

EXTENSION ACTIVITY  
GENERAL CHEMISTRY

# IONIZATION ENERGY



## Activity Directions

This activity will serve as practice for the topics covered in the Ionization Energy game, as well as help you build on many of the concepts you learned in the Radii Trends game. This activity is best used in conjunction with not only the tutorial levels, but also supplementary learning resources such as course lectures, textbook reading, etc. Questions labeled “Lock It In” are simply opportunities for you to solidify what you have accomplished in each task and help ensure you meet each objective.

1. Log into Collisions and navigate to the Ionization Energy Game.
2. Play the Tutorial levels, if you haven't done so already.
3. Exit the levels and enter the Ionization Energy sandbox.
4. Follow all instructions as written below. Be sure to reference your course's textbook, lecture notes, etc. as needed.



## OBJECTIVE 1

Demonstrate an understanding of the relationship between effective nuclear charge and ionization energy.

A highly important concept in chemistry is the idea of ionization energy. Ionization energy describes the amount of energy required to remove an electron from a neutral atom in the gaseous state as described in the equation below. The energy required to remove the first electron is called the “first ionization energy”, while the removal of successive electrons earns the labels “second ionization energy”, “third ionization energy”, and so on. electrons earns the labels “second ionization energy”, “third ionization energy”, and so on.



Note that in the Ionization Energy game, ionization energy is described in “units of energy”. In reality, however, ionization energies are typically given as kilojoules per mole (kJ/mol) or electronvolts (eV).

**TASK 1:** Pull out the atom of each element listed in the table below from the atom bank. Record the number of units of energy required to remove the first valence electron (the first ionization energy) from each. The third column of the table will be left blank until *Task 2*.

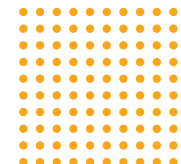
Element	First Ionization Energy (units of energy)	Effective Nuclear Charge on Valence Electrons
Sodium (Na)		
Aluminum (Al)		
Selenium (Se)		
Bromine (Br)		



# OBJECTIVE 1

Demonstrate an understanding of the relationship between effective nuclear charge and ionization energy.

**TASK 2:** The values in the periodic table below represent the effective nuclear charge on different electrons in the ground state atom of each element. Find the effective nuclear charge on **the last valence electron level** for each of the elements that you used in *Task 1* and complete the table.



Z	H 1 1.000																	He 2 1.688	
1s																			
Z	Li 3 2.691 1.279	Be 4 3.685 1.912											B 5 4.680 2.576 2.421	C 6 5.673 3.217 3.136	N 7 6.665 3.847 3.834	O 8 7.658 4.492 4.453	F 9 8.650 5.128 5.100	Ne 10 9.642 5.758 5.758	
1s																			
2s																			
2p																			
Z	Na 11 10.626 6.571 6.802 2.507	Mg 12 11.609 7.392 7.826 3.308											Al 13 12.591 8.214 8.963 4.117 4.066	Si 14 13.575 9.020 9.945 4.903 4.285	P 15 14.558 9.825 10.961 5.642 4.886	S 16 15.541 10.629 11.977 6.367 5.482	Cl 17 16.524 11.430 12.993 7.068 6.116	Ar 18 17.508 12.230 14.008 7.757 6.764	
1s																			
2s																			
2p																			
3s																			
3p																			
Z	K 19 18.490 13.006 15.027 8.680 7.726 3.495	Ca 20 19.473 13.776 16.041 9.602 8.658 4.398	Sc 21 20.457 14.574 17.055 10.340 9.406 4.632 7.120	Ti 22 21.441 15.377 18.065 11.033 10.104 4.817 8.141	V 23 22.426 16.181 19.073 11.709 10.785 4.981 8.983	Cr 24 23.414 16.984 20.075 12.368 11.466 5.133 9.757	Mn 25 24.396 17.794 21.084 13.018 12.109 5.283 10.528	Fe 26 25.381 18.599 22.089 13.676 12.778 5.434 11.180	Co 27 26.367 19.405 23.092 14.322 13.435 5.576 11.855	Ni 28 27.353 20.213 24.095 14.961 14.085 5.711 12.530	Cu 29 28.339 21.020 25.097 15.594 14.731 5.842 13.201	Zn 30 29.325 21.828 26.098 16.219 15.369 5.965 13.878	Ga 31 30.309 22.599 27.091 16.996 16.204 7.067 15.093 6.222	Ge 32 31.294 23.365 28.082 17.790 17.014 8.044 16.251 6.780	As 33 32.278 24.127 29.074 18.596 17.850 8.944 17.378 7.449	Se 34 33.262 24.888 30.065 19.403 18.705 9.758 18.477 8.287	Br 35 34.247 25.643 31.056 20.219 19.571 10.553 19.559 9.028	Kr 36 35.232 26.398 32.047 21.033 20.434 11.316 20.626 9.338	
1s																			
2s																			
2p																			
3s																			
3p																			
4s																			
4d																			
Z	Rb 37 36.208 27.157 33.039 21.843 21.303 12.388 21.679 10.881 4.985	Sr 38 37.191 27.902 34.030 22.664 22.168 13.444 22.726 11.932 6.071	Y 39 38.176 28.622 35.003 23.552 23.093 14.264 25.397 12.746 6.256 15.958	Zr 40 39.159 29.374 35.993 24.362 23.846 14.902 25.567 13.460 6.446 13.072	Nb 41 40.142 30.125 36.982 25.172 24.616 15.283 26.247 14.084 5.921 11.238	Mo 42 41.126 30.877 37.972 25.982 25.474 16.096 27.228 14.977 6.106 11.392	Tc 43 42.109 31.628 38.941 26.792 26.384 17.198 28.353 15.811 6.227 12.882	Ru 44 43.092 32.380 39.951 27.601 27.221 17.656 29.359 16.435 6.485 12.813	Rh 45 44.076 33.155 40.940 28.439 28.154 18.582 30.405 17.140 6.640 13.442	Pd 46 45.059 33.883 41.930 29.221 29.020 18.986 31.451 17.723 6.756 13.618	Ag 47 46.042 34.634 42.919 30.031 29.809 19.865 32.540 18.562 6.875 14.763	Cd 48 47.026 35.386 43.909 30.841 30.692 20.869 33.607 19.411 7.192 15.877	In 49 48.010 36.124 44.898 31.631 31.521 21.761 34.678 20.369 8.192 16.942 8.470	Sn 50 48.992 36.859 45.885 32.420 32.353 22.658 35.742 21.265 9.512 17.970 9.102	Sb 51 49.974 37.595 46.873 33.209 33.184 23.544 36.800 22.181 10.629 18.974 9.995	Te 52 50.957 38.331 47.860 33.998 34.009 24.408 37.839 23.122 11.617 19.960 10.809	I 53 51.939 39.067 48.847 34.787 34.841 25.297 38.901 24.030 13.404 20.934 11.612	Xe 54 52.922 39.803 49.835 35.576 35.668 26.173 39.947 24.957 14.218 21.893 12.425	
1s																			
2s																			
2p																			
3s																			
3p																			
4s																			
4d																			
5s																			
4d																			
5p																			

**LOCK IT IN:**  
Based on what you see with your atoms, what broad relationship exists between the effective nuclear charge and the first ionization energy?

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Effective Nuclear Charge values from Clementi et al. 1963 and 1967



## OBJECTIVE 2

Demonstrate an understanding of the successive ionization energies.

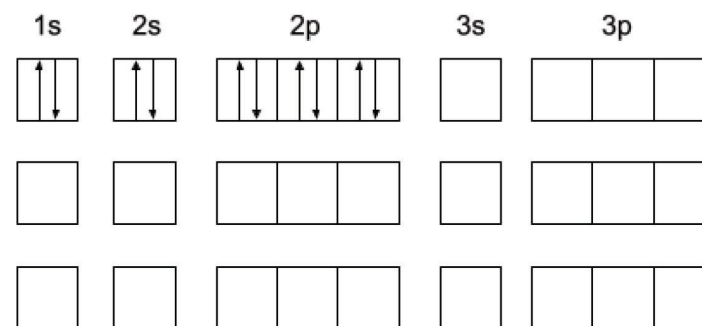
**TASK 3:** For this task you will explore successive ionization energies. The sandbox allows you to remove more than just one electron from an atom. As such, you are able to see how the amount of energy required to remove successive electrons changes.

1. In the designated spaces below, enter the first, second, and third ionization energies for sodium and magnesium determined using the sandbox.
2. You must also determine the difference/size of the jump between the first and second and second and third ionization energies.
3. To aid in your understanding of what each ionization energy represents, complete the electron configuration and orbital diagrams of the atom after each electron removal.
4. The first few sections have been completed for the sodium atom to help you.

### Sodium

	Ionization Energy (units of energy)	Difference From Previous IE (units of energy)	Electron Configuration
First IE	5	<del>                    </del>	$1s^2 2s^2 2p^6 3s^0$
Second IE	46	39	
Third IE			

### Orbital Diagram





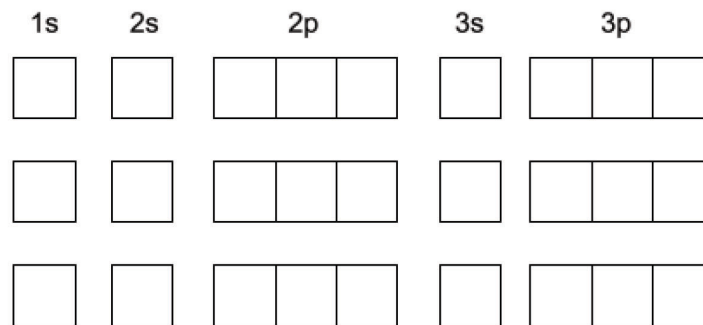
## OBJECTIVE 2

Demonstrate an understanding of the successive ionization energies.

### Magnesium

	Ionization Energy (units of energy)	Difference From Previous IE (units of energy)	Electron Configuration
First IE		X	
Second IE			
Third IE			

#### Orbital Diagram



#### LOCK IT IN:

Identify the trend in successive ionization energies. Explain why this trend occurs.



#### LOCK IT IN:

Explain why the largest jump in ionization energy does not occur at the same point in sodium and magnesium. Hint: Look at the orbital diagram to see where the electron being removed is located.




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### OBJECTIVE 3

Demonstrate an understanding of exceptions to normal patterns of ionization energy.

**TASK 4:** We can use the sandbox and our understanding of electron configurations to study some special phenomena involving ionization energies. The first of these involves the elements beryllium and boron.

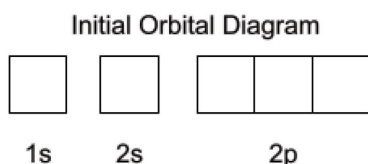
To begin, look at the effective nuclear charges of beryllium (Be) and boron (B) using the table from *Task 2*. As you remember, effective nuclear charge increases from left to right across a period. Boron is located just to the right of beryllium in the same period. In the space below, write a claim as to which of the two should have the higher first ionization energy and provide your reasoning.

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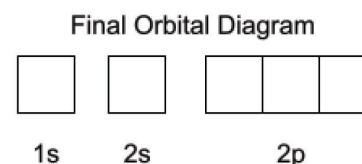
In the sandbox, remove a beryllium atom and a boron atom from the bank. Complete the orbital diagram for each atom before removing one electron and recording the ionization energy in the spaces below. After you remove the electron, complete the orbital diagram for each ion.

#### Beryllium

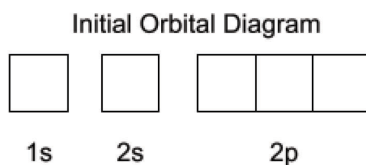


First Ionization Energy  
(units of energy)

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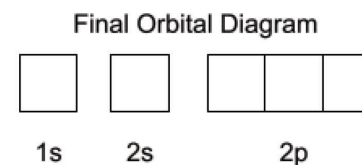


#### Boron



First Ionization Energy  
(units of energy)

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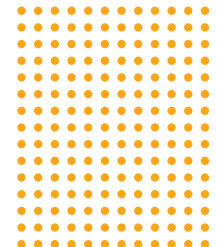




### OBJECTIVE 3

Demonstrate an understanding of exceptions to normal patterns of ionization energy.

Did the ionization energies modeled in the sandbox support or refute your initial claim about the first ionization energies of beryllium and boron? Use the data you collected to support your decision.

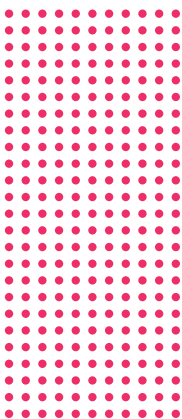


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#### LOCK IT IN:

When thinking about atoms and ions, it is very important to remember that there is a very complex balance of attractive and repulsive forces between electrons and protons and electrons with other electrons. These interactions are complemented by a complex suite of other factors and aspects of quantum mechanics. One result of these different effects is that fully filled subshells are more stable than partially filled ones. Use this information to explain why you observed what you did when determining the first ionization energies of beryllium and boron.



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### OBJECTIVE 3

Demonstrate an understanding of exceptions to normal patterns of ionization energy.

**TASK 5:** We will now explore another ionization energy phenomenon using the elements nitrogen and oxygen.

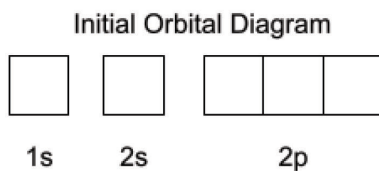
To begin, look at the effective nuclear charges of nitrogen (N) and oxygen (O) using the table from *Task 2*. As you remember, effective nuclear charge increases from left to right across a period. Oxygen is located just to the right of nitrogen in the same period. In the space below, write a claim as to which of the two should have the higher first ionization energy and provide your reasoning.

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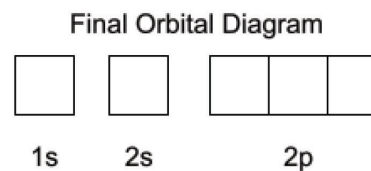
In the sandbox, remove a nitrogen atom and an oxygen atom from the bank. Complete the orbital diagram for each atom before removing one electron and recording the ionization energy in the spaces below. After you remove the electron, complete the orbital diagram for each ion.

#### Nitrogen

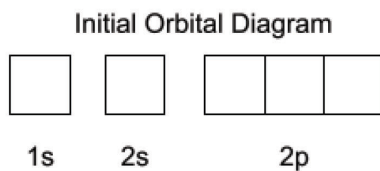


First Ionization Energy  
(units of energy)

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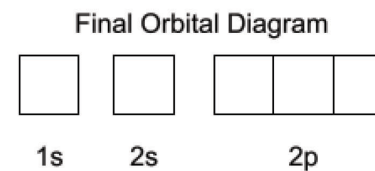


#### Oxygen



First Ionization Energy  
(units of energy)

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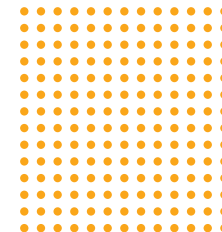
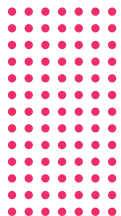




### OBJECTIVE 3

Demonstrate an understanding of exceptions to normal patterns of ionization energy.

Did the ionization energies modeled in the sandbox support or refute your initial claim about the first ionization energies of nitrogen and oxygen? Use the data you collected to support your decision.



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#### LOCK IT IN:

Another result of the complexity of the atom is that exactly half-filled subshells are also more stable than partially filled ones. Use this information to explain why you observed what you did when determining the first ionization energies of nitrogen and oxygen.



#### LOCK IT IN:

Describe in a few sentences the relationship between effective nuclear charge and ionization energy going across a period. Explain why there are occasionally exceptions to this relationship.

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## OBJECTIVE 4

Demonstrate an understanding of the trends in ionization energy on the periodic table.

**TASK 6:** Use the sandbox to identify the ionization energies of the elements indicated on the section of the periodic table below.

			VIIIA 8A
			2 <b>He</b> Helium 4.003
15 VA 5A	16 VIA 6A	17 VIIA 7A	
7 <b>N</b> Nitrogen 14.007	8 <b>O</b> Oxygen 15.999	9 <b>F</b> Fluorine 18.998	10 <b>Ne</b> Neon 20.180
15 <b>P</b> Phosphorus 30.974	16 <b>S</b> Sulfur 32.066	17 <b>Cl</b> Chlorine 35.453	18 <b>Ar</b> Argon 39.948
33 <b>As</b> Arsenic 74.922	34 <b>Se</b> Selenium 78.971	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.798

Element	First Ionization Energy (units of energy)
Nitrogen	
Phosphorus	
Arsenic	
Sulfur	
Chlorine	



## OBJECTIVE 4

Demonstrate an understanding of the trends in ionization energy on the periodic table.

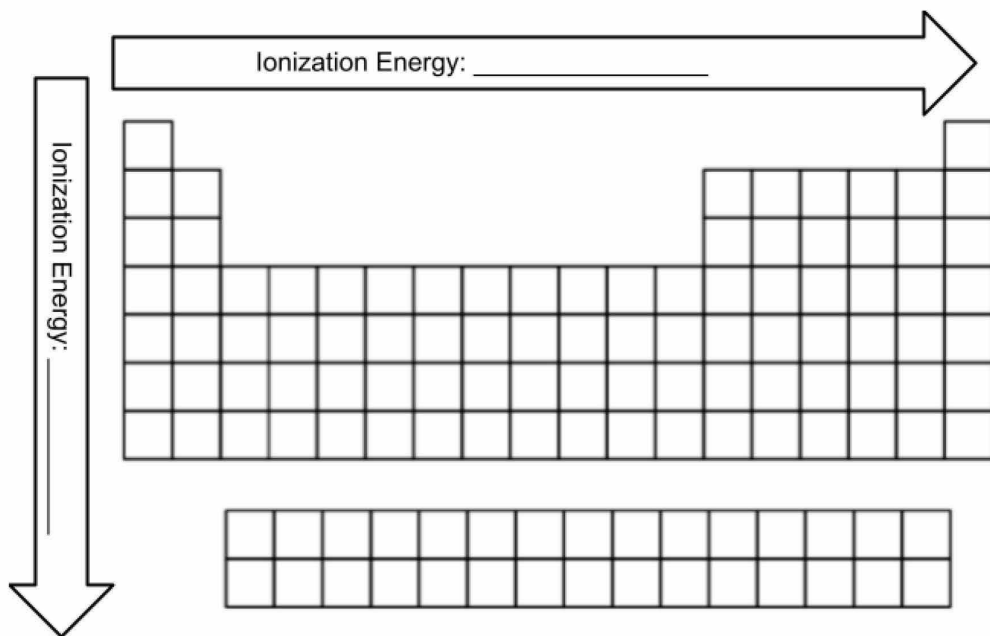
### LOCK IT IN:

Label the periodic table below with the terms “increasing” or “decreasing” based on the general trends in ionization energy. Remember that there will be exceptions!



### LOCK IT IN:

Justify the trend you identified going from left to right across a period using the concept of effective nuclear charge.




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### LOCK IT IN:

Justify the trend you identified going down a group using the concept of increasing principal quantum number (n).

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## OBJECTIVE 5

Demonstrate an understanding of the trends in electron affinity on the periodic table.

Another important concept in chemistry is the idea of electron affinity. Electron affinity describes the energy change associated with adding an electron to a neutral atom in the gaseous state as described in the equation below.



Note that in the Ionization Energy game, electron affinity is described in “units of energy”. In reality, however, electron affinities are typically given as kilojoules per mole (kJ/mol) or electronvolts (eV). Unlike ionization energy, electron affinities can either be negative, positive, or zero. A negative electron affinity indicates that energy is released by the addition of the electron, while a positive one indicates that energy is required to add the electron. Accordingly, a very negative electron affinity can be described as a very high electron affinity while the opposite is true for a very positive electron affinity.

**TASK 7:** Pull out the atom of each element listed in the table below from the atom bank. Record the number of units of energy released (include a negative sign) or used (include a positive sign) to add an electron to each element.

Element	Electron Affinity (units of energy)
Sodium (Na)	
Magnesium (Mg)	
Aluminum (Al)	
Sulfur (S)	
Chlorine (Cl)	



## OBJECTIVE 5

Demonstrate an understanding of the trends in electron affinity on the periodic table.

**TASK 8:** Trends in electron affinity are less identifiable going down a group of the periodic table. However, there are other patterns that emerge, particularly across a period. Use the information you gathered in Task 6 and the image of Period 3 below to help you answer the questions beneath it.

Metals				Nonmetals			
sodium 11 <b>Na</b> 22.990	magnesium 12 <b>Mg</b> 24.305	aluminium 13 <b>Al</b> 26.982	silicon 14 <b>Si</b> 28.086	phosphorus 15 <b>P</b> 30.974	sulfur 16 <b>S</b> 32.065	chlorine 17 <b>Cl</b> 35.453	argon 18 <b>Ar</b> 39.948

### LOCK IT IN:

What is the general trend in electron affinity that exists going from left to right across a period?



### LOCK IT IN:

Argon (Ar) has by the far the lowest electron affinity of the elements in period 7. Explain why this makes sense using its electron configuration of  $1s^22s^22p^63s^23p^6$ .



### LOCK IT IN:

Assuming the data you collected in *Task 7* is representative (which it is), compare the electron affinities of metals with nonmetals (excluding argon).



### LOCK IT IN:

Compare the electron affinity you observed for sodium with that of magnesium. Explain why that makes sense considering that the electron configuration of sodium is  $1s^22s^22p^63s^1$  and the electron configuration of magnesium is  $1s^22s^22p^63s^2$ .





## OBJECTIVE 6

Demonstrate an understanding of how the octet rule helps determine the charge of a main group ion.

One of the most crucial concepts in understanding the main group elements and their behaviors is the octet rule. This phenomenon describes the tendency of atoms to prefer having eight electrons in the valence shell. More specifically, atoms prefer to have full valence s and p subshells and, as you will see in other games, will react with other elements in ways that allow them to achieve such a state as best as possible. This same situation is often described as an attempt by atoms to resemble the nearest noble gas (Group 8) on the periodic table since noble gases in their neutral ground state all have full valence shells.

**TASK 9:** In this task, you will once again take a look at the elements of Period 3. However, this time you will be determining how to help these elements satisfy the octet rule in the most energetically favorable manner.

1. Use the sandbox to determine the amount of energy required to reach a complete octet by removing electrons from each atom and then by adding electrons. In the case that there is not enough energy available in the sandbox to complete a task, simply enter “ >100” to indicate that more than 100 units of energy would be necessary to complete the removal or addition of an electron.
2. Decide if it is more energetically favorable to add or remove electrons and indicate how many electrons should be added or removed.
3. Determine the charge of the ion satisfying the octet rule. Remember that electrons are negatively charged!

Element	Energy Required to Add Electrons to Complete Octet (units of energy)	Energy Required to Remove Electrons to Complete Octet (units of energy)	Most Energetically Favorable Scenario? ("gain electrons" or "lose electrons")	Change in # of Electrons for Most Energetically Favorable Scenario	Charge of Ion Satisfying Octet Rule
Sodium (Na)					
Magnesium (Mg)					
Aluminum (Al)					
Phosphorus (P)					
Sulfur (S)					
Chlorine (Cl)					



## OBJECTIVE 6

Demonstrate an understanding of how the octet rule helps determine the charge of a main group ion.

Metals				Nonmetals			
sodium 11 <b>Na</b> 22.990	magnesium 12 <b>Mg</b> 24.305	aluminium 13 <b>Al</b> 26.982	silicon 14 <b>Si</b> 28.086	phosphorus 15 <b>P</b> 30.974	sulfur 16 <b>S</b> 32.065	chlorine 17 <b>Cl</b> 35.453	argon 18 <b>Ar</b> 39.948

### LOCK IT IN:

According to trends in the Period 3 elements, do **metals** generally prefer to gain or lose electrons to achieve a complete octet?



### LOCK IT IN:

Using what you have seen so far in this sandbox activity, is it more energetically favorable to form cations from elements with low ionization energies to complete the octet rule or from those with high ionization energies?



### LOCK IT IN:

According to trends in the Period 3 elements, do **nonmetals** generally prefer to gain or lose electrons to achieve a complete octet?



### LOCK IT IN:

Using what you have seen so far in this sandbox activity, is it more energetically favorable to form anions from elements with low electron affinities to complete the octet rule or from those with high electron affinities?





# OBJECTIVE 7

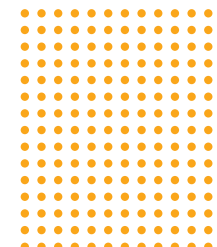
Demonstrate an understanding of how the ionic radius is determined by the difference between the nuclear charge and the number of electrons.

**TASK 10:** Complete the table with your knowledge of electron configurations and atomic radii gained during the Radii Trends game. Then rank the atoms by radius in the designated space beneath the table. Use a periodic table as necessary.

Element	# of Protons	# of Electrons	Electron Configuration	Orbital Diagram					
Sulfur (S)				<input type="checkbox"/> 1s	<input type="checkbox"/> 2s	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 2p	<input type="checkbox"/> 3s	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 3p	<input type="checkbox"/> 4s
Chlorine (Cl)				<input type="checkbox"/> 1s	<input type="checkbox"/> 2s	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 2p	<input type="checkbox"/> 3s	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 3p	<input type="checkbox"/> 4s
Potassium (K)				<input type="checkbox"/> 1s	<input type="checkbox"/> 2s	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 2p	<input type="checkbox"/> 3s	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 3p	<input type="checkbox"/> 4s
Calcium (Ca)				<input type="checkbox"/> 1s	<input type="checkbox"/> 2s	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 2p	<input type="checkbox"/> 3s	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> 3p	<input type="checkbox"/> 4s


Largest Radius

Smallest Radius







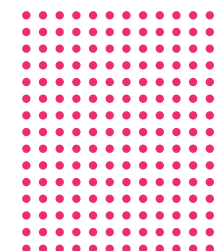
## OBJECTIVE 7

Demonstrate an understanding of how the ionic radius is determined by the difference between the nuclear charge and the number of electrons.

**TASK 11:** Create the ions listed in the table below in the sandbox and make sure to “Check” them so that they appear in the bottom panel. Once they all appear there, complete the rest of the table and rank them by ionic radius.

Ion	# of Protons	# of Electrons	Electron Configuration	Orbital Diagram
$S^{2-}$				<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"><input type="checkbox"/> 1s</div> <div style="text-align: center;"><input type="checkbox"/> 2s</div> <div style="text-align: center;"><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/> 2p</div> <div style="text-align: center;"><input type="checkbox"/> 3s</div> <div style="text-align: center;"><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/> 3p</div> <div style="text-align: center;"><input type="checkbox"/> 4s</div> </div>
$Cl^{-}$				<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"><input type="checkbox"/> 1s</div> <div style="text-align: center;"><input type="checkbox"/> 2s</div> <div style="text-align: center;"><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/> 2p</div> <div style="text-align: center;"><input type="checkbox"/> 3s</div> <div style="text-align: center;"><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/> 3p</div> <div style="text-align: center;"><input type="checkbox"/> 4s</div> </div>
$K^{+}$				<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"><input type="checkbox"/> 1s</div> <div style="text-align: center;"><input type="checkbox"/> 2s</div> <div style="text-align: center;"><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/> 2p</div> <div style="text-align: center;"><input type="checkbox"/> 3s</div> <div style="text-align: center;"><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/> 3p</div> <div style="text-align: center;"><input type="checkbox"/> 4s</div> </div>
$Ca^{2+}$				<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"><input type="checkbox"/> 1s</div> <div style="text-align: center;"><input type="checkbox"/> 2s</div> <div style="text-align: center;"><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/> 2p</div> <div style="text-align: center;"><input type="checkbox"/> 3s</div> <div style="text-align: center;"><input type="checkbox"/><input type="checkbox"/><input type="checkbox"/> 3p</div> <div style="text-align: center;"><input type="checkbox"/> 4s</div> </div>

	<b>Largest Radius</b>





## OBJECTIVE 7

Demonstrate an understanding of how the ionic radius is determined by the difference between the nuclear charge and the number of electrons.

### LOCK IT IN:

Are the trends in atomic radius and ionic radius the same? Explain your answer.



### LOCK IT IN:

You should notice that the ions in Task 10 are isoelectronic—ions with the same electron configurations. Explain why these ions do not all have the same radius. As part of your answer, justify why the smallest and largest ions are that way.



### LOCK IT IN:

Compare the radius of cations and anions with their parent atoms.



### LOCK IT IN:

With which noble gas do these elements all share an electron configuration?





## OBJECTIVE 8

Demonstrate an understanding of the trends in ionic radius on the periodic table.

**TASK 12:** Depending on what ions remain in the bottom panel of your sandbox, ensure that you either have or create lithium ( $\text{Li}^+$ ), sodium ( $\text{Na}^+$ ), and potassium ( $\text{K}^+$ ) ions. Rank them by radius in the space below.

lithium 3 <b>Li</b> 6.941
sodium 11 <b>Na</b> 22.990
potassium 19 <b>K</b> 39.098


**Largest Radius**

**Smallest Radius**



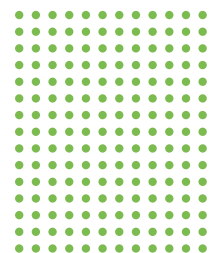
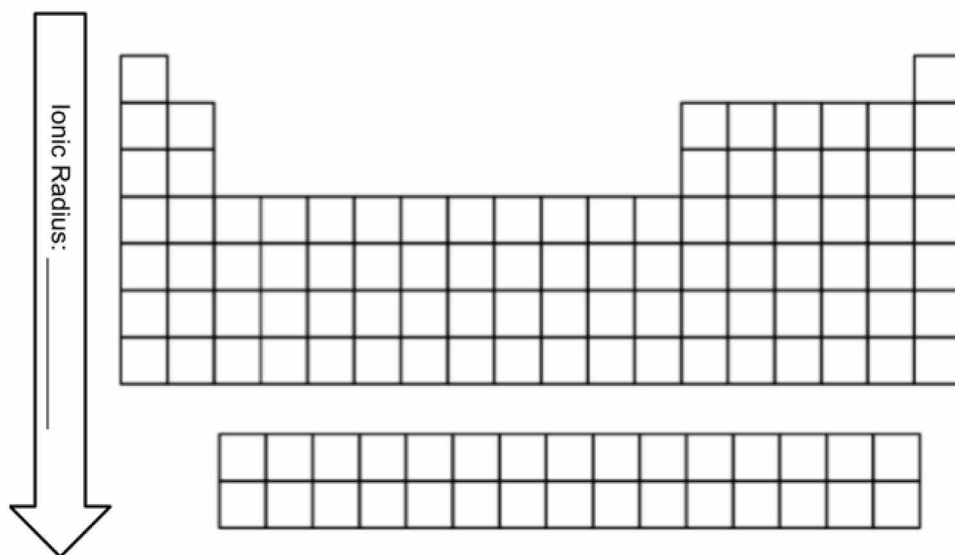
## OBJECTIVE 8

Demonstrate an understanding of the trends in ionic radius on the periodic table.

### LOCK IT IN:

The trend in ionic radius going right across a period for the main group elements (transition elements are more complex) is that the radius decreases for the positive ions and then increases at the first negative ion and then decreases from there. Label the periodic table below with the term “increasing” or “decreasing” based on the trend in ionic radius going down a group.

i





## CLOSURE

**CLOSURE:** Rubidium (Rb) and Iodine (I) are two elements in Period 5 that are not available to you in the sandbox for the Ionization Energy game. However, you should be able to use what you have learned so far to demonstrate your overall understanding of the concepts presented in the game. Compare the ions for rubidium and iodine on their ionization energy, electron affinity, and ionic radius using only a periodic table. Enter a greater than (>) or less than (<) symbol into the table. Then provide a brief justification as to why you chose the symbol you did using what you have learned.

In the table, identify how many electrons the atom would lose or gain to satisfy the octet rule and identify the charge of the resulting ion. You must also justify your answers there as well.

	53	37	
	I	Rb	<u>Justification</u>
<b>Ionization Energy</b>	> or <		
<b>Electron Affinity</b>			
<b>Ionic Radius</b>			

Element	# of electrons Lost or Gained to Satisfy Octet Rule	Charge of Resulting Ion	Justification
Rubidium			
Iodine			