

Unit 4

NAME

Class Work

12/4/13

4.8 Ions and Ionization Energy

SPARK: submit your lab, have your 4.7 homework out

1. Complete participation rubric!
2. Which atom is larger K or Br?
3. What is an ion?
4. How does an atom become an ion, (hint they gain or lose something)?

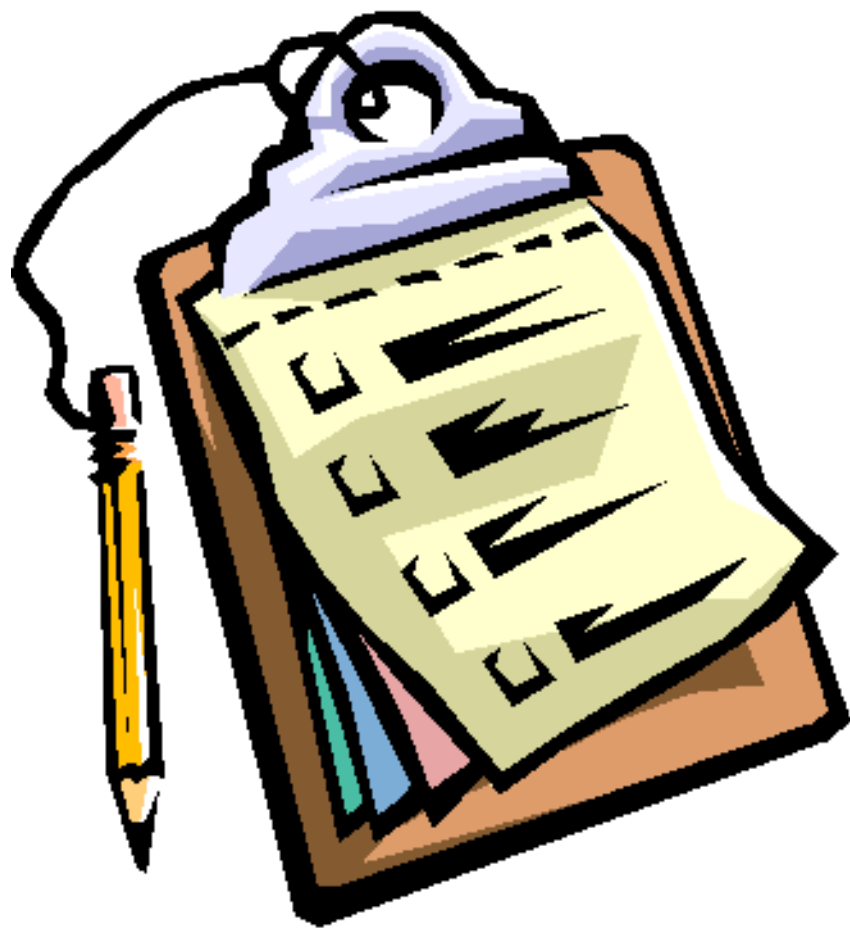
Objective

SWBAT identify ions, compare ionic radius and find trends in ionization energy.

Valence Electron POP Quiz

Agenda:

- Do Now/Objective
- Quiz
- Video
- Notes
- Practice
- Homework



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Video Time!

- What is it called when an atom gains or loses an electron?
- Atoms with nearly empty valence shells give up electrons. They are called...
- Negative valence elements are found on what side of the periodic table?

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THINK ABOUT IT!!!

(4 mins)

Potassium atom	Potassium Ion
<p><i>Potassium is the eighth most abundant element on the earth, but it is never found free in nature.</i></p> <p>Draw the lewis dot diagram for potassium (K).</p> <p>Number of protons:</p> <p>Number of neutrons:</p> <p>Number of electrons:</p> <p>Electron Configuration:</p> <p>Real electron configuration:</p>	<p><i>Potassium ions are necessary for the function of all living cells.</i></p> <p>Draw the lewis dot diagram for potassium ion (K^+).</p> <p>K^+</p> <p>Number of protons: 19</p> <p>Number of neutrons: 20</p> <p>Number of electrons: 18</p> <p>Electron Configuration: 2- 8- 8</p> <p>Real electron configuration:</p>

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COMPARE AND CONTRAST: How are potassium atoms different from potassium ions?

(1 min)

Octet Rule

- All atoms want to have 8 valence electrons like the noble gases.

Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

Give it a Try! (5mins)

Determine the number of electrons needed to fulfill the octet rule.

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Give it A Try!

Na Valence Electrons: _____ Has to gain:_____ Has to lose:_____	O Valence Electrons: _____ Has to gain:_____ Has to lose:_____	N Valence Electrons: _____ Has to gain:_____ Has to lose:_____
Li Valence Electrons: _____ Has to gain:_____ Has to lose:_____	S Valence Electrons: _____ Has to gain:_____ Has to lose:_____	H Valence Electrons: _____ Has to gain:_____ Has to lose:_____

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Words to Know

Vocabulary	Definition	Examples
Ion	An element with a charge.	
Anion	An atom with a negative charge.	
Cation	An atom with a positive charge.	

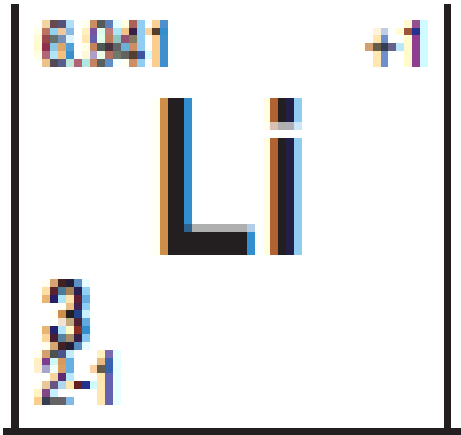
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The Next Big Dilemma: Anion or Cation?

- Determine the number of electrons required to get a full 8 in the outermost electron shell by adding
- Determine the number of electrons required to get a full 0 in the outermost electron shell by subtracting
- The number that is lower will be the action that element will take to become an ion
- If addition and subtraction numbers are the same, then element has the ability to do BOTH THINGS

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Example: What ion will the following atom form?



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Quick Check (1min)

- How many electrons does a Mg^{+2} have?
- How is this different from a Mg atom?
- What is the electron configuration for a Ca^{+2} ion?

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Quick Practice (5mins)

Calcium --valence electrons: _____ --gain or lose how many electrons? _____ --charge of ion: _____ Ion electron configuration: _____	Beryllium --valence electrons: _____ --gain or lose how many electrons? _____ --charge of ion: _____ Ion electron configuration: _____	Bromine --valence electrons: _____ --gain or lose how many electrons? _____ --charge of ion: _____ Ion electron configuration: _____	Sulfur --valence electrons: _____ --gain or lose how many electrons? _____ --charge of ion: _____ Ion electron configuration: _____
Strontium --valence electrons: _____ --gain or lose how many electrons? _____ --charge of ion: _____ Ion electron configuration: _____	Boron --valence electrons: _____ --gain or lose how many electrons? _____ --charge of ion: _____ Ion electron configuration: _____	Carbon --valence electrons: _____ --gain or lose how many electrons? _____ --charge of ion: _____ Ion electron configuration: _____	Potassium --valence electrons: _____ --gain or lose how many electrons? _____ --charge of ion: _____ Ion electron configuration: _____

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Check for Understanding (1 min)

- What kind of ion will sodium become?
 1. Cation
 2. Anion
 3. Bohr Ion
 4. Negative Ion























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Ionic Radius

- Positive Ions are smaller than the atoms from which they are formed
- Negative Ions are larger than the atoms from which they are formed
- In your own words, explain this in your notes. I will ask 3-4 of you to share.
 - Cations are smaller because the excess protons draw the outer electrons in closer to the nucleus.
 - Anions are larger because there is added repulsion between the outer electrons.

Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

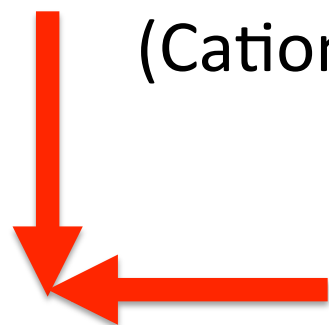
Atomic/Ionic Radii

1A		2A		3A	
 Li 1.52	 Li⁺ 0.60	 Be 1.11	 Be²⁺ 0.31		
 Na 1.86	 Na⁺ 0.95	 Mg 1.60	 Mg²⁺ 0.65	 Al 1.43	 Al³⁺ 0.50
 K 2.31	 K⁺ 1.33	 Ca 1.97	 Ca²⁺ 0.99	 Ga 1.22	 Ga³⁺ 0.62
 Rb 2.44	 Rb⁺ 1.48	 Sr 2.15	 Sr²⁺ 1.13	 In 1.62	 In³⁺ 0.81

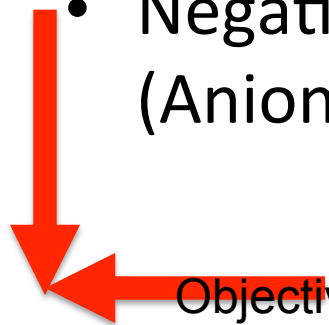
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Trend: Ionic Radius

- Positive Ions (Cations) - Smaller



- Negative Ions (Anions) - Bigger



Sizes of atoms and their ions in pm

Group 1		Group 2		Group 13		Group 16		Group 17	
Li ⁺	Li	Be ²⁺	Be	B ³⁺	B	O	O ²⁻	F	F ⁻
90	134	59	90	41	82	73	126	71	119
Na ⁺	Na	Mg ²⁺	Mg	Al ³⁺	Al	S	S ²⁻	Cl	Cl ⁻
116	154	86	130	68	118	102	170	99	167
K ⁺	K	Ca ²⁺	Ca	Ga ³⁺	Ga	Se	Se ²⁻	Br	Br ⁻
152	196	114	174	76	126	116	184	114	182
Rb ⁺	Rb	Sr ²⁺	Sr	In ³⁺	In	Te	Te ²⁻	I	I ⁻
166	211	132	192	94	144	135	207	133	206

Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

- Compared to the radius of a neutral chlorine atom, the radius of its ion will be
 1. larger because chlorine loses an electron
 2. larger because chlorine gains an electron
 3. smaller because chlorine loses an electron
 4. smaller because chlorine gains an electron

Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

- Compared to the radius of a neutral sodium atom, the radius of its ion will be
 1. larger because sodium loses an electron
 2. larger because sodium gains an electron
 3. smaller because sodium loses an electron
 4. smaller because sodium gains an electron

Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

IONIC Radius Questions

- Which atom has an ion with the largest radius ?
 1. Cl
 2. Ca
 3. S
 4. Se

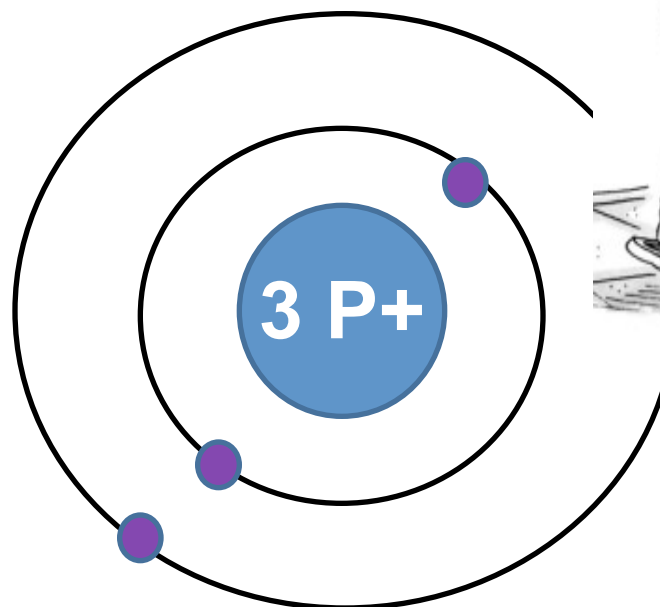
Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

Ionization Energy

- The amount of energy needed to remove a valence electron from a neutral atom



Example:
Li



Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

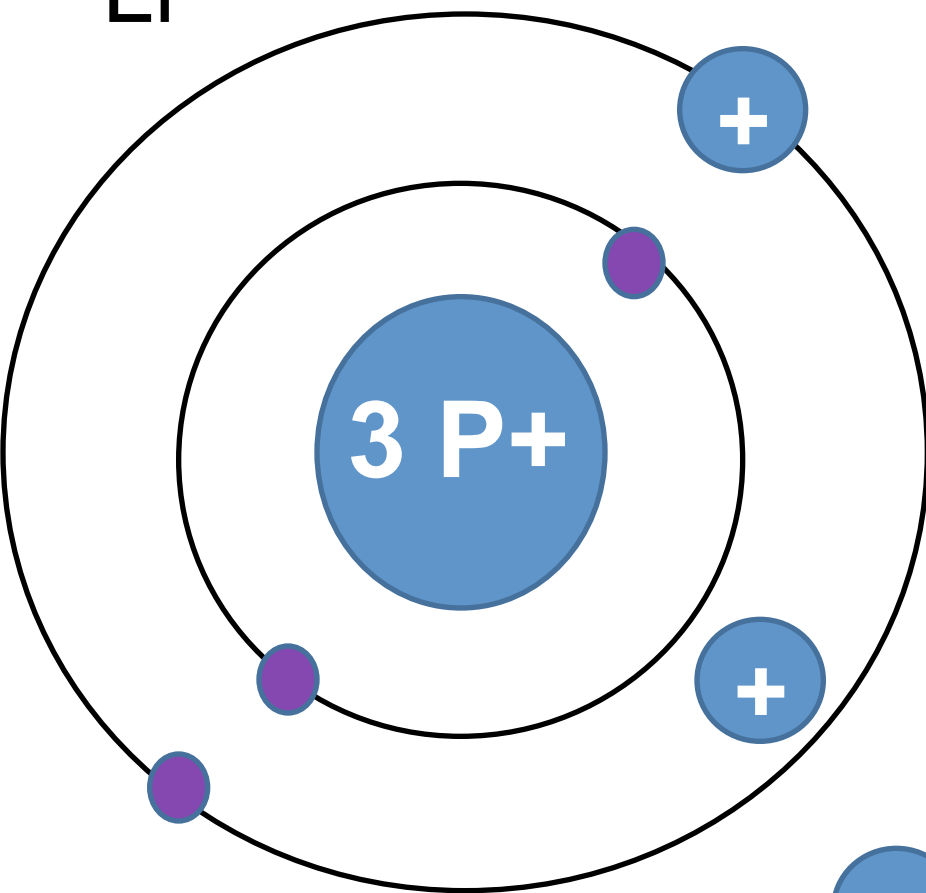
Predict the Trend! Follow these steps.

Left to Right (across a Period)

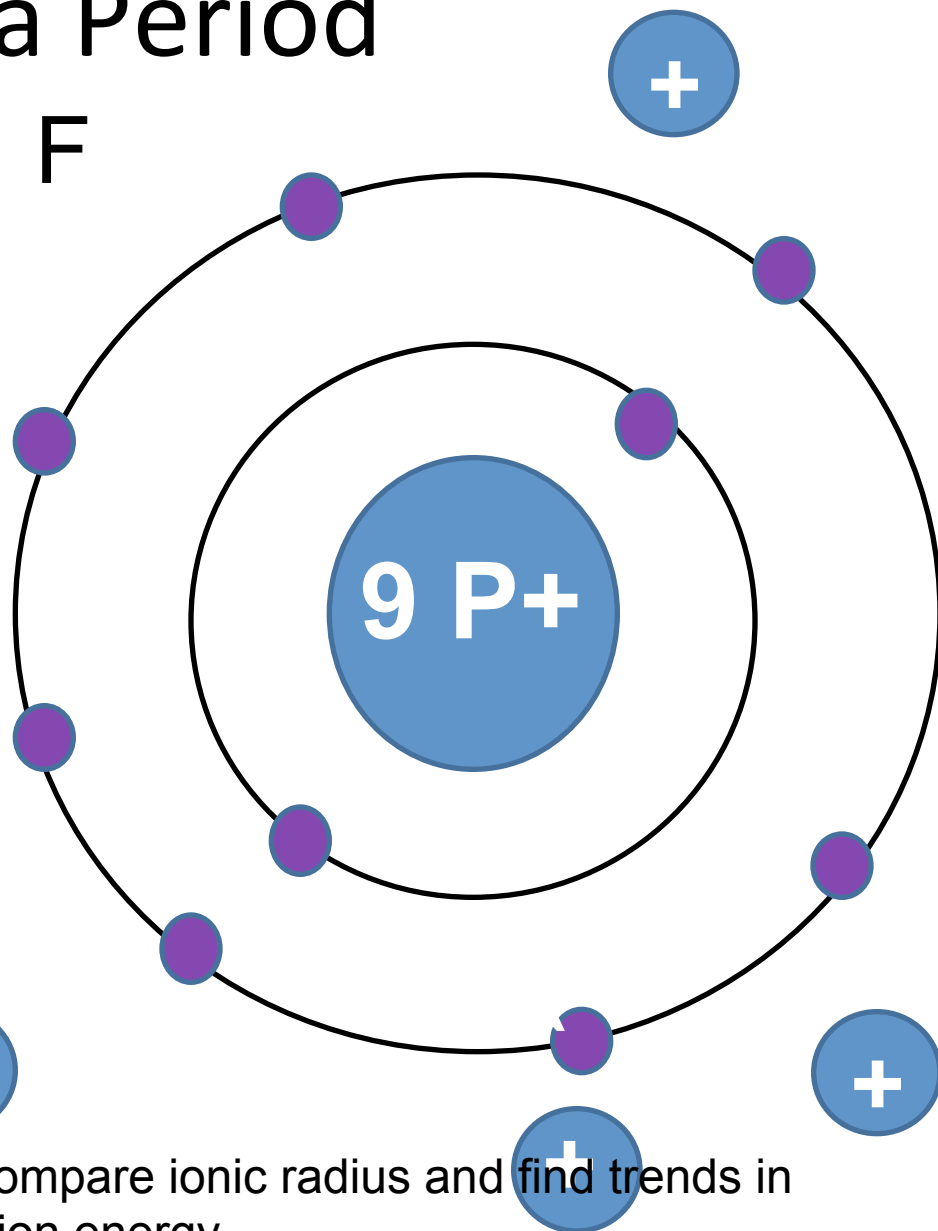
1. KNOWN: We are adding additional Positive charge to the nucleus
2. KNOWN: We are adding electrons to the SAME energy level
3. Are the valence electrons closer to or further from the nucleus as we move right?
4. Is it easier to remove an electron from an atom toward the left or to the right?

Across a Period

Li



F



Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

Predict the Trend! Follow these steps.

Top to Bottom (down a Group)

1. KNOWN: We are adding additional energy levels
2. KNOWN: The increased positive charge (additional protons) is shielded by the the inner energy levels of electrons
3. Are the valence electrons closer or further from the nucleus as we move down?
4. Is it easier to remove an electron from an atom toward the top or the bottom?

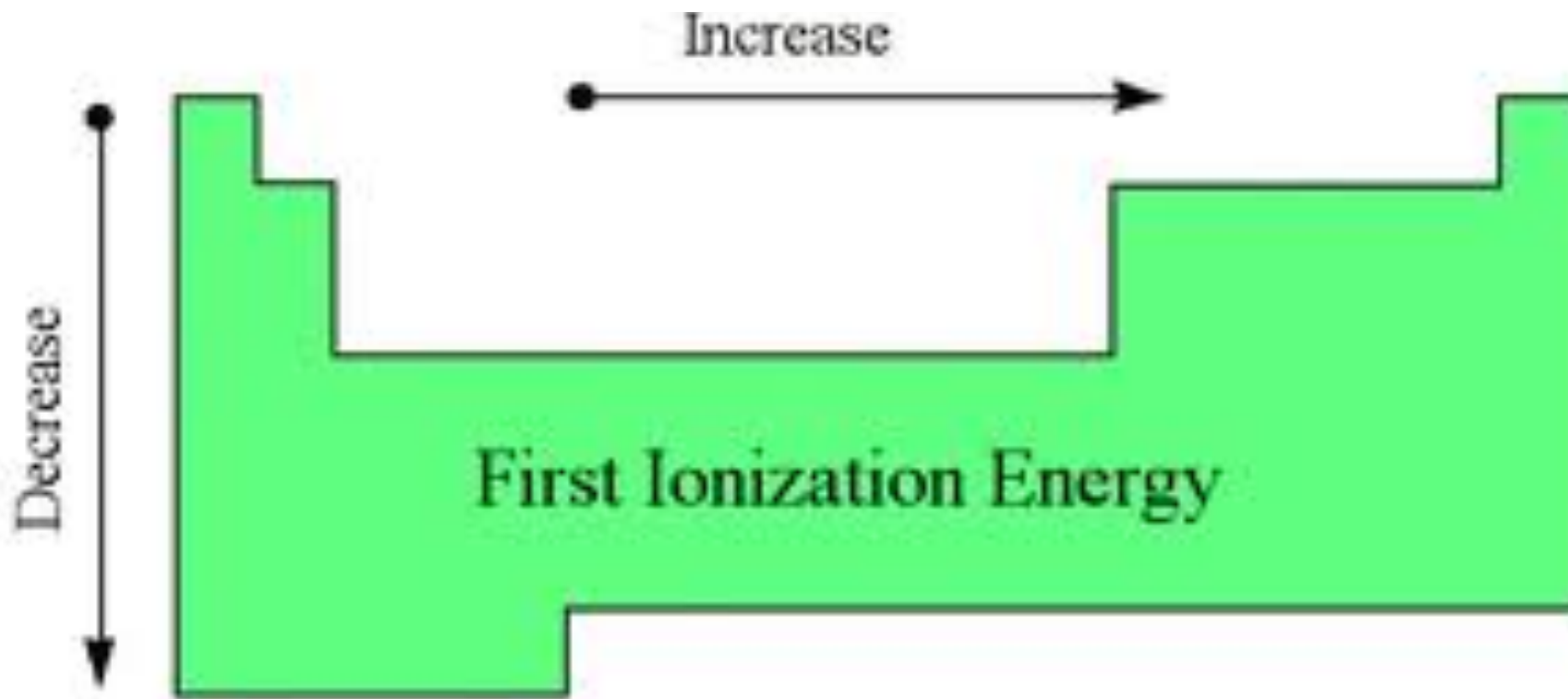
Li

Na

Why? Protons have less pull on electrons in further energy levels because the outer electrons are shielded more by the inner electron shells.

Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

Trend: Ionization Energy




General trends for the energy required to remove the first electron (first ionization energy) of an element

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Summary



- **Across a period: Ionization Energy Increases**
 - As the number of protons increases, electrons are more strongly attracted and hence...
 - More energy is needed to remove them from the atoms
 - **Down a group: Ionization Energy Decreases**
 - Valence electrons are in higher energy levels and thus, further from the nucleus.
 - It takes less energy to remove them when they are further from the positive charge of the nucleus and shielded by other energy levels of electrons
- 

Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

Independent work

- Answer questions in your handout.
- You may work quietly with your neighbors!

Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

Exit Ticket

Complete the Exit Ticket!

Objective: SWBAT identify ions, compare ionic radius and find trends in ionization energy.

HOMEWORK

Finish any incomplete classwork!

Objective: SWBAT identify the number of valence electrons in and draw a Lewis Dot Diagram of any element.