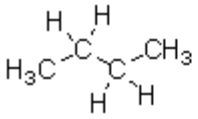
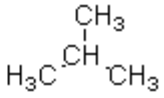
Dr. Davies
Organic I Chemistry
**Determination of isomers from molecular formula**

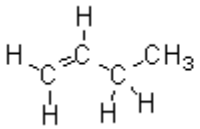
Hydrocarbons containing only single bonds between carbon and hydrogen are said to be saturated. All noncyclic saturated hydrocarbons fit the formula $C_nH_{2n+2}$.

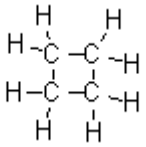
Suppose a molecule has a molecular formula of $C_4H_{10}$, is it saturated? Completing the formula, where n = 4 (the number of carbons), and 2(4)+2=10. Therefore, we conclude the molecule is saturated, and any 4 carbon noncyclic isomer with only single bonds will fit this formula.

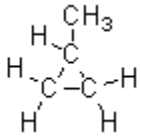




Suppose our molecule has a formula of $C_4H_8$. This compound is 2 hydrogens short of saturation, or equal to 1degree of unsaturation. Therefore, any 4 carbon isomer with 1 double bond, or 1 ring will fit this formula.

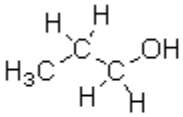


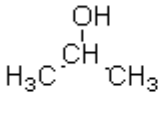


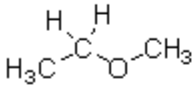


How does **oxygen** effect this formula? Not at all. If a compound has the formula $C_3H_8O$ the compound is saturated. If the compound has a formula $C_3H_6O$, it has one degree of unsaturation in the form of a double bond or a ring.

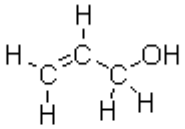
**$C_3H_8O$**

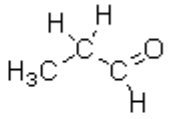


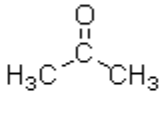


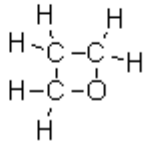


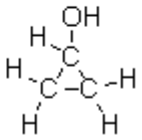
**$C_3H_6O$**





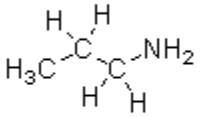


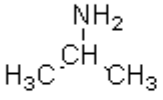


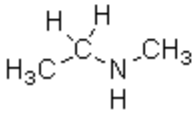


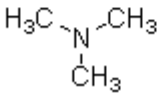
For every **nitrogen** in the formula, one additional hydrogen needs to be added to the formula. Therefore, a compound with a formula of $C_3H_9N$ would be saturated, while a compound with formula $C_3H_7N$ would have one degree of unsaturation.

**$C_3H_9N$**

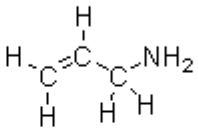


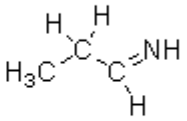


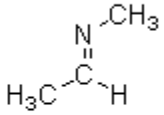


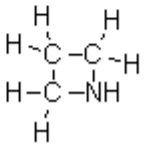


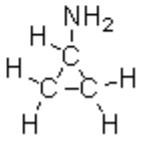
**$C_3H_7N$**











**Halogens** (F, Cl, Br, I) are similar to hydrogen in that they form one bond with other atoms. Therefore, for every halogen present subtract one hydrogen from the total. So $C_3H_7Br$ is a saturated compound.