Chemistry Lecture #27: Electron Dot Structures.

We've learned that the s orbital has a spherical shape, and a p orbital has a dumb bell shape. Electrons randomly move around these regions of space.

We can draw a picture of the electrons moving around the nucleus of an atom in their s and p orbitals. We'll use the symbol of the element to represent the nucleus, and a dot to represent an electron.

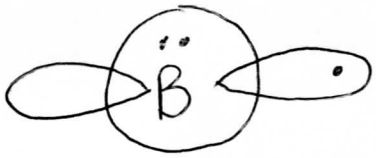
To draw a picture of hydrogen, we first need its electron configuration. The configuration for hydrogen is $1s^1$. So it has one electron in an s orbital. Below is a picture of an electron orbiting the nucleus of hydrogen in an s orbital.

The electron configuration of helium is $1s^2$. Below is a picture of two electrons orbiting the nucleus of helium in an s orbital.

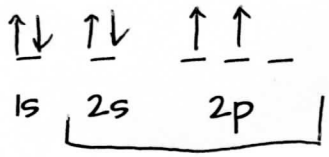
Most of the time we are only interested in the electrons that are in the highest energy level. These electrons are called valence electrons.

If we want to draw a picture of the valence electrons orbiting the nucleus of a lithium atom, we first need the electron configuration. The configuration of lithium is $1s^2\ 2s^1$. The highest energy level with electrons is the second energy level. Thus, the valence electron is in $2s^1$, and we ignore the $1s^2$ term. Below is a picture of the valence electron orbiting the lithium nucleus.

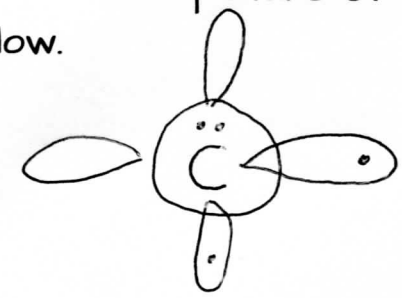
Let's draw a picture of the valence electrons orbiting the nucleus of a boron atom. The electron configuration of boron is $1s^2\ 2s^2\ 2p^1$. The highest energy level with electrons is the 2nd energy level, so we ignore the $1s^2$ term. We draw two electrons in the sphere shaped 2s orbital, and we draw one electron in the dumb bell shaped p orbital.



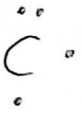
Let's now draw the valence electrons orbiting the nucleus of a carbon atom. This time I'll draw an arrow diagram for the electron configuration.



The highest energy level with electrons is the second energy level, so we ignore the $1s^2$ term. There are 2 electrons in the 2s orbital. There is an electron in one p orbital, and an electron in another p orbital. The picture of the electrons in the s and p orbitals is below.



Most of the time, we only want to see the valence electrons; we aren't interested in the shape of the s and p orbitals. If we draw the picture with only the electrons and the nucleus, the picture for carbon looks like this:

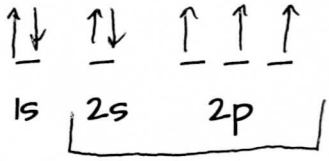


A picture with only the valence electrons and the symbol for the element is called an electron dot structure. It is also called a Lewis diagram.

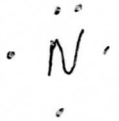
Here are the steps for drawing a Lewis diagram for an atom:

1. Draw the electron configuration for the atom. I recommend using an arrow diagram.
2. Count the number of electrons in the highest energy level. These are the valence electrons.
3. Write the symbol for the element.
4. Put valence electrons at the top, bottom, left or right or the element symbol. Do not put more than 2 electrons on a side. It does not matter which side you put the electrons.
5. Some books tell you to add the electrons one at a time to each side in a clockwise or counter-clockwise manner. This is acceptable. For right now, we just want to get the correct number of electrons around the symbol.

Let's draw an electron dot structure for nitrogen. The configuration of nitrogen is

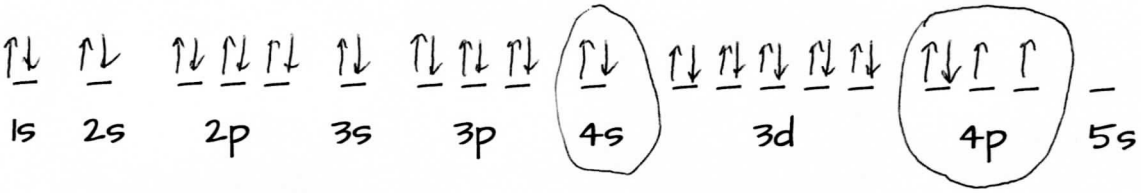


There are 2 electrons in the 2s orbital and 3 single electrons in the 2p orbital. The structure is given below.



Notice that we would get the same structure if we added 5 electrons one at a time to each side.

Let's draw an electron dot structure for selenium. The electron configuration of selenium is



The highest energy level with electrons is the 4th energy level. We ignore the electrons in 1s, 2s, 2p, 3s, 3p, and 3d levels. There are two electrons in 4s and four electrons in 4p. The structure is given below.