

**Supplemental Instruction**  
**Biology 1441**  
**Spring 2007**  
**SI Leader: Syed Abbas**

Name \_\_\_\_\_

Date \_\_\_\_\_

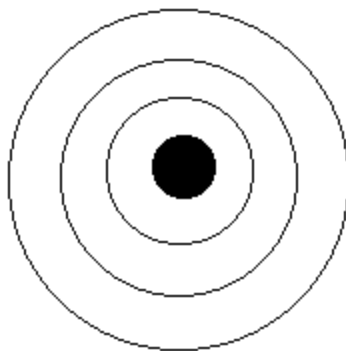
**Handout 3. Drawing Electron Shell Diagrams**

Electron shell diagrams help us visualize how electrons are arranged around the nucleus. Each shell has a certain amount of potential energy that corresponds to the distance of the shell from the nucleus. Therefore, an electron shell farther from the nucleus has greater potential energy than an electron shell closer to the nucleus. Each shell has a maximum number of electrons it can hold:

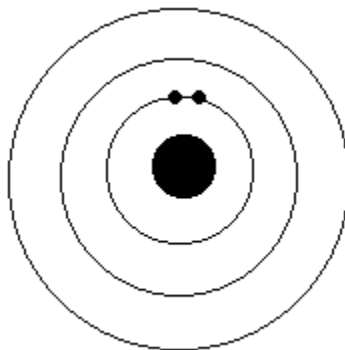
- 1st shell = 2 electrons
- 2nd shell = 8 electrons
- 3rd shell = 8 electrons

If given the atomic number for a neutral atom and using the rules stated above, one can easily draw an electron shell diagram. Remember, the number of electrons in a neutral atom is equal to the number of protons. Electron shell diagrams also help us determine how many valence electrons an atom may have. (Valence electrons are the electrons in the outermost electron shell.) This is important because valence electrons determine the chemical behavior of an atom. The number of valence electrons an atom has can be easily determined graphically. Drawing electron shell diagrams also show us the valence of an atom. The valence of an atom is basically the atom's bonding capacity. Atoms like to have completely full valence shells. The number of valence electrons an atom may have may not be enough for the atom to have a complete outermost electron shell. The valence of an atom is therefore the number of electrons an atom needs to complete its outermost electron shell or its valence shell. Knowing what the valence of an atom is helps us predict what kind of bonds the atom might form.

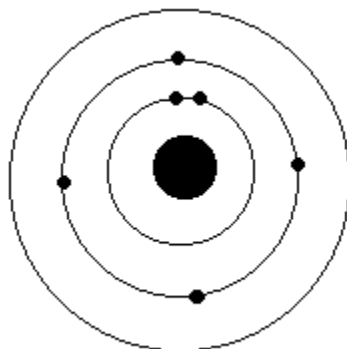
We could simply draw an electron shell diagram out, using the diagram provided below:



1. Since we know that carbon has 6 total electrons we can start placing them in each level, keeping the rules mentioned above in mind. Each electron shell has a certain number of orbitals. Orbitals are basically three-dimensional spaces which electrons occupy most of the time. A single orbital can hold no more than 2 electrons. Therefore, the orbital in the first shell holds two electrons.



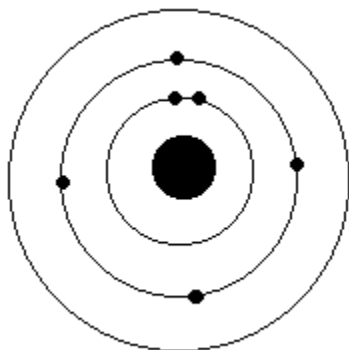
2. Now, since we have placed 2 electrons in the first electron shell, we still have four more to fill in. Since we know that a single orbital can hold no more than 2 electrons, and the 2<sup>nd</sup> shell can hold a maximum of 8 electrons; thus, the 2<sup>nd</sup> electron shell contains 4 orbitals. The rule is to go through and place one electron in each available orbital first before we start pairing them up.



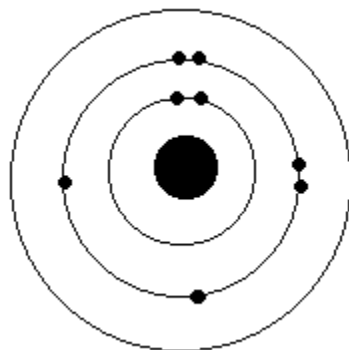
The reason for placing them spread apart is to maximize the distance between the negatively charged electrons contained within the orbitals. Like charges tend to repel each other. As we know, electrons are negatively charged. Now, we have used all of the

available electrons, and there are 4 valence electrons in an atom of carbon.

3. But what if we had more than 6 electrons in an atom? How would we draw them? A good example of such a situation is oxygen. Oxygen has a total of 8 electrons. To show how the electrons are arranged around the nucleus of an oxygen atom, we use the example of carbon above to continue.



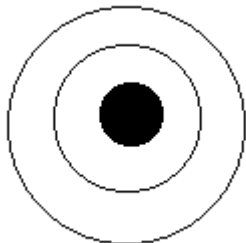
We see in the diagram above that oxygen would still have 2 electrons remaining. Since the 2nd electron shell can hold a maximum of 8 electrons, we can simply pair up two of these electrons. Electrons like to be paired up because electrons occupy three-dimensional spaces called orbitals. And, a single orbital can hold no more than 2 electrons. Therefore, we would have the following electron shell diagram for oxygen:



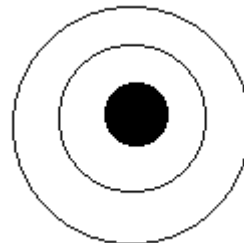
### Practice Diagrams

Instructions: Despite the fact that completed electron shell diagrams may be found in your textbook, it is encouraged that you complete these exercises with only your knowledge and the information provided. Draw the electron shell diagrams for the elements and their given atomic numbers, and write the number of valence electrons next to the element's name.

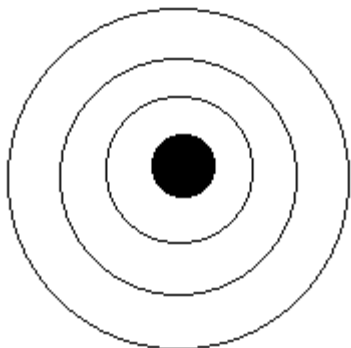
1. Lithium; 3;



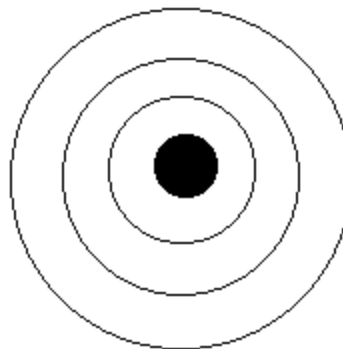
2. Nitrogen; 7



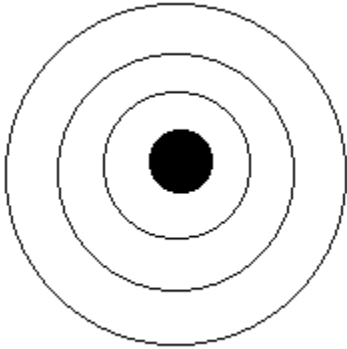
3. Fluorine; 9



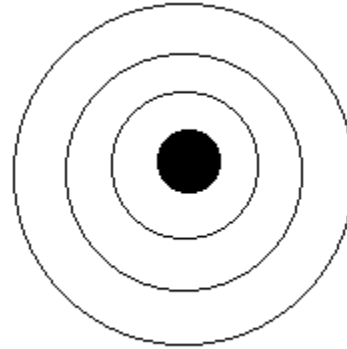
4. Sodium; 11



5. Phosphorus; 15



6. Sulfur; 16



Bibliography: Campbell, Neil A.; Jane B. Reece. Biology. 7th Ed. Pearson Benjamin Cummings: 2005.