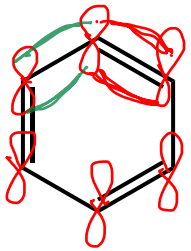
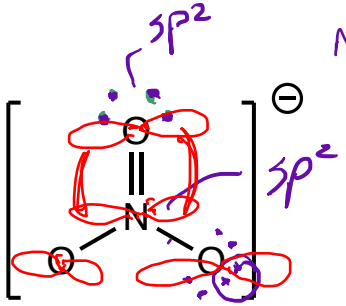
Declocalized Electrons

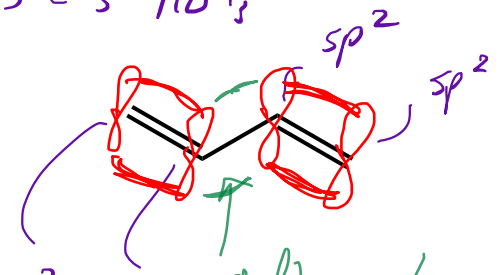
Section 8.1 - 8.4

O atom --- 1 σ bond + 2 pairs lp e⁻'s = 3 hybrids needed

N: 3 σ bonds = 3 HO's







adjacent p orbitals

sp² hybridized C atoms

More than two adjacent p orbitals... a single skeletal structure don't give us enough information about the properties of the molecule. We need to use MO theory or create a resonance hybrid (a new kind of drawing) from a series of resonance contributors (also referred to as resonance structures).

a string of π bonds 1 after the other is really a string of p orbitals

with lone pair e⁻'s ... lp e⁻'s can be reorganized into a p orbital

empty orbitals, like with a C^+, are also p orbitals

No moving atoms

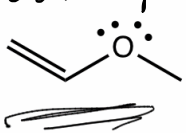
Only move e^-'s: lp e^-'s, π e^-'s, unpaired e^-'s

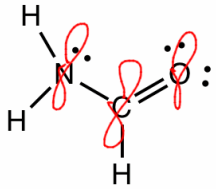
Don't move σ-bonds

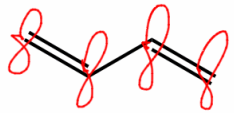
Not all possible drawings of resonance contributors are considered relevant... (more to come on this point later)

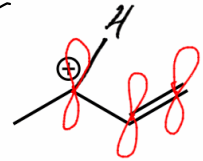
Using modeling kits to draw resonance structures

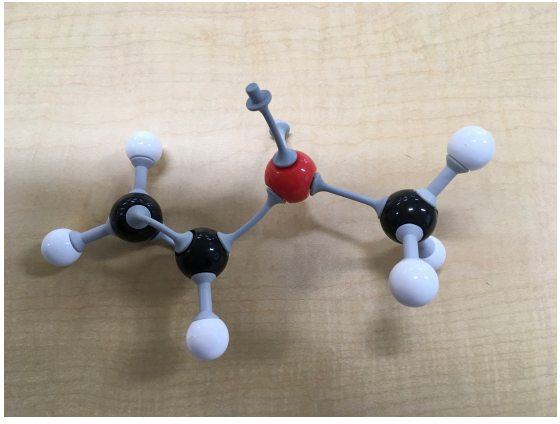
Model all e⁻'s... use O atoms with 4 holes
For all bonds not to H atoms use the bendy bonds
All H atoms are connected with short bonds
Lone-pair e⁻'s are modeled using the bendy bonds



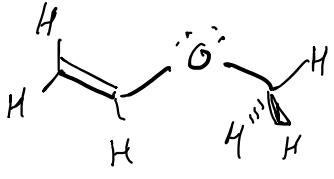








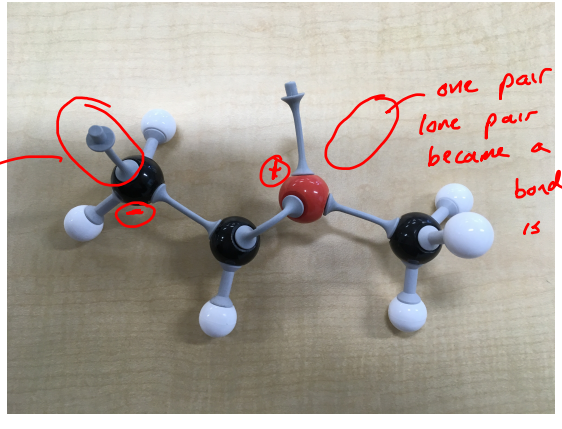
Build the molecule + line up one pair of lone-pair e^-'s with π bond



add lone-pair e^- & H atoms to drawings if that helps you keep track

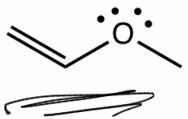
Disconnect π bond from C atom closest to lone-pair e^-'s on O, but leave the e^-'s connected to the C atom at the other end of the π bond.

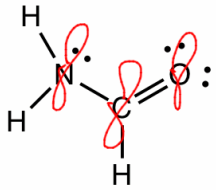
Connect lone-pair e^-'s to C atom that had its π bond removed.

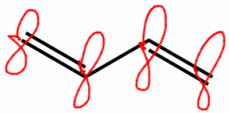


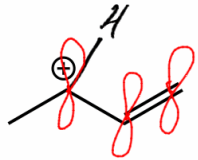
Using modeling kits to draw resonance structures

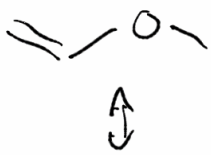
Model all e⁻'s... use O atoms with 4 holes
For all bonds not to H atoms use the bendy bonds
All H atoms are connected with short bonds
For lone-pair e⁻'s use bendy bonds

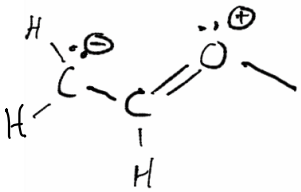


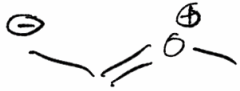




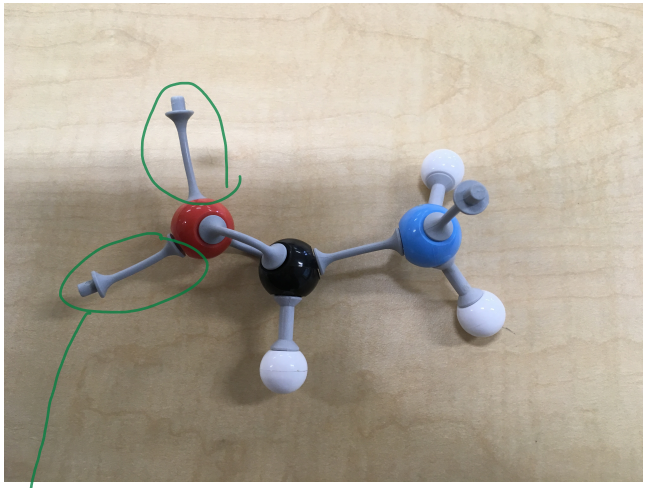




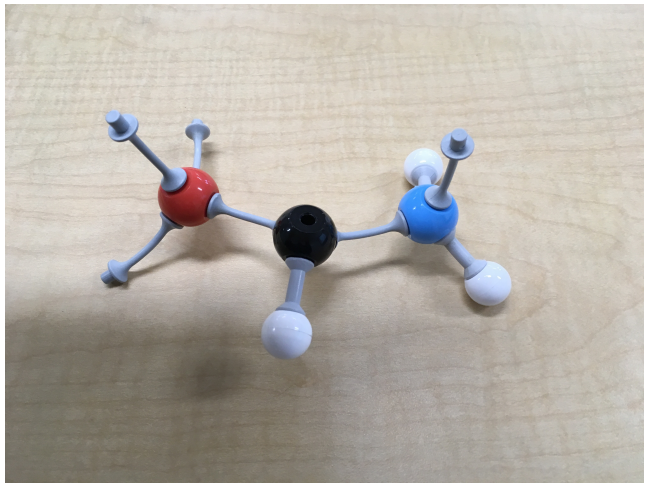




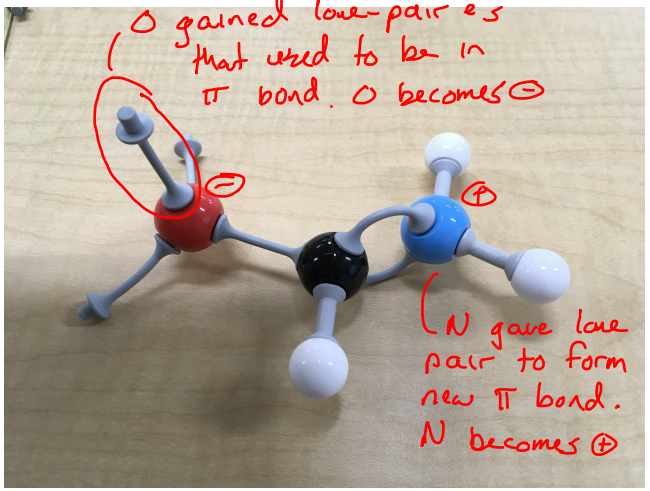
remember, not a reaction.
Just using arrows to keep track of drawings



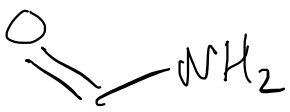
Build your molecule
short bonds for bonds to H atoms
bendy bonds for all other bonds + lone-pair e^-'s
Ignore these lone-pair e^-'s, they are perpendicular to the π bond.



Pull the π bond off of the C atom while leaving the e^-'s connected to the O atom.

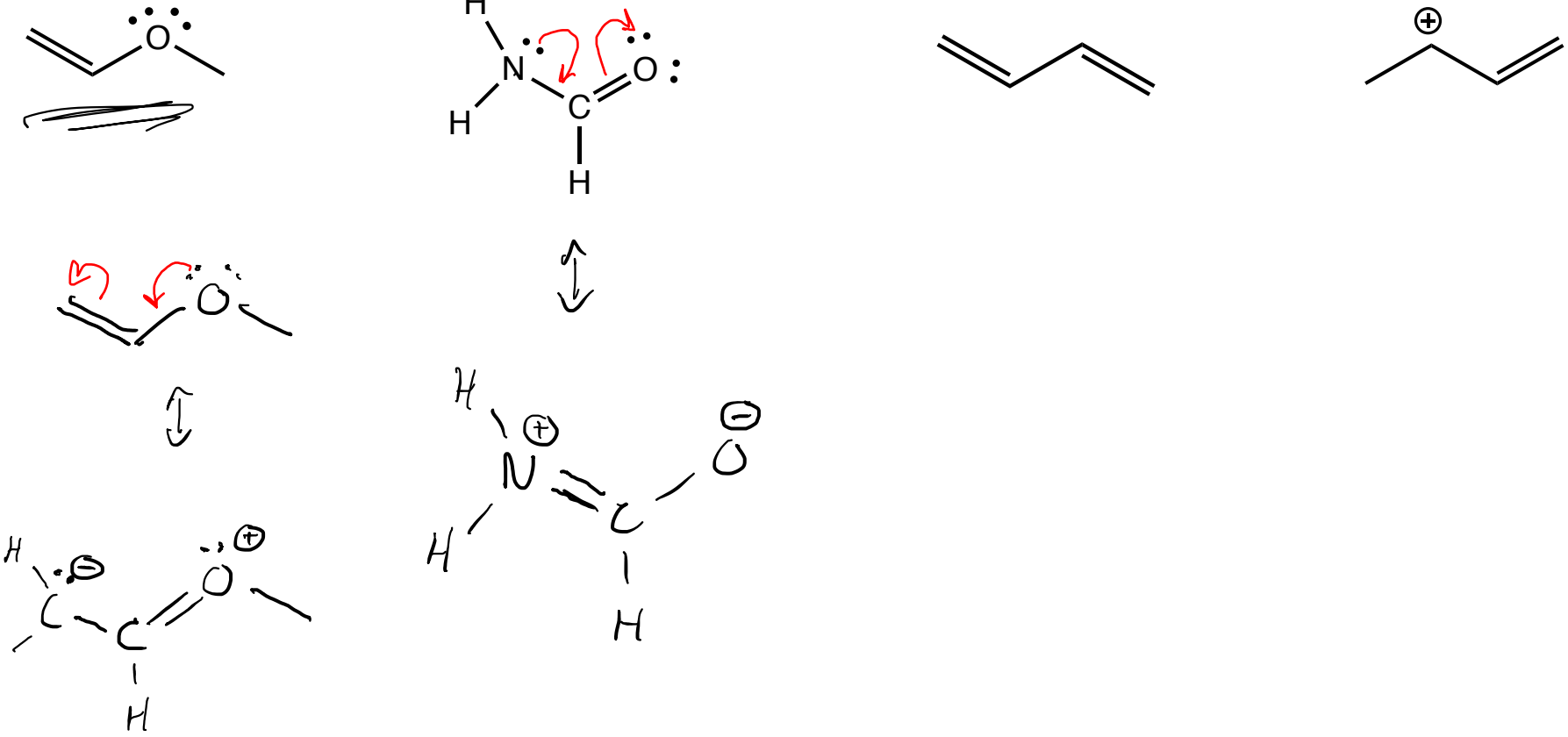


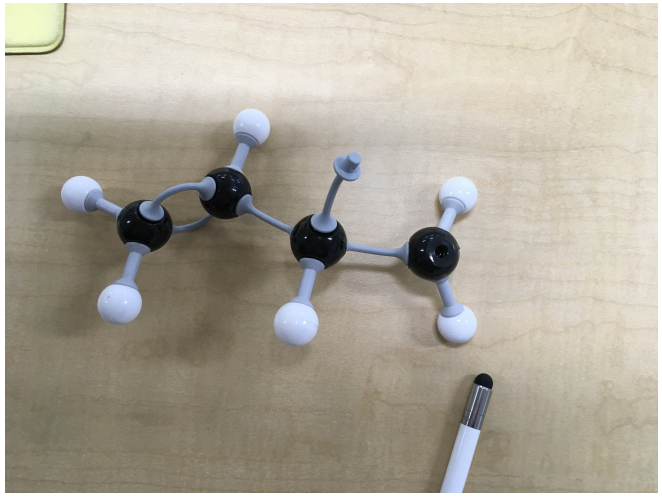
Take the lone-pair e^-'s on the N and connect them to the hole that was just created on the C.



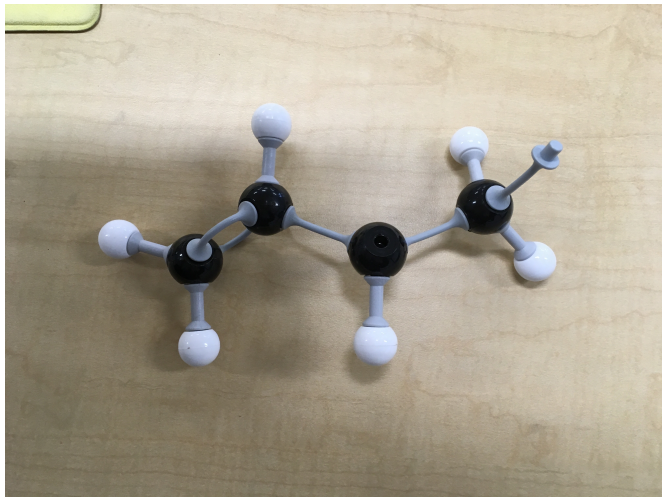
Using modeling kits to draw resonance structures

Model all e⁻'s... use O atoms with 4 holes
For all bonds not to H atoms use the bendy bonds
All H atoms are connected with short bonds
For lone-pair e⁻'s use bendy bonds

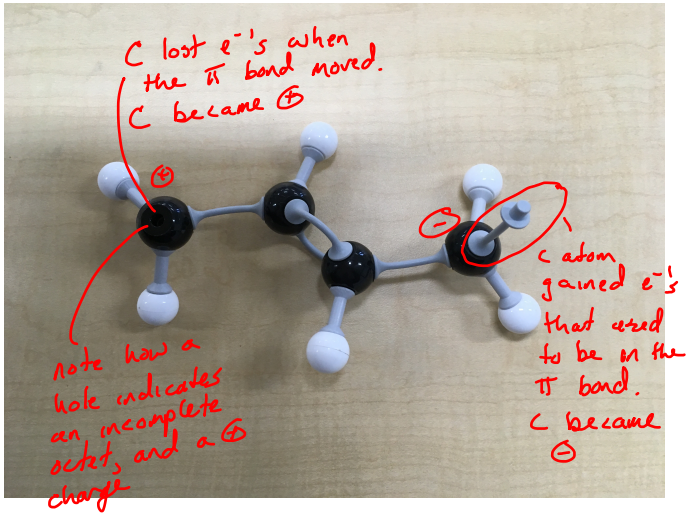




Build your molecule. If you disconnect the wrong end of the double bond there won't be a move available.



Just reconnect the bond and pull the other end free.



Pull the far end of the other π bond free, and connect it to the hole that became available from the last move.

Using modeling kits to draw resonance structures

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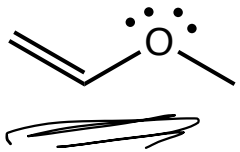
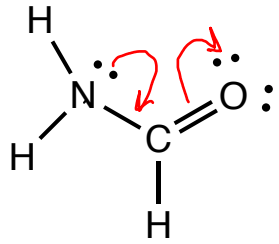
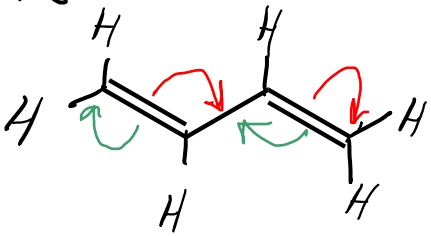
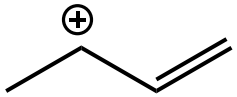
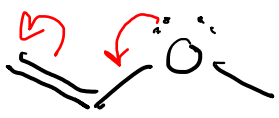
All H atoms are connected with short bonds
For lone-pair e⁻'s use bendy bonds

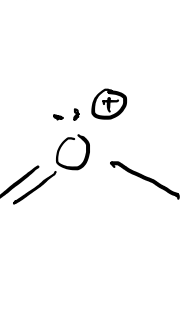


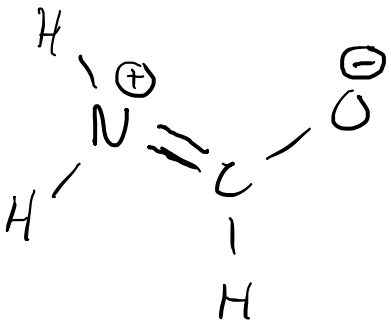


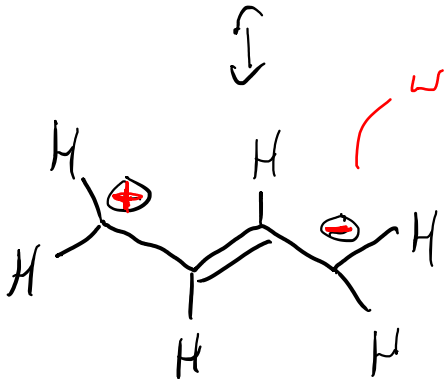




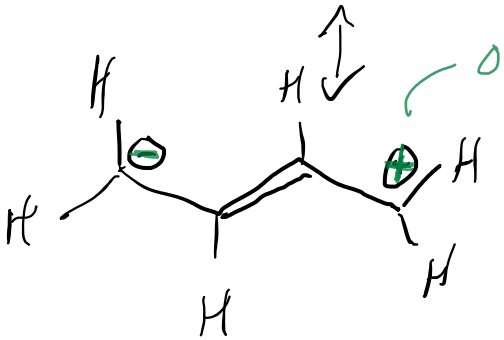








we can move e⁻'s from the left to the



or we can move e⁻'s from the right to the left

Using modeling kits to draw resonance structures

Model all e⁻'s... use O atoms with 4 holes
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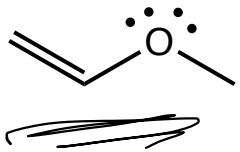
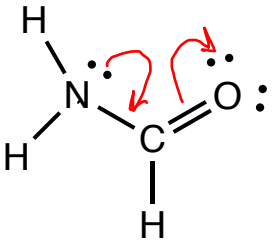
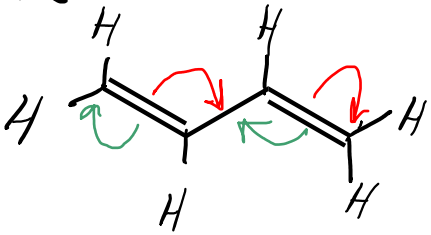
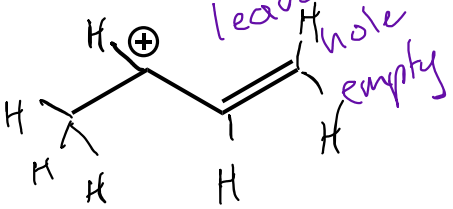
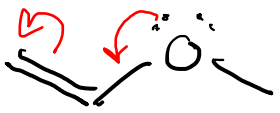
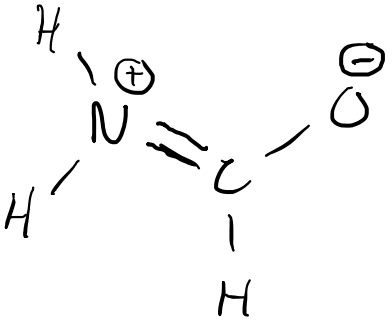


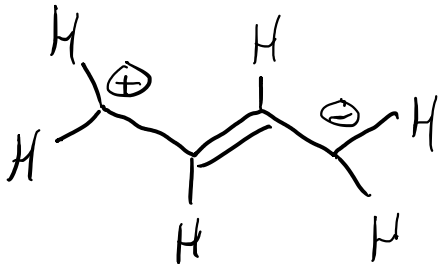


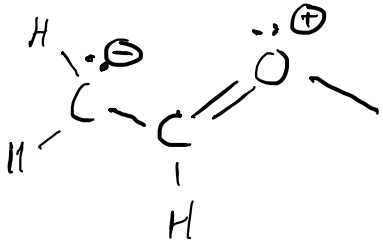


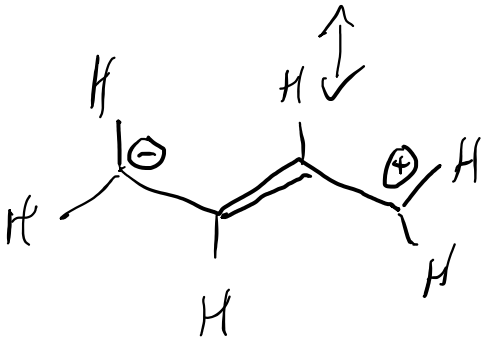


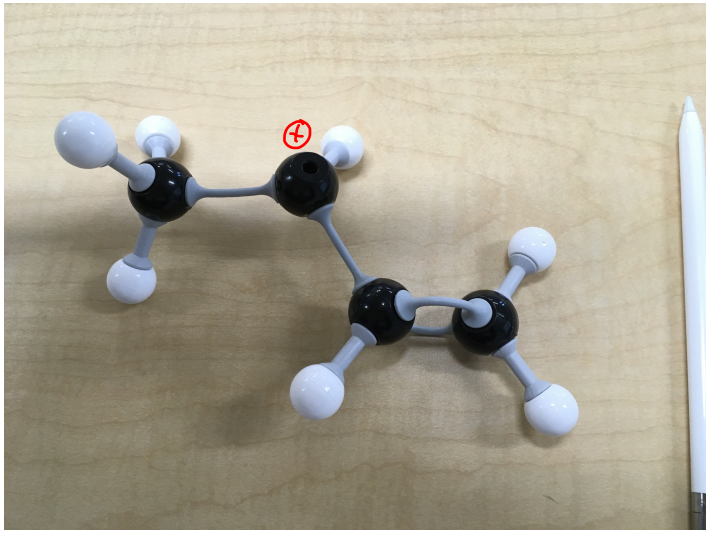






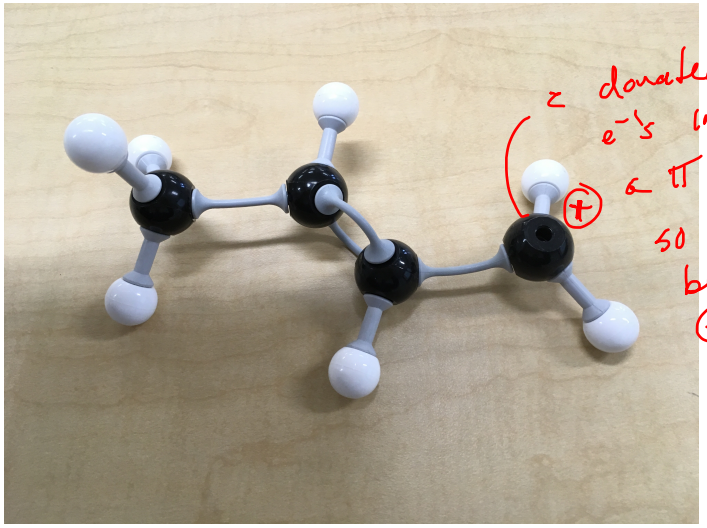






Line up the hole so it is aligned with π system.

Pull π bond from far right and attach to the $C^{\oplus}$ which already had a hole.



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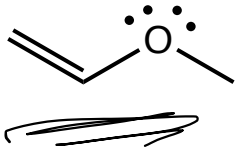
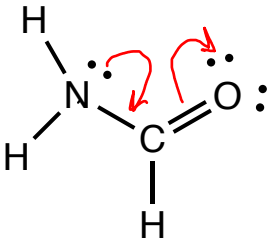
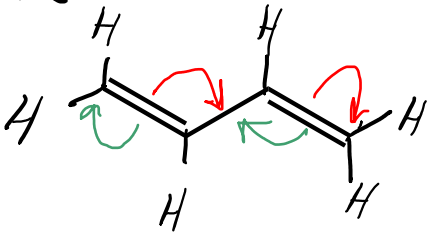


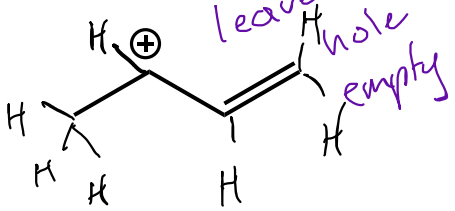


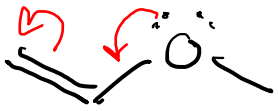


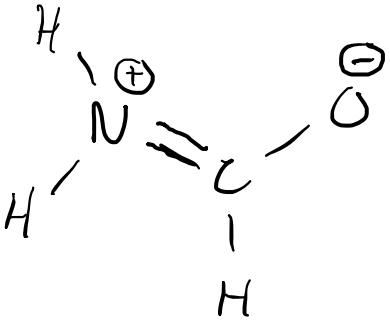
bonds

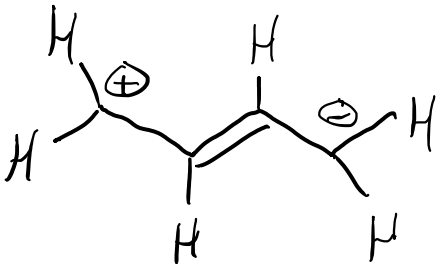
now do we model the CO?

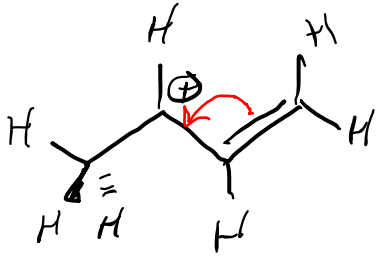
leave a hole empty

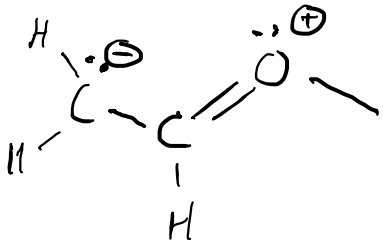


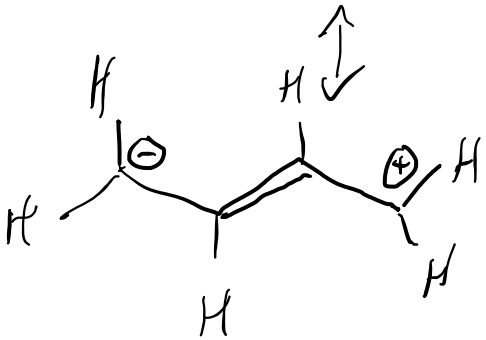


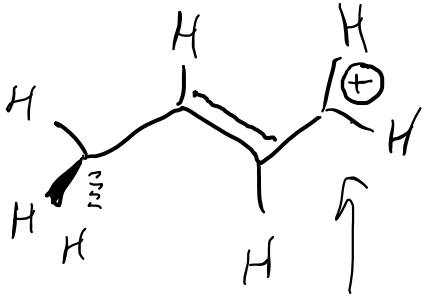






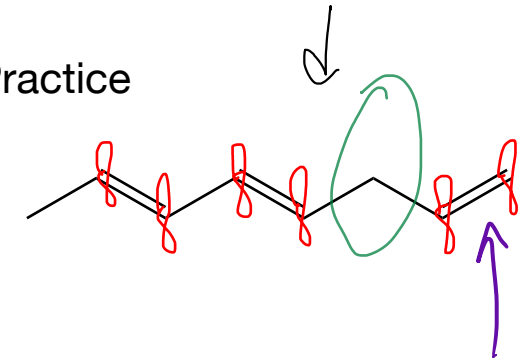




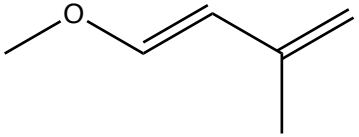


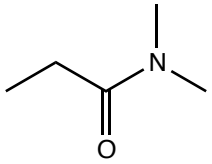
not a 1° C⁺

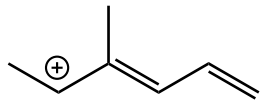
Practice



leave me alone!







Weighted Averages: The good, the bad, and the ugly