# Orbital Hybridization

### Knowledge/Understanding:

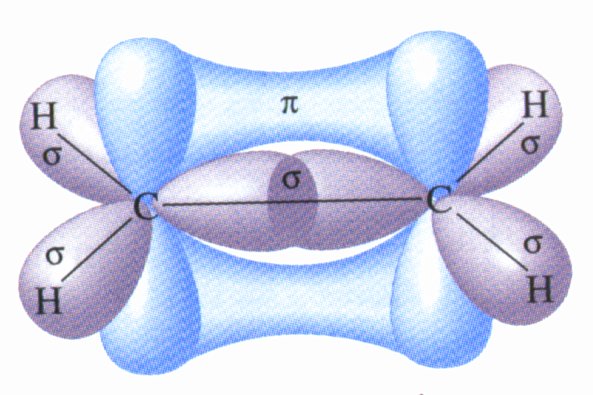
* the meanings of the terms “hybrid orbital” and “hybridization”

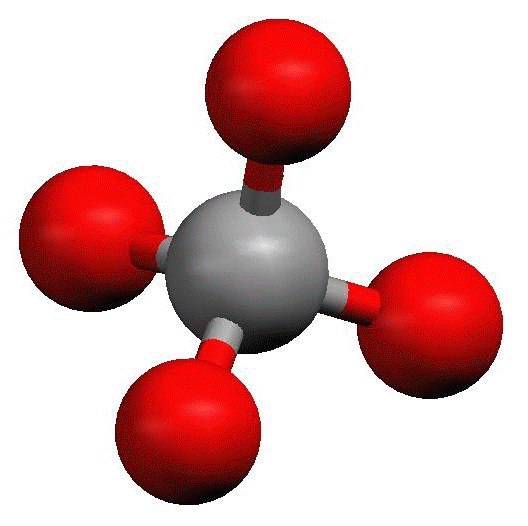
### Skills:

* determine the hybridization of the central atom in simple molecules

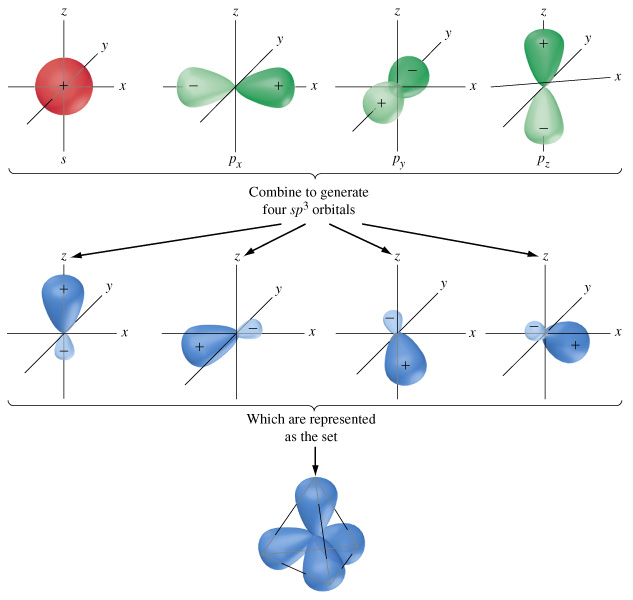
orbital:

hybrid orbital:

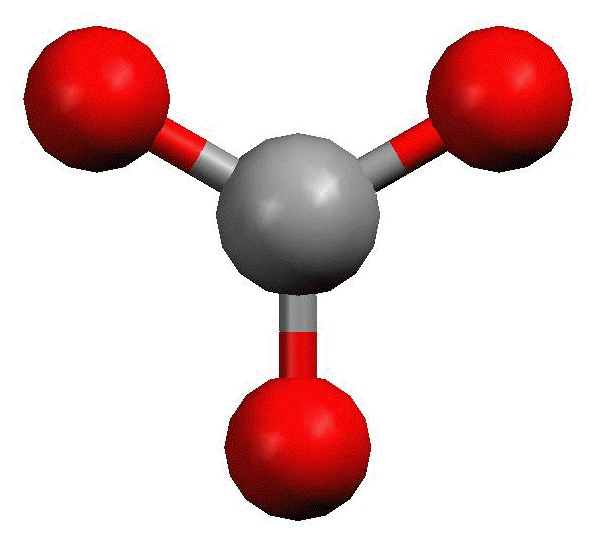
When atoms form covalent bonds, the electrons move to the space between the two atoms. The space where the bonding electrons are is still called an \_\_\_\_\_\_\_\_\_\_\_\_, even though its shape is now *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*from the shapes of the orbitals in the *s*, *p*, *d*, or *f* sub-levels of a single atom.

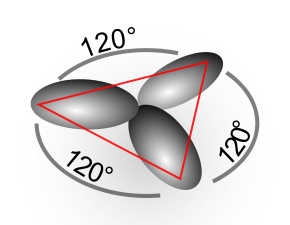
Recall that molecules with \_\_\_\_\_\_\_ electron cloud regions (tetrahedral, trigonal pyramidal, or bent with single bonds, like H2O), are based on a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ VSEPR shape:

The shape of the orbitals is the shape determined by the four electron clouds. It looks like the following:

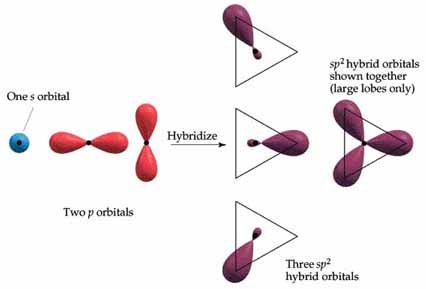


If we wanted to create four orbitals like this one by reshaping the *s* and *p* orbitals of an atom’s valence shell, we would need to start with \_\_\_\_\_ *s* and \_\_\_\_\_ *p* orbitals. We therefore call this bonding orbital an *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*, because it looks like a hybrid between the one *s* and three *p* orbitals.

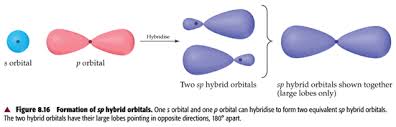
Similarly, molecules with \_\_\_\_\_\_\_\_\_\_\_ electron clouds are based on the trigonal planar VSEPR shape:



This hybrid orbital would come from \_\_\_\_ s and \_\_\_\_ p orbitals, and would be called an *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*:



Finally, the hybrid orbital from \_\_\_\_\_ *s* and \_\_\_\_\_\_ *p* orbital is indeed called an *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*.

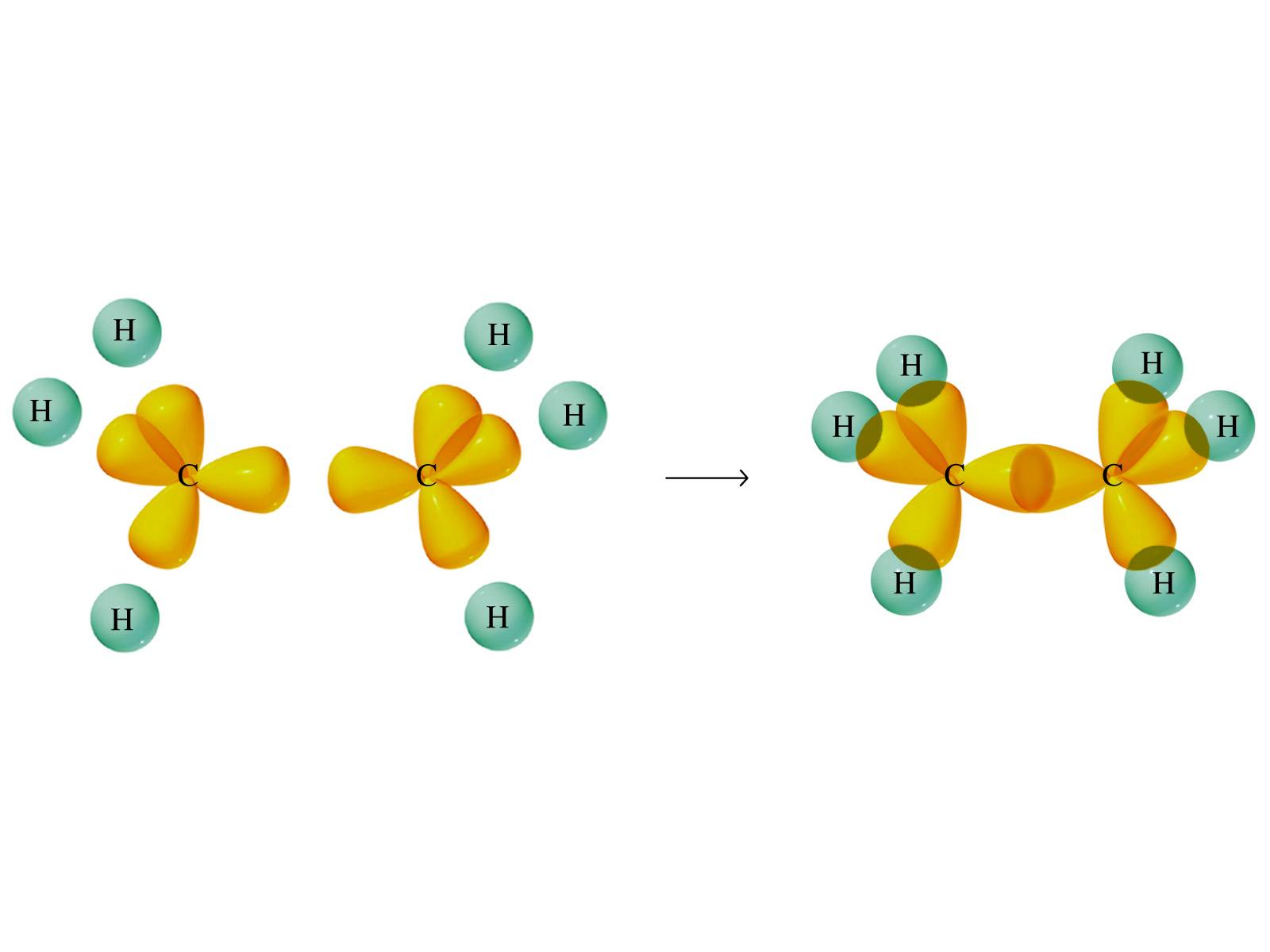


**VSEPR Shapes for Hybrid Orbitals**

|  |  |
| --- | --- |
| Hybridization | VSEPR Shape(s) |
| sp3 | tetrahedral, trigonal pyramidal, bent (104.5°) |
| sp2 | trigonal planar, bent (118°) |
| sp | linear |

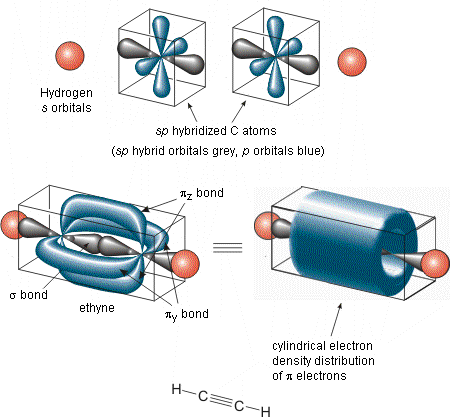
Ex : What would be the hybridization around carbon in a molecule of ethane

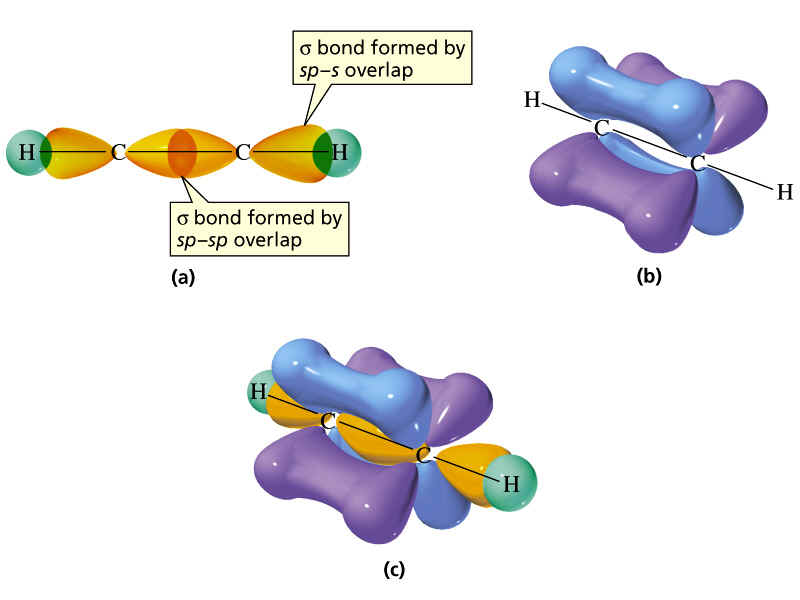
(C2H6)?



Ex : What would be the hybridization around carbon in a molecule of ethyne

(C2H2)?





**What you need to know about geometry (Notes 10D and 10E):**

1. Be able to draw Lewis dot structures with proper formal charges
2. Identify simple molecular geometry shape:
   1. Names (linear, bent, trigonal planar, trigonal pyramidal, tetrahedral)]
   2. Hybridization (sp, sp2, sp3)
3. Identify expanded octet molecular geometry shape:
   1. Names (trigonal bipyramidal, see-saw, T-shaped, octahedral, square pyramidal, square planar)
4. Relative bond angles
   1. Lone pairs repel more than bonded pairs = smaller bond angles
   2. 2 sets of lone pairs repel more than 1 set = smaller bond angles
   3. Double bond repels more than a single bond = uneven bond angles
5. Double/Triple bonds limit bond rotation