Part I: Principle Energy Levels and Sublevels

You will use this Periodic Table throughout this Explore activity. Make sure that you are very neat with your work as you go. Start by following the instructions outlined below. Use the STAAR Reference Periodic Table as a guide.

Color the entire s orbital block yellow. These are all of the Group 1A and 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 3A-8A elements.

Color the entire d orbital block red. These are all of the Group B, or transition elements.

Color the entire f orbital block blue. These are the Lanthanide and Actinide series elements.
Part I: Principle 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 on page 1 of this Student Journal. On the left hand side of the table, write in the principle energy levels at the beginning of each period. Label each as \( n = 1 \), \( n = 2 \), etc. Remember that the letter \( n \) represents the principle energy level. The first one has been completed for you. Do not label the lanthanide or actinide series section.

You will not copy all of the information from the note cards from the class PT here. Simply “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 PT in this way.

Now, using the information from the PT on page 1 of this Student Journal, fill in the first 3 columns of the table below. You will add the number of electrons that each sublevel can hold and the maximum number of electrons that each principle energy level can hold after the next few activities.

<table>
<thead>
<tr>
<th>Principle Energy Level, Quantum Number (( n ))</th>
<th>Number of sublevels</th>
<th>“Name” of electron sublevels available</th>
<th>Number of electrons each sublevel can hold</th>
<th>Maximum Number of electrons each principle energy level can hold</th>
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</table>
Part I: Principle 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 sublevels may be found in the representative elements. These are also known as the Group A elements or Main Group elements?

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

3. What atomic sublevel is found in the Lanthanide and Actinide series elements?

4. The element nitrogen is found in the second period of the Periodic Table. What principle energy level (n) is nitrogen (N) in? What about potassium (K)?

5. Describe the pattern that you see on the class Periodic Table. How are the sublevels arranged, or ordered?

6. There was a break in the pattern starting with principle energy level 4 and the element scandium (Sc). What was this break, and why do you think this break may have occurred? Hint: it has to do with electron energies.
### Part II: Orbital Filling Diagrams

Remember: The 1s orbital is filled first, followed by the 2s orbital. Refer to Part II of your Student Guide if you need direction.

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>1s</th>
<th>2s</th>
<th>2pₓ</th>
<th>2pᵧ</th>
<th>2pᶻ</th>
<th>3s</th>
<th>3pₓ</th>
<th>3pᵧ</th>
<th>3pᶻ</th>
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<tbody>
<tr>
<td>Hydrogen (H)</td>
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<td><strong>Helium (He)</strong></td>
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<td>Beryllium (Be)</td>
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<td>Boron (B)</td>
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<td>Carbon (C)</td>
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<td>Nitrogen (N)</td>
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<td>Oxygen (O)</td>
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<td>Fluorine (F)</td>
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<td><strong>Neon (Ne)</strong></td>
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<td>Sodium (Na)</td>
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<td>Aluminum (Al)</td>
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<td>Silicon (Si)</td>
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<td>Phosphorus (P)</td>
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<td>Sulfur (S)</td>
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<td>Chlorine (Cl)</td>
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<td><strong>Argon (Ar)</strong></td>
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Part II: Orbital Filling Diagrams, continued

You have filled in the Periodic Table in Part I of your Student Journal, and the orbital filling diagram for principle energy levels in Part II of your Student Journal. Fill in the maximum number of electrons that each sublevel can hold, using the correct spin for each electron. Once you have completed this diagram, complete the table in Part I of this Student Journal. You can calculate the maximum number of electrons that each principle energy level can hold by calculating how many sublevels are in each principle energy level.

\[
\begin{array}{ccc}
\text{s orbitals} & \text{p orbitals} & \text{d orbitals} \\
\quad & \quad & \quad \\
\quad & \quad & \quad \\
\quad & \quad & \quad \\
\end{array}
\]

\[
\begin{array}{ccc}
\text{f orbitals} & \quad & \quad \\
\quad & \quad & \quad \\
\quad & \quad & \quad \\
\quad & \quad & \quad \\
\end{array}
\]

1. The diagrams on this page are similar to the orbital filling diagram that you completed on page 4 of this Student Journal. Describe the information that you can obtain from diagrams such as this, and be as specific as you can. You should list at least three things.

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

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

- [Diagram of s orbital]
- [Diagram of p orbital]
- [Diagram of d orbital]
- [Diagram of f orbital]
Part III: Writing Electron Configurations

You are now ready to write the electron configurations for each element. For the first two examples, use the orbital filling diagram for the element found in Part II of the Student Guide, and then write the complete electron configuration for that element below.

Oxygen:

Phosphorus:

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 found in Part II of the Student Guide.

Helium:

Neon:

Argon:

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

Carbon:

Nickel:

Bromine:
Reflection and Conclusion

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. Which element is represented by the following electron configuration: \([\text{Ne}]\ 3s^2, 3p^4\)?

__________________________________________________________________________

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

__________________________________________________________________________
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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. These electrons are found in the s and p sublevels. 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.
Terms: atom, electrons, electron orbital, principle energy level, sublevel, Periodic Table, periods, representative element, transition elements, lanthanide and actinide series, s, p, d, f, electron configuration.