why are positive ions smaller than their atoms?
- What is electronegativity?
- What element has the highest electronegativity?