**AP Chemistry Unit 6 - Bonding - Hybridization Handout**

**Hybridization**

* Mixing of atomic orbitals to make new “hybrid” orbitals of new energy and shape suitable for chemical bonding.
* Concept of mixing atomic orbitals into new hybrid orbital's (with different energies shapes, etc than original atomic orbitals)
* Useful in explaining molecular geometry
* Hybrid bonding
	+ σ bond (sigma)
		- single bond

Single bond – sigma

Double bond – sigma, pi

Triple bond – sigma, pi, pi

* + - free rotation characterized by head on overlap
		- also part of double and triple bonds
	+ π bond
		- double/triple bonds
		- no rotation
		- can only with empty p orbitals
* To create 4 areas around a central atom you need to utilize 4 orbitals (think valence)



 1 s orbital used 3 p orbitals used 4 sp3 orbitals



Example Carbon

4 σ Bonds

0 π Bonds

0 paired

hybridization

P

Energy

S + P + P + P = SP3

S

* Produces 4 singly occupied orbitals
* The energy released by the formation of 2 additional bonds more than compensates for the excitation energy required, energetically favoring the formation of 4 C-H bonds
* To create 3 areas around a central atom, you need to utilize 3 orbitals



 1 s orbital used 2 of 3 p’s orbitals 1 p orbital unchanged

 3 sp2 orbitals

Example SP2 - using N

1 π Bonds

hybridization

P

P

Energy

2 σ Bonds

1 paired e

S + P + P = **SP2**

S

* To create 2 areas around a central atom, you need to utilize 2 orbitals



 1 s orbital used 1 of 3 p’s orbitals 2 p orbitals unchanged

 2 sp orbitals

Example SP - using C

2 π Bonds

hybridization

P

P

Energy

2 σ Bonds

0 paired e

S + P = **SP**

S