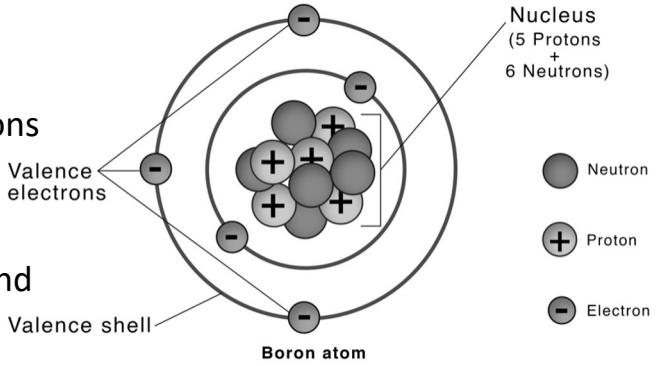
# Subatomic Particles

## Inner and Valence Electrons ($e^-$)

Electrons contain different roles within the atom

**Inner (*Shell*) Electrons**
Provide repulsive force (- to -)
helping protect valence electrons

**Valence (*Outer*) Electrons**
Electrons that communicate
(*transferred or shared*) and bond
(*connect*) with other atoms

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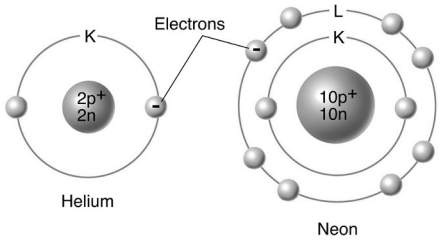
# Subatomic Particles

## Energy Levels

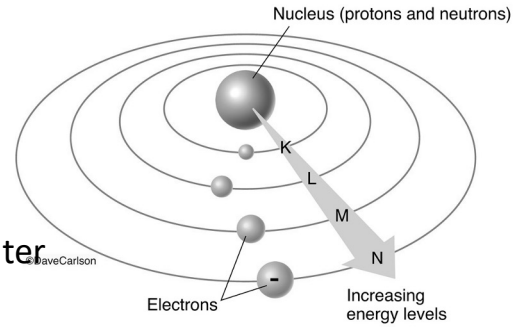
Energy levels are the locations of the electrons within the atomic structure




## Energy Levels and Structure

Inner Energy Levels (*orbitals*)
Locations for the first filling (*inner*) electrons within the atomic structure.

Outer Energy Levels (*orbitals*)
Locations for the final filling (*valence*) outer electrons within the atomic structure.

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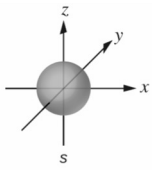
# Subatomic Particles

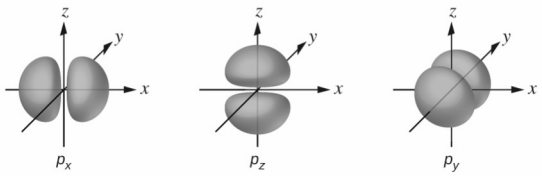
## Atomic Orbitals and Orbital Filling

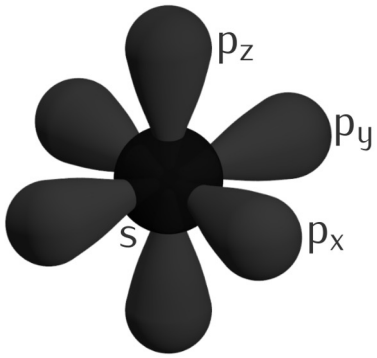
Orbitals are predicted electron locations around the atom to minimize electron repulsion in the orbitals.

0, 1 or 2 $e^-$ allowed per orbital




Electrons always fill one per suborbital before pairing together




**Overall Orbital Set**

8 electrons fit within 4 orbitals in the s, $p_x$, $p_y$, $p_z$ orbital set

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# Subatomic Particles

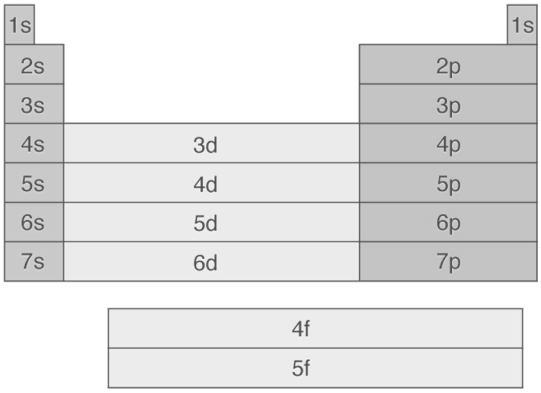
## Orbital Filling and the PT

<u>Down a group on Periodic Table</u>

Additional orbitals form as the atom gets larger down the table making the atom larger overall down the table.

Each larger number is a larger atom
1s → 2s → 3s → 4s → 5s → 6s → 7s

Orbital Types (s, p, d, and f) are the locations elections fill to make the atom larger as additional electrons are added.




The Periodic Table diagram showing the increasing number of each orbital (*s, p, d, f*) as more electrons are added to atomic structures.

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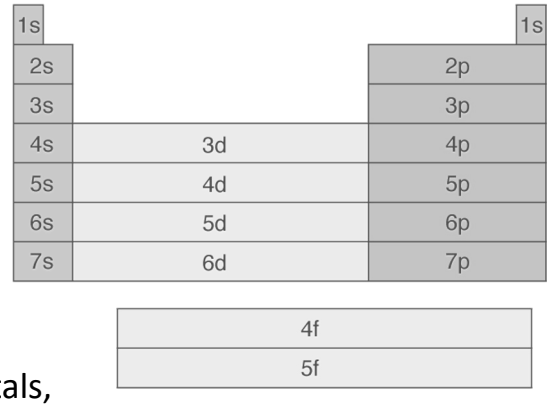
# Subatomic Particles

## Orbital Filling and the PT

Across a period on the PT

Additional electrons get added to the energy levels (*1 – 7*) as electrons are added across the table




S and P Orbital Filling

Two electrons are added to the s orbitals, then adding six electrons to the p orbitals

$ns^1\ ns^2\ np^1\ np^2\ np^3\ np^4\ np^5\ np^6$

$1e^-\ \ 2e^-\ \ 3e^-\ \ 4e^-\ \ 5e^-\ \ 6e^-\ \ 7e^-\ \ 8e^-$

Electrons fill across the table within an energy level (1-7). D orbitals are used for larger heavier elements.

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# Atomic Structure and Groups

Valence Electrons and Energy Levels

| Group | Valence Electrons | Group | Valence Electrons | Period | Energy Levels | | Period | Energy Levels | |
|---|---|---|---|---|---|---|---|---|---|
| 1A<br>1 | 1 | 4A<br>14 | 4 | 1 | 0 Inner<br>1 Outer | 1 Total | 5 | 4 Inner<br>1 Outer | 5 Total |
| 2A<br>2 | 2 | 5A<br>15 | 5 | 2 | 1 Inner<br>1 Outer | 2 Total | 6 | 5 Inner<br>1 Outer | 6 Total |
| 1B - 10B<br>3 – 12 | 2* | 6A<br>16 | 6 | 3 | 2 Inner<br>1 Outer | 3 Total | 7 | 6 Inner<br>1 Outer | 7 Total |
| 3A<br>13 | 3 | 7A<br>17 | 7 | 4 | 3 Inner<br>1 Outer | 4 Total | | | |
| | | 8A<br>18 | 8 | | | | | | |

The number of valance electrons is based on the “A” numbering (1A, 2A, 3A… 1, 2, 3…)

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