The Aufbau Principle and The Periodic Table (Section 4 of Notes, Chapter 7)

Honors Pre-AP Chemistry

Please Read p. 322-329.

To help in understanding the following notes, you need to look at the periodic tables on p. 326, bottom, and p. 327, top.

The table at the bottom of **p. 326** shows the "blocks" of the Periodic Table.

s-block: Groups 1 and 2 (including He). Elements in these groups have their **final electrons** filling into the "s" orbitals on the energy level (n) of that period.

p-block: Groups 13 to 18 (or 3A to 8A). Elements in these groups have their final electrons filling into "p" orbitals on the energy level (n) of the period they are on.

d-block: Groups 3 to 12. Elements in these groups have their final electrons filling into "d" orbitals on energy levels (n) **one less** than the period they are on.
(**Notice**. The d-orbitals are on an energy level one less than the period they fall on. For example, 3-d orbitals of the d block are on the 4^{th} period of the table.)

f-block: Elements 58-71 and elements 90-103 make up the f-block. Their energy levels are **two less** than the period they fall on. (**Notice.** Elements 58-71 follow La which is on the 6^{th} period, and elements 90-103 follow Ac which is on the 7^{th} energy level.)

We do not deal much with elements in the f-block so do not worry about them unless you are going on to study advanced chemistry later in your career.

What does this mean?

Look at the Periodic Table on **p. 327** at the top. The blocks are in color.

Let's pick an element and "build up" their electrons into energy levels and orbitals.

Example: "P" phosphorous has 15 e^-s. These electrons will fill in orbitals starting from the top of the periodic table (where the lowest energy is) and across the periods.

The first 2 e^-s of P are in the **1s orbital** of the P atom. (The 1^{st} e^- is in the 1s orbital, n=1, ℓ =0, spinning "up" and the 2^{nd} e^- is also in the 1s orbital of P atom spinning "down".)

The second 2 e^-s of P are in the **2s orbital** of the P atom (2^{nd} energy level, n=2, s-orbital, ℓ = 0, with one spinning "up" and one spinning "down".)

The next 6 e^-s are filling into the "three" **2p orbitals** of the P atom (2^{nd} energy level, n=2, ℓ = -1, 0, or 1). The first three e^-s of the 6 fill the three orbitals singly spinning "up" first, the last three electrons of the 6 fill the 2p orbitals doubling and spinning "down". (Hund's rule—they fill singly before doubling).

That takes care of the first 10 e^-s of P. We have 5 more to fill orbitals.

The next 2 e^-s of P go into the **3s orbital** (n=3, and ℓ=0) with one spinning "up" and one spinning "down".

The last 3 e^-s of P go into the three, **3p orbitals** (n=3, ℓ= -1, 0, and 1). The three electrons go into the three orbitals of p because they need to fill singly first. **They will all spin "up".**

So Phosphorous (P) will have a configuration as follows:

Electron Configuration: $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^3$

Orbital Diagram: ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑ ↑ ↑

Remember: "up" spin fills first into the orbital and "down" spins fill into orbitals of a subshell after they fill "up" singly.
Notice the last three electrons of P are all spinning up and are singly filled.

The electron configuration and orbital diagrams of an element fill across the table and through the blocks.

I will do one more element for you. Se (selenium) There are 34 e^-s.

$1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^2$ $3d^{10}$

↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓

$4p^4$

↑↓ ↑ ↑

Notice: 4s orbital fills before the 3d orbitals.
Notice: The last 4 electrons in the 4p orbitals fill all three of the p-orbitals "up" first before doubling up and spinning "down".

I will explain how to do the Noble Gas electron configurations for elements and how to find the 4 quantum numbers for particular electrons in different elements in the last set of notes.

I still have Trends in the Periodic Table to cover. There are 5 of them. I will cover them in the 5th and last section but you will not have homework on the Trends.

Homework: Do problems #83, 85, 86, 87, 88. **Do BOTH the electron configurations and orbital diagrams for all the elements regardless of whether they only ask for one or the other. Due April 23, Thursday.**

Watch Video on Electronic Structure again.