Name: _____ Date: _____

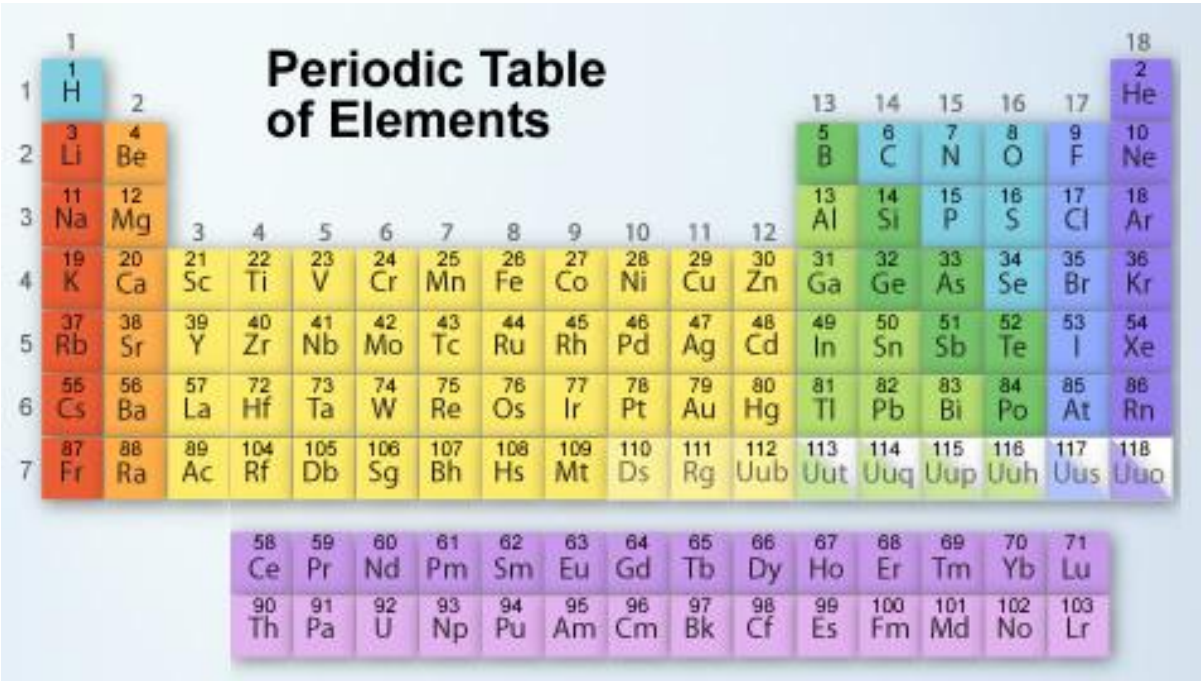
Problem Solving: Electron Configurations and the Periodic Table

Learning goals
After completing this activity, you will be able to …

- Determine the order in which subshells are filled based on the periodic table.
- Write the theoretical electron configuration of any element.

Note: It would be helpful to have a copy of the periodic table with you as you do this activity.

Introduction
Have you ever wondered about the shape of the periodic table? The organization of elements into columns, or groups, was originally based on their chemical properties. These chemical properties, however, arise from a more fundamental characteristic of atoms: their electron configurations. As you work through the questions below, use a periodic table as a guide.



1. The first row of the periodic table represents the 1*s* subshell (shell 1, subshell *s*). Based on the number of elements in that row, how many electrons can fit into an *s* subshell? Explain.

   _____

   How many orbitals are in an *s* subshell? (Each orbital fits 2 electrons.) _____

2. The first two elements in the second row represent the 2*s* subshell. The remainder of the second row represents the 2*p* subshell. How many electrons can fit into a *p* subshell?

   _____

   How many orbitals are in a *p* subshell? _____

3. The electron configuration for boron is written $1s^2 2s^2 2p^1$. The electron configuration for carbon is $1s^2 2s^2 2p^2$. Based on this pattern, write the electron configurations for nitrogen (N), oxygen (O), fluorine (F), and neon (Ne).

   Nitrogen: _____ Oxygen: _____

   Fluorine: _____ Neon: _____

4. Based on what you have learned so far, what subshell is filled in each of the following sequences?

   Sodium (Na) – Magnesium (Mg): _____ Aluminum (Al) – Argon (Ar): _____

   Potassium (K) – Calcium (Ca): _____ Gallium (Ga) – Krypton (Kr): _____

5. Notice that we just skipped the middle part of the fourth row, scandium (Sc) through zinc (Zn). This is the 3*d* subshell. Count the number of elements in this section.

   A. How many electrons does a *d* subshell hold? _____

   B. How many orbitals does a *d* subshell contain? _____

   C. Based on the periodic table, write the electron configurations of the following:

      Iron (Fe): _____

      Zirconium (Zr): _____

6. You may have noticed that the 4*s* subshell is filled before the 3*d* subshell. Some energy levels overlap with the energy levels above and below, so electrons are added to an energy level with a higher number (such as 4*s*) before being added to an energy level with a lower number (such as 3*d*). You can use the periodic table as a guide to the order in which subshells are filled.

   Based on what you have learned so far, what is the order of subshell filling from 1*s* to 6*s*?

   _____

7. Elements 57 through 71 (La – Yb) represent the filling of the 4*f* subshell.

   A. How many electrons does an *f* subshell hold? _____

   B. How many orbitals does an *f* subshell contain? _____

   C. Based on the periodic table, write the electron configurations for the following:

      Gadolinium (Gd): _____

      Radon (Rn): _____

   (Note: At this point in the periodic table, the filling of subshells becomes less predictable. Lanthanum (La) is not included with the other elements in this row because its last electron goes into the 5*d* subshell rather than the 4*f* subshell.)

8. What subshell is represented by elements 89 through 102? _____

9. What pattern do you notice in the number of orbitals for the subshells *s*, *p*, *d* and *f*? _____

   _____

10. **Putting it all together:** Label each region in the periodic table below with the subshell that it represents. (The first two subshells have been done for you.)