CHM 2201 Fall 2007
Organic Chemistry Lab I
Department of Chemistry
Villanova University

Learning to Use the Molecular Model Kit and the Basics of Isomerism

If you haven't already done so, buy a "Molecular Visions" molecular model kit from the stockroom. It is the kit that comes in the green plastic box.

Here is what we'll cover in today's lab:

1) **The Common 2nd Row Element Presentations (pp 10-11 of the model kit manual)**

With the help of your professor and TA's, together we are going to go through some of the contents of your kit. We will follow what is on pages 10-11 of the manual that came with your kit.

Note: try to learn which pieces are needed to make organic compounds; also note how to put all the pieces back in the box as it is a tight fit and every piece has a particular place!

2) **Assembly and Disassembly of Atoms "With Bonds" (pp 15-17)**

Carefully follow the descriptions on making an sp^3 hybridized atom, and making atoms joined by a double bond. It is important to learn how to put these pieces together properly and securely, and learn how to take them apart efficiently.

3) **Constructing a variety of molecules**

We'll begin by keeping things simple: putting together molecules containing only carbon and hydrogen, frequently called *hydrocarbons*.

And we'll start off with *saturated* acyclic hydrocarbons. What does this mean? Saturated means all the carbons are sp^3 hybridized (or maybe a better way to think of it is that the molecule is saturated with hydrogens, thus all carbon-carbon bonds present are single bonds). Acyclic means "non-cyclic", meaning there are no rings of carbon atoms present, which says that from any carbon atom in the molecule, you cannot traverse along the carbon chain and get back to the same carbon you started from.

Exercise #1

Try putting together these molecules with your models, given the molecular formula (name in parentheses):

CH_4 (methane)

C_2H_6 (ethane)

C_3H_8 (propane)

Note how three-dimensional these systems are, and how many different shapes (what organic chemists call *conformations* or *conformers*, the latter is short for 'conformational isomers') that ethane and propane can have. Various conformers of a hydrocarbon are obtained by rotating about the C-C single bonds.

You will learn from lecture that there is usually considered to be "free rotation" about C-C single bonds. Note that *free rotation* is in quotes. That is

because there are barriers to the rotation about C-C single bonds, but these barriers are usually very small and the thermal energy present at ambient conditions (i.e. ~20 °C) is sufficient that the barriers are easily traversed..

Question #1: What is the general formula for a saturated acyclic hydrocarbon?

Exercise #2

Now put together a molecule with molecular formula C_4H_{10}.

You probably put together this one, didn't you?

$CH_3CH_2CH_2CH_3$

The molecule above is known as *n*-butane (where the '*n*' stands for normal, meaning somehow it is 'normal' in organic chemistry when all the carbons in a molecule are bonded together one after the other, in one continuous chain). Note that *n*-butane is also commonly written on paper as the following *carbon skeletal diagram* (also called a *bond-line formulas*):

Note that in this notation a carbon atom is implied at the end of each line (unless some other atom is explicitly written), and that none of the hydrogens are drawn. In this type of drawing, the only atoms explicitly shown are those that are not carbon or a hydrogen bonded to carbons (but hydrogens bonded to other atoms like N or O are shown).