Explore Student Journal

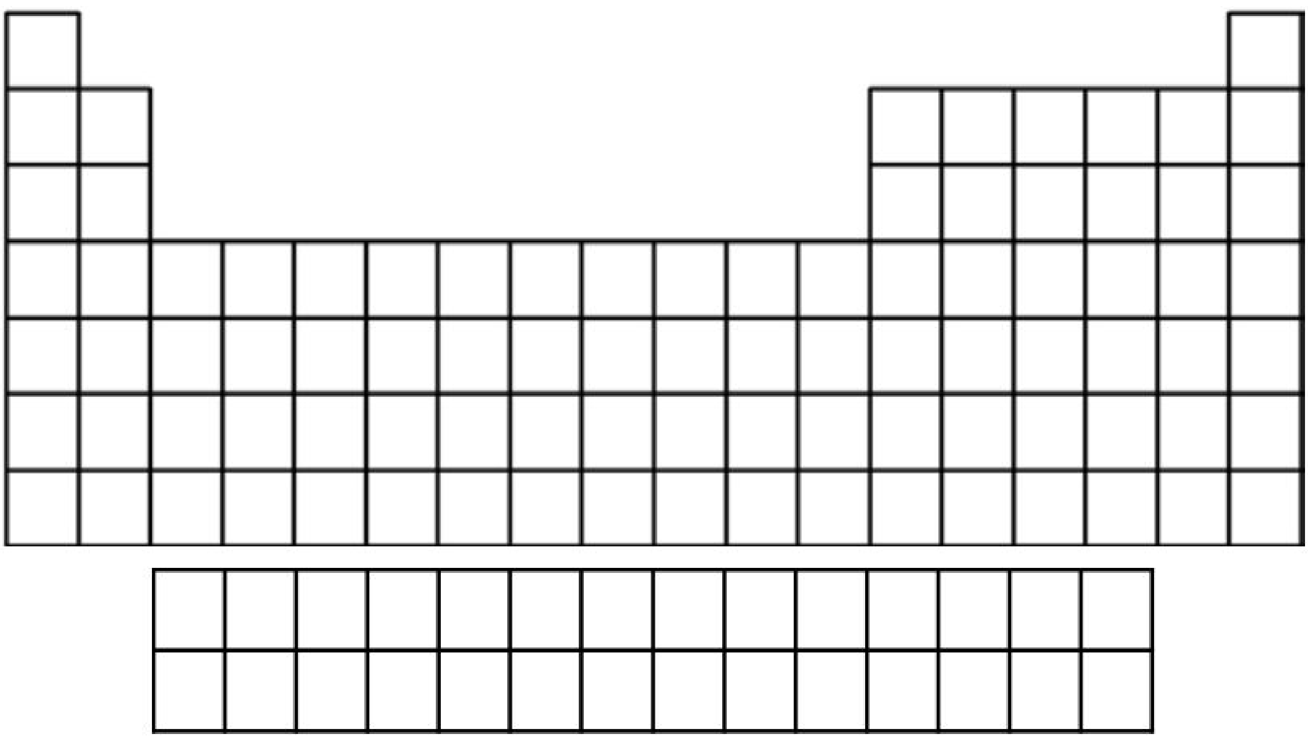
Name: ______________________________ Date: __________

Part I: Principal Energy Levels and Subshells

You will use the periodic table image on this page throughout this Explore activity, so make sure that you are very neat with your work as you go. Start by following the instructions outlined below. Use the provided Student Reference Sheet as a guide.

- Color the entire s orbital block yellow. These are all of the group 1 (also known as group 1A) and 2 (2A) elements. The element helium is considered an s-orbital element, not a p-orbital element.
- Color the entire p orbital block green. These are all of the group 13-18 (3A-8A) elements.
- Color the entire d orbital block red. These are all of the group 3-12 (group 1B-8B, or transition elements).
- Color the entire f orbital block blue. These are the lanthanide and actinide series elements. Make sure to note where these groups begin on your periodic table.

n = 1



Explore Student Journal

Part I: Principal Energy Levels and Sublevels, continued

This may all seem very confusing to you at this point, but do not worry. Follow the step-by-step instructions found on this page in exactly the order that they are given. By the time you are finished, you will be able to write and understand any electron configuration. Go back to the colored periodic table you have just finished. On the left hand side of the table, write in the principal energy levels at the beginning of each period. Label each as n = 1, n = 2, etc. Remember that the letter n represents the principal energy level. The first one has been completed for you. Do not label the lanthanide or actinide series section.

Next, “block out” each electron orbital section. For example, in the 2s section, place a 2s between lithium and beryllium, and then draw arrows to each side to show where the 2s orbital block is. Complete the periodic table in this way. Now use your completed periodic table to fill in the first two columns of the table below. After the next few activities, you will add the number of orbitals within each subshell, the number of electrons that each subshell can hold, and the maximum number of electrons that each principal energy level can hold.

Principle Energy Level, Quantum Number (n)	Number and Type of Electron Subshell	Number of Orbitals Within Each Subshell	Total Number of Electrons Each Subshell Can Hold	Maximum Number of Electrons Each Principle Energy Level Can Hold

Explore Student Journal

Part I: Principal Energy Levels and Sublevels, continued

Use the information from the periodic table created by the class to help you answer the following questions.

1. What atomic subshells can be found in the representative elements? These are also known as the group A elements or main group elements.

2. What atomic subshell is found in the transition elements?

3. What atomic subshell is found in the lanthanide and actinide series elements?

4. The element nitrogen is found in the second period of the periodic table. In what principal energy level (n) is nitrogen (N)? What about potassium (K)?

5. Describe the pattern that you see on the class periodic table. How are the subshells arranged, or ordered?

6. There was a break in the pattern starting with principal energy level 4 and the element scandium (Sc). What was this break? Why do you think this break may have occurred? Hint: It has to do with electron energies.

Explore Student Journal

Part II: Orbital Filling Diagrams

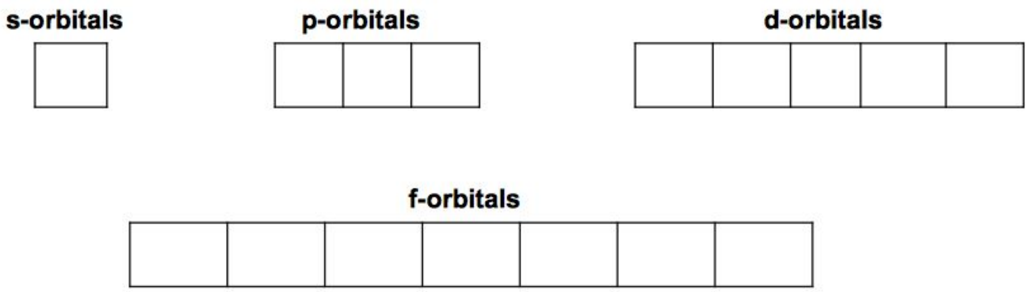
1. Complete the orbital filling diagram below.

Element	1s	2s	$2p_x$	$2p_y$	$2p_z$	3s	$3p_x$	$3p_y$	$3p_z$
Hydrogen (H)									
Helium (He)									
Lithium (Li)									
Beryllium (Be)									
Boron (B)									
Carbon (C)									
Nitrogen (N)									
Oxygen (O)									
Fluorine (F)									
Neon (Ne)									
Sodium (Na)									
Magnesium (Mg)									
Aluminum (al)									
Silicon (Si)									
Phosphorus (P)									
Sulfur (S)									
Chlorine (Cl)									
Argon (Ar)									

Explore Student Journal

Part II: Orbital Filling Diagrams, continued

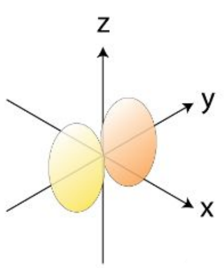
2. You have filled in the periodic table in Part I and the orbital filling diagram for the first three principal energy levels in Part II. Fill in the maximum number of electrons that each sublevel can hold, using the correct spin for each electron.

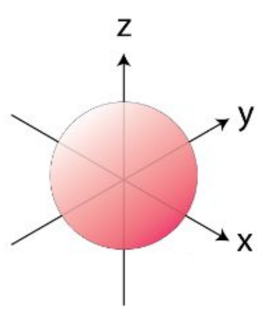


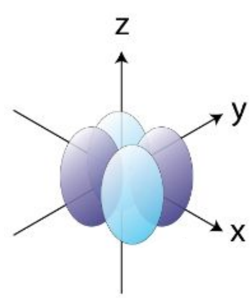
Once you have completed the diagram above, complete the table in Part I. You will identify the number of orbitals that can be found in each subshell. Using that information, you can find the maximum number of electrons that each principal energy level can hold by calculating the number of electrons that can be found in each orbital of the subshells found in each principal energy level.

3. The diagrams on this page are similar to the orbital filling diagram that you completed previously. Describe the information that you can obtain from diagrams such as this. Be as specific as you can. You should list at least three things.

4. Which shape belongs to which atomic sublevel? Write your answer below the shape.







Explore Student Journal

Part III: Writing Electron Configurations

1. You are now ready to write the electron configurations for each element. For the first two examples, use the orbital filling diagram for the elements from Part II of the Student Journal and write the complete electron configuration for that element below.

   Oxygen:
   Phosphorus:

2. Now that you have had some practice, use what you know to write the complete electron configurations for the first three noble gases. Notice that these elements may be found in bold in the orbital filling diagram you completed in Part II.

   Helium:
   Neon:
   Argon:

3. Now write both the complete electron configuration and the electron configuration using a noble gas core for the following elements.

   Carbon:
   Nickel:
   Bromine:

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Part IV (Extension): Lewis Valence Electron Dot Structures and Electron Configurations

1. Draw the Lewis valence electron dot structure for each of the following elements in the space above the element's name.

bromine neon oxygen phosphorus

2. The electron configuration for an element is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$. What are the valence electrons? How do you know they are the valence electrons?

3. Group 2 (group 2A) is known as the alkaline earth metals. What would the Lewis valence electron dot structures look like for each member of the alkaline earth metals? Explain your answer.

4. Why are Lewis valence electron dot structures important in chemistry?

5. Why is the maximum number of dots that may be drawn around any single element eight?

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Part V: Effects of Chemical Properties from Configurations

Observe the following elements and their configurations.

Sodium (Na): $1s^2 2s^2 2p^6 3s^1$
Magnesium (Mg): $1s^2 2s^2 2p^6 3s^2$
Aluminum (Al): $1s^2 2s^2 2p^6 3s^2 3p^1$

1. What type of elements are they?

2. Observe their valence electrons. What do they have in common?

3. If they are trying to get to eight valence electrons, would it be more energetically favorable to gain more electrons or lose electrons?

4. What general conclusion can you determine about metals when they are attempting to reach their eight electrons?

   Observe the following elements and their configurations.
   Nitrogen (N): $1s^2 2s^2 2p^3$
   Sulfur (S): $1s^2 2s^2 2p^6 3s^2 3p^4$
   Chlorine (Cl): $1s^2 2s^2 2p^6 3s^2 3p^5$

5. What type of elements are they?

6. Observe their valence electrons. What do they have in common?

7. If they are trying to get to eight valence electrons, would it be more energetically favorable to gain more electrons or lose electrons?

8. What general conclusion can you determine about nonmetals when they are attempting to reach their eight electrons?

Explore Student Journal

Reflections and Conclusions

1. According to the Aufbau principle, which principle energy level would have higher energy, n = 2 or n = 5?

2. Which element has the following complete electron configuration: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$?

3. Draw the Lewis valence electron dot structure for the element represented by the following electron configuration: $[Ne]3s^2 3p^4$?

4. Why do the electrons within a specific orbital have different spins?

5. What connection do you notice regarding an element's atomic number and the number of electrons represented in that element's complete electron configuration?

6. Write the complete electron configuration for the element gold (Au) in the space below. Use the diagram from Part II of your Student Guide to help you.

7. When looking at the representative elements (group A or main group elements), the number of electrons in the highest occupied energy level will be the same as the elements' group number, if using the 3A-8A group numbers. These electrons are found in the s and p subshells. What is another name for these types of electrons?

8. Using all of the following terms, develop a graphic organizer based on what you have learned in this Explore. Use additional paper, if needed.

   The terms: atom, electrons, electron orbital, principle energy level, subshell, periodic table, periods, representative element, transition elements, lanthanide and actinide series, s, p, d, f, Lewis valence electron dot structure, valence electron, and electron configuration.