

LESSON 2.2 – INVESTIGATING PATTERNS IN THE PERIODIC TABLE

EVIDENCE NOTEBOOK

KEY IDEAS

- In 1865 _____ arranged the first 16 elements (excluding hydrogen and helium) in order of increasing atomic mass.
 - What is atomic mass (2.1 Review)?
 - Illustrate how the 16 elements were arranged.
 - The properties of the elements repeated with the _____ element which is why he called it the law of _____.
- _____ arranged all 63 known elements at the time in order of _____.
 - Show an example where this periodic table did NOT fit neatly in order of increasing mass.
 - Why were gaps placed in this periodic table?
- _____ law is the model used for today's periodic tables. They are ordered by _____.

4. Periodic Table Vocabulary

Vocabulary	Definition	Identify the Locations of the Terms
Period		<p style="text-align: center;">PERIODIC CHART OF THE ELEMENTS</p> <p style="text-align: center;">IA IIA IIIB IVB VB VIB VIIB VIII IB IIB IIIA IVA VA VIA VIIA VIIIa (Noble Gases)</p>
Group		
Alkali Metals		
Alkaline-Earth Metals		
Transition Metals		
Halogens		
Noble Gases		

5. Atomic Radius Trends

- Moving down a group, _____ of electrons are added around the nucleus. Each shell _____ the more distant shells from the nucleus and the valence electrons get further away from the nucleus.
- Moving from the left to the right across a period, protons are being added but _____ electrons stay the same. This makes the shield less effective and the atomic radius _____.

6. Ionization Energy Trends

- Ionization is the energy required to _____.
- Moving down a group ionization energy _____. As more _____ are added to the nucleus the valence electrons (-) are shielded from the nucleus (+) making it easier to _____ them.

c. Moving from left to the right ionization energy _____. As more _____ are added while the core electrons stay the same, the valence electrons are drawn closer to the nucleus making it harder to remove them.

7. Electron Negativity Trends

a. Electron negativity is the measure of how strongly the nucleus of an atom _____ electrons for other atoms in a bond.

b. Moving down a group electron negativity _____. As more _____ are added to the nucleus the nucleus becomes more shielded, making it more difficult to attract new electrons.

c. Moving from left to the right electronegativity _____. As more _____ are added while the core electrons stay the same, the nucleus is able to attract new electrons to it. Group 18, the _____, are not electron negative because they have a full set of _____ and no room to add more electrons.

8. Illustrate the atomic radius, ionization energy and electronegativity trends on the period table:

PERIODIC CHART OF THE ELEMENTS																			
IA	IIA	IIIB	IVB	VB	VIB	VII B	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	INERT GASES				
1 H 1.00797														1 H 1.00797	2 He 4.0026				
3 Li 6.939	4 Be 9.0122													5 B 10.811	6 C 12.0112	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.183
11 Na 22.9898	12 Mg 24.312													13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453	18 Ar 39.948
19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.909	36 Kr 83.80		
37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30		
55 Cs 132.905	56 Ba 137.34	*57 La 138.91	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po (210)	85 At (210)	86 Rn (222)		
87 Fr (223)	88 Ra (226)	†89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 ? (271)	111 ? (272)	112 ? (277)								
Numbers in parenthesis are mass numbers of most stable or most common isotope.		* Lanthanide Series																	
Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.		58 Ce 140.12	59 Pr 140.907	60 Nd 144.24	61 Pm (147)	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.924	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.97				
The group designations used here are the former Chemical Abstract Service numbers.		† Actinide Series																	
		90 Th 232.038	91 Pa (231)	92 U 238.03	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (256)	103 Lr (257)				

NAME: _____ DATE: _____ PERIOD: _____

9. Place the following elements in order from smallest to largest radius: Si, O, N, P

10. Place the following elements in order from weakest to greatest ionization energy: Cl, P, S, Si

11. Place the following elements in order from weakest to greatest electronegativity energy: Na, Li, Rb, K

12. Why does the radius of atoms increase as you move down a group?

13. Why does the electronegativity increase as you move across a period?

14. In 1937, a limited supply of helium resulted in the airship Hindenburg being filled with hydrogen instead. On one trip, the Hindenburg burst into flames and was destroyed in less than one minute. Complete the statement about the Hindenburg. Hydrogen burns easily and is more | less reactive than helium because it has a higher | lower ionization energy. Helium is unreactive because it does not lose electrons | protons easily and therefore does not have an assigned atomic radius | electronegativity.
15. Which element would you expect to have the highest electronegativity?
 - a. calcium because it has one valence electron
 - b. cesium because it has a large atomic mass
 - c. fluorine because it needs one electron to fill its valence shell
 - d. phosphorus because it is a nonmetal
16. A scientist determines that an element has a high reactivity and a large atomic radius. What other properties does the element most likely have?
 - a. high electronegativity and high ionization energy

- b. high electronegativity and low ionization energy
 - c. low electronegativity and high ionization energy
 - d. low electronegativity and low ionization energy
17. According to periodic trends, at which position on the periodic table would an element most likely have an electronegativity higher than that of calcium? *Select all correct answers.*
- a. just above calcium
 - b. just below calcium
 - c. just to the left of calcium
 - d. just to the right of calcium
18. What statement best explains why fluorine has a smaller atomic radius than oxygen?
- a. Fluorine has fewer electrons than oxygen.
 - b. Fluorine has one more proton than oxygen.
 - c. Fluorine has low electronegativity.
 - d. Fluorine forms bonds readily with oxygen.
19. Put these elements in order of decreasing electronegativity, with the highest electronegative element as being first.

1.	a. tin (Sn, Group 14, Period 5)
2.	b. rubidium (Rb, Group 1, Period 5)
3.	c. bromine (Br, Group 17, Period 4)
4.	d. lithium (Li, Group 1, Period 2)
5.	e. cadmium (Cd, Group 12, Period 5)

20. Photoelectric cells produce an electric current when electromagnetic radiation shines on them. This happens only when the radiation shining on the material contains a certain amount of energy. Why is cesium often used in photoelectric cells?
- a. Cesium has one of the largest atomic radii, so its electrons are tightly held.
 - b. Cesium has one of the highest ionization energies, so its electrons are tightly held.
 - c. Cesium has a high electronegativity, so its electrons are easily ejected.
 - d. Cesium has one of the lowest ionization energies, so its electrons are easily ejected.
21. A sample of potassium (K, found in Group 1) and a sample of iodine (I, found in Group 17) react, forming potassium iodide, KI, which is used to treat thyroid conditions. Complete the statement to describe this reaction. The reaction that creates potassium iodide happens because electrons are pulled away from the more | less electronegative element, potassium, by the more | less

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electronegative element, iodine. The more electronegative element is found in Group 1 | Group 17. The less electronegative element is in Group 1 | Group 17.

22. Explain how the pattern in ionization energy across a period of the periodic table compares to the pattern in atomic radius size across a period.

23. Suppose you have a sample of potassium. Describe several ways you could use periodic trends and a knowledge of valence electrons to predict the element's reactivity and how the element will behave in a chemical bond.

24. Describe generally how the trends in ionization energy and atomic radius apply to the noble gases, and explain the reason for these trends.

25. Which element has the lowest electronegativity? *Refer to the periodic table.*
- a. Carbon
 - b. Fluorine
 - c. Lithium
 - d. Oxygen
26. Which element is most similar in behavior to calcium? *Refer to the periodic table.*
- a. Magnesium
 - b. Chlorine
 - c. Sodium
 - d. Sulfur
27. Which atoms will have the greater electronegativity?
- a. small atoms with small numbers of protons
 - b. small atoms with large numbers of protons
 - c. large atoms with small numbers of protons
 - d. large atoms with large numbers of protons
28. Which term describes the energy required to remove an electron from an atom?
- a. electron affinity
 - b. electron energy
 - c. electronegativity
 - d. ionization energy
29. How does ionization energy change as you move left to right in Period 4 from potassium through iron? *Refer to the periodic table.*
- a. It does not change.
 - b. It generally increases.
 - c. It generally decreases.
 - d. It varies unpredictably.
30. Which alkaline earth metal has the highest ionization energy? *Refer to the periodic table.*
- a. Barium
 - b. Calcium
 - c. Magnesium
 - d. Strontium

31. How does the atomic radius change as you move left to right in Period 3 from aluminum through chlorine? *Refer to the periodic table.*
- It does not change.
 - It generally increases.
 - It generally decreases.
 - It varies unpredictably.
32. Which statement is the best reason why the atomic radius generally increases with atomic number in each group of elements?
- A new octet forms.
 - The nuclear charge increases.
 - The number of neutrons increases.
 - The number of occupied shells increases
33. Which term describes the ability of an atom in a chemical compound to attract electrons from another atom in the compound?
- electron affinity
 - electronegativity
 - ionization potential
 - electron configuration
34. Which gas is unreactive according to its position in the periodic table? *Refer to the periodic table.*
- Neon
 - Carbon
 - Oxygen
 - Sodium