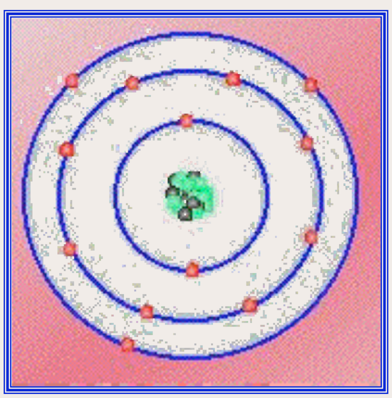
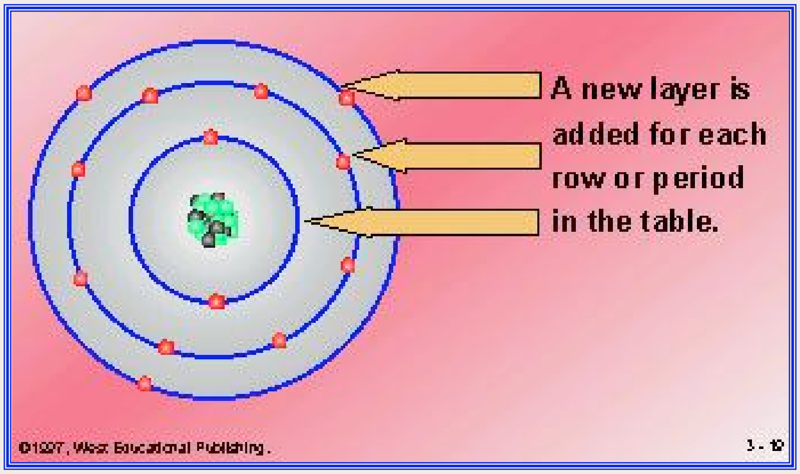
Electron Configuration

Electrons in Layers

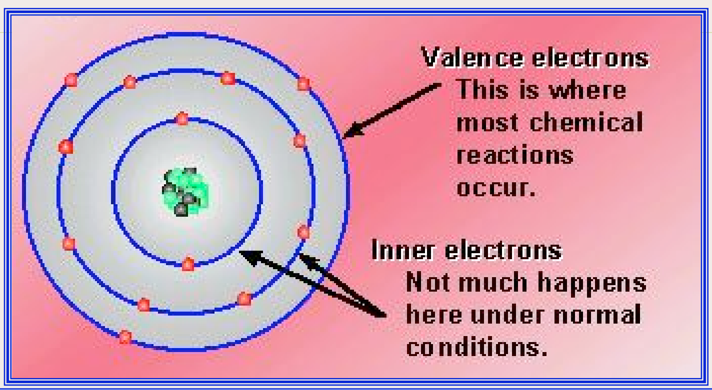


- An atom as a series of layers
- Each layer holds a certain # of electrons
- More electrons can fit in layers that are further out!

Electron Arrangement



Rules for Valence Electrons



Outermost shell (highest value of principal energy level)
= Valence shell

Principle Energy Levels

Each energy level can only hold so many electrons.

Maximum number of electrons = $2 n^2$

Shell (n)	Maximum # of e-
1	2
2	8
3	18
4	32

 3 - 22

Sublevels

n	# of sublevels	types
1	1	s
2	2	s, p
3	3	s, p, d
4	4	s, p, d, f,
5, 6, 7	4	s, p, d, f

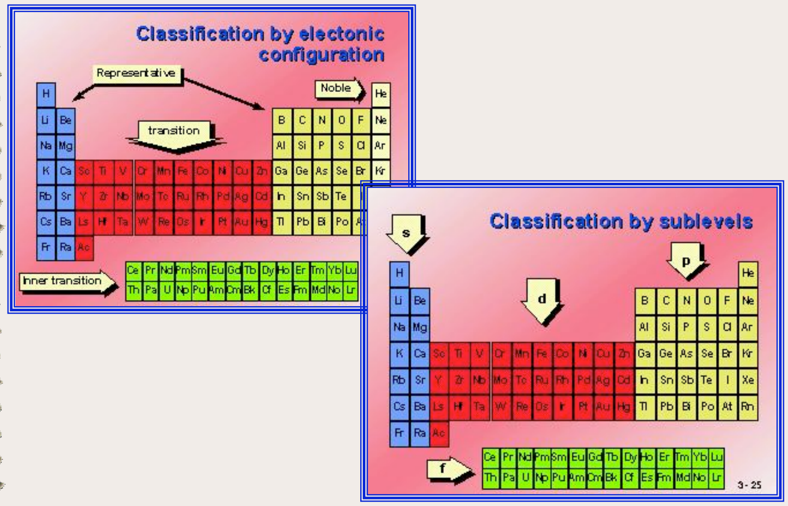
Sublevels

Sublevel	Maximum # of Electrons
s	2
p	6
d	10
f	14

Distinguishing Electron
last electron added to an element

- Representative: **s** or **p** as last electron
- Noble gas: all **s** or **p** filled
- Transition: last electron is in d level
- Inner transition:last electron is an **f**

Classification of Elements

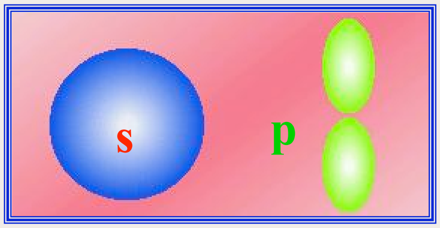


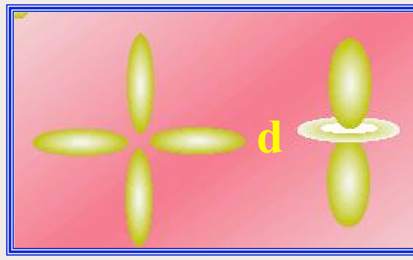
Orbitals

Sublevel	Maximum # of electrons	Number of orbitals
s	2	1
p	6	3
d	10	5
f	14	7

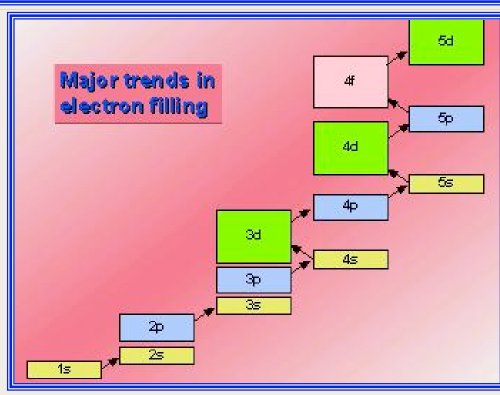
Each sublevel contains orbitals which can hold a maximum of 2 electrons

Orbital Shapes





Order of Filling

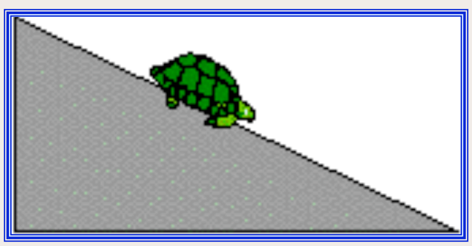


Lowest energy levels fill first

The Octet Rule

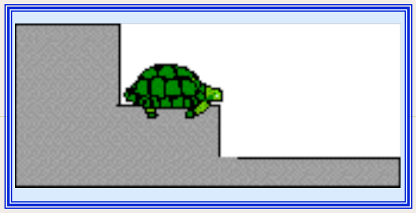
- Atoms are most stable if they have a filled or empty outer layer of electrons
- Except for H & He, a filled layer contains 8 electrons
- Atoms grain or lose electrons to make a filled or empty outer layer
- Atoms gain, lose, or share electrons based on what is energetically easiest

Energy Considerations



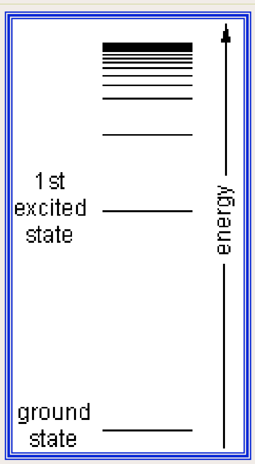
A turtle sitting on a ramp can have ANY height above the ground …and so any potential energy

Energy is continuous



- A turtle sitting on a staircase can take on **ONLY** certain **discrete** energies
- energy is required to move the turtle up the steps **(absorption)**
- energy is released when the turtle moves down the steps **(emission)**
- only **discrete** amounts of energy are absorbed or released (energy is said to be **quantized**)

Hydrogen Energy *Staircase*



bottom step is called the

ground state

higher steps are called

excited states

ground state electronic configuration

- H 1 $1s^1$
- He 2 $1s^2$
- Li 3 $1s^2\ 2s^1$
- Be 4 $1s^2\ 2s^2$
- B 5 $1s^2\ 2s^2\ 2p^1$
- C 6 $1s^2\ 2s^2\ 2p^2$
- N 7 $1s^2\ 2s^2\ 2p^3$
- O 8 $1s^2\ 2s^2\ 2p^4$
- F 9 $1s^2\ 2s^2\ 2p^5$
- Ne 10 $1s^2\ 2s^2\ 2p^6$
- Na 11 $1s^2\ 2s^2\ 2p^6\ 3s^1$

Hints

- the noble gas core under the valence shell is chemically inert
- simplify the notation for electron configurations by replacing the core with a noble gas symbol in square brackets

Valence Electrons

- O $1s^2\ 2s^2\ 2p^4$ He $2s^2\ 2p^4$

  [He] $2s^2\ 2p^4$

- Cl $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$ Ne $3s^2\ 3p^5$

  [Ne] $3s^2\ 3p^5$

- Al $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$ Ne $3s^2\ 3p^1$

  [Ne] $3s^2\ 3p^1$

- Fe Ar $3d^6$ $4s^2$

  [Ar] $3d^6\ 4s^2$

- Sn Kr $4d^{10}$ $5s^2\ 5p^2$

  [Kr] $4d^{10}\ 5s^2\ 5p^2$

- Hg Xe $4f^{14}\ 5d^{10}$ $6s^2$

  [Xe] $4f^{14}\ 5d^{10}\ 6s^2$

- Pu Rn $5f^6$ $7s^2$

  [Rn] $5f^6\ 7s^2$

Sources

- http://online.redwoods.cc.ca.us/instruct/Milo/3/sld001.htm
- http://antoine.frostburg.edu/chem/senese/101/electrons/index.shtml