Volume 25, Issue 3

C_3 News

Fall 2000

Newsletter of College Chemistry Canada/La Chemie Collégialle au Canada

President's Report

Bob Perkins

Well here we are nearly through the fall semester!! I'm teaching second year organic chemistry in-between my activities with the KUC Faculty Association. I have been dealing with a couple of cases in which students have launched complaints with administration over faculty members demanding too much work in some of their courses. I am certain that many of you have been hearing similar rumblings over the years. My impression is that some of our students in the last few years are demanding more and more from our institutions while at the same time they are willing to put less and less into their courses. Luckily such students are in the minority, but it does concern me when a student says to me you can't expect me to work this hard; I don't at my job, and they pay me to do that.

As the time demands on our students (as well as ourselves) increase, many individuals discover that there are simply not enough hours in a day to address everything that needs doing. A typical textbook in chemistry now contains more material than one can hope to cover in two semesters of classroom exposure. My classroom style has changed over the past 10 years, I am now spending less time lecturing and more time working with groups of students. This change in style is to help them develop the critical-thinking/problem-solving skills necessary to cope with this rapidly increasing body of knowledge. My hope is that these skills will also be transferable to their other subjects as well as their lives outside the classroom.

Is it working? It is always gratifying to hear back from students once they have gone on to other things. This past month included a note from a mature student now in dental school in Nova Scotia, another one from a student in medical school in the US, and another from an engineering student at UBC. The common theme from all three was the thanks for encouraging (forcing?) them to approach learning from the process rather than the content perspective. There is more to learning than simply trying to memorize lecture notes; unfortunately, many of our students have used that technique for too many years to believe that there is any other way of handling the enormous volume of material in their courses. I like to think that I have been successful convincing some of them otherwise.

Anyway, enough on that topic. The preparations for our joint conference in Montreal next May are going well. Have a look at the symposia topics on the Web and consider making a submission. Bob Browne (Douglas College) is the contact for General Papers and I am looking after Exam Question Exchange. My thoughts on this are that we all have some unique/neat ways of testing specific topics in our courses and that it would be a great forum to discuss them over a beer during a poster session. Please also consider sending in a short note to Norm describing what is happening at your institution.

All the best for the rest of the semester.

Bob Perkins – President

Inside This Issue

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Hands On Isomers - Part 1
IUPAC Nomenclature

Bob Perkins

Presented in part at the 83rd Canadian Society for Chemistry Conference and Exhibition, May 27-31, 2000 at Calgary Alberta.

Of the approximately 25 million unique chemical compounds presently known, over 95% of them can be classified as organic; i.e., they contain at least one carbon atom. The IUPAC system of nomenclature was established in order to have a common method to name these organic compounds. Most introductory chemistry courses have a small section on simple organic molecules and naming is usually restricted to hydrocarbons. Students are expected to memorize the prefixes/suffixes for the various functional groups as well as the number of carbon atoms contained in the molecule.

Over the past few years I have been decreasing the amount of memorization that I expect from my students and concentrating more on developing their critical thinking and problem solving skills using cooperative problem-based learning. Over the next few papers in this series I will present a mini-course in organic chemistry and show how I have used this approach to allow my first year students to improve the skills mentioned above.

The first aspect of this approach is that I view the prefixes/suffixes for the various functional groups as well as the number of carbon atoms contained in the molecule as information that the students should have in front of them at all times. I consider it to be same situation as providing a copy of the Periodic Table of elements. On every midterm exam (as well as final exam) I provide the students with the information shown below.❄

Homologous Series of Alkanes

methane CH_4 ethane CH_3CH_3 propane $CH_3CH_2CH_3$

butane $CH_3CH_2CH_2CH_3$ pentane $CH_3(CH_2)_3CH_3$

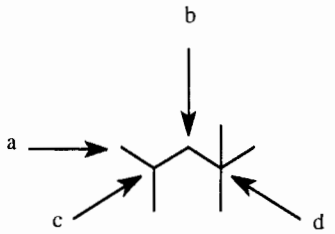
hexane $CH_3(CH_2)_4CH_3$ heptane $CH_3(CH_2)_5CH_3$

octane $CH_3(CH_2)_6CH_3$

nonane $CH_3(CH_2)_7CH_3$

decane $CH_3(CH_2)_8CH_3$

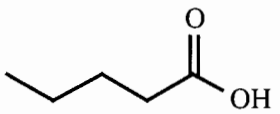
I use the zigzag notation for drawing organic molecules (it is initially confusing for students, but saves time drawing structures later on as they become more comfortable using it) and stress that since carbon must always have four covalent bonds, the number of hydrogen atoms present at any carbon atom may simply be obtained by subtracting the number of bonds from four. Using this method, for the molecule 2,4,4-trimethylpentane, carbon a is connected to three hydrogens, carbon b is connected to two hydrogens, carbon c is connected to one hydrogen and carbon d is connected to no hydrogens.



2,4,4-trimethylpentane

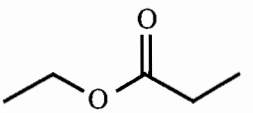
Carbon a is classified as being primary as it is attached to only one other carbon atom, and the hydrogen atoms bonded to carbon a are known as primary hydrogen atoms. Extending this concept leads to the designation of secondary for carbon b, tertiary for carbon c and quaternary for carbon d. The students could also quickly determine that the compound contains fifteen primary hydrogen atoms, two secondary hydrogen atoms and one tertiary hydrogen atom.

Functional Groups



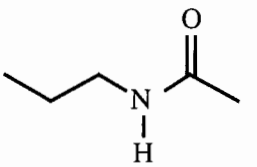
pentanoic acid

(carboxylic acid)



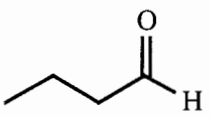
ethyl propanoate

(ester)



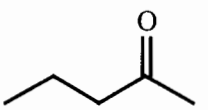
N-propyl ethanamide

(amide)



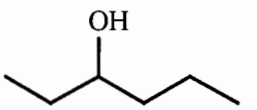
butanal

(aldehyde)



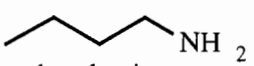
2-pentanone

(ketone)



3-hexanol

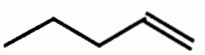
(alcohol)



butylamine

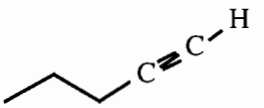
or 1-butanamine

(amine)



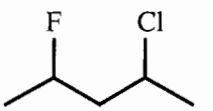
1-pentene

(alkene)



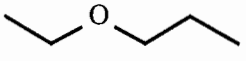
1-pentyne

(alkyne)



2-chloro-4-fluoropentane

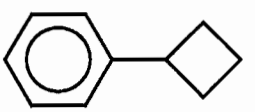
(alkyl halide)



ethyl propyl ether

or 1-ethoxypropane

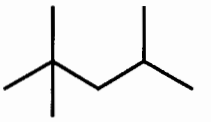
(ether)



cyclobutylbenzene

or phenylcyclobutane

(alkyl benzene)



2,2,4-trimethylpentane

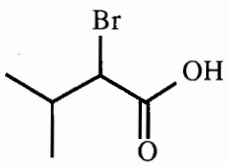
(alkane)

Functional Group Priorities & Prefixes/Suffixes

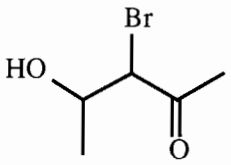
Functional Group	Prefix	Suffix
carboxylic acid	----	-oic acid
ester	----	-oate
amide	----	-amide
aldehyde	oxo	-al
ketone	oxo	-one
alcohol	hydroxy	-ol
amine	amino	-amine
alkene	enyl	-ene
alkyne	ynyl	-yne
alkyl halide	halo	----
ether	oxy	-ether
alkyl benzene	phenyl	-benzene
alkane	yl	-ane

The functional group at the top of the list (carboxylic acid) has the highest priority for naming, the functional group at the bottom of the list (alkane) has the lowest priority for naming. I indicate to the students that a compound which contains several functional groups can be named by finding the group with the highest priority and ending the name with the appropriate suffix. The presence of the other functional groups can be indicated by using their appropriate prefixes.

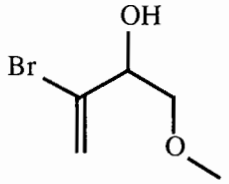
Here at Kwantlen we are fortunate to have a class set of molecular models. During class I have the students work in groups of three to build molecules using the same molecular formula, draw the structures using the zigzag convention, and then provide their IUPAC names. I have each group put their molecules on the blackboard so that the rest of the students can see that there are many possible isomeric structures for the same molecular formula (more about this in Part 2 of the series). I will illustrate the process by considering four compounds (**A**, **B**, **C** and **D**) which have the same molecular formula $C_5H_9BrO_2$.



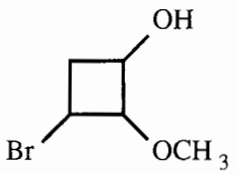
A



B



C



D

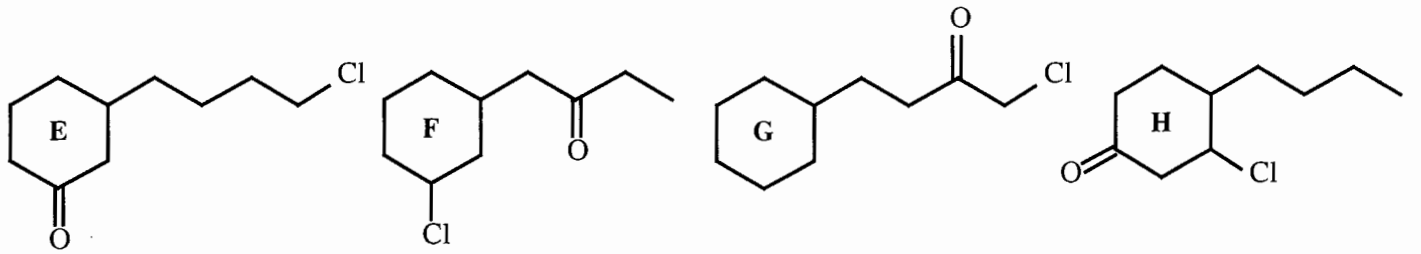
Compound **A** has a carboxylic acid as part of a longest chain of four carbon atoms with a Br atom connected to carbon number 2 and a methyl group connected to carbon number 3. The complete IUPAC name for the compound would be: **2-bromo-3-methylbutanoic acid**

Compound **B** has an alcohol and a ketone in addition to the Br atom. According to the priority listing of functional groups, a ketone is more important than an alcohol. Using the same procedure as above, the complete IUPAC name for the compound would be: **3-bromo-4-hydroxy-2-pentanone**

Compound **C** has an alcohol, an alkene and an ether in addition to the Br atom. The alcohol is the most important functional group and therefore must receive the lowest number when deciding where to begin naming the compound. Using the same procedure as above, the complete IUPAC name for the compound would be: **3-bromo-1-methoxy-3-penten-2-ol**

Compound **D** has an alcohol, an ether and a ring in addition to the Br atom. The alcohol is again the most important functional group and therefore must receive the lowest number when deciding where to begin naming the compound. Using the same procedure as above, the complete IUPAC name for the compound would be: **3-bromo-2-methoxy-1-cyclobutanol**

The students quickly discover that by making small changes in the structure of a molecule they are forced to come up with very different IUPAC names. I will finish **Part 1** by considering the following four isomeric compounds **E**, **F**, **G** and **H**.



The names of all four compounds will end in -one as the ketone functional group is the most important. As the highest priority functional group, the ketone must also receive the lowest possible number. The use of brackets will be required to separate two substituent numbers for compounds **E** and **F** as the two functional groups are on different parts of the molecule; i.e., one on the cyclohexyl portion and the other one on the butyl portion.

In compound **E** carbon number one is where the ketone group is located. At carbon number three on the ring we have a butyl group attached. The first carbon atom out from the ring is numbered as one, the chlorine atom is therefore attached to carbon number four. The use of a set of brackets for the butyl side chain will result in the following IUPAC name: 3-(4-chlorobutyl)-1-cyclohexanone.

In compound **F** carbon number one is where the four carbon chain is attached to the six-membered ring. The chlorine atom on the ring is attached to carbon number three as the point of attachment to the higher priority butyl chain must occur at carbon number one. The use of a set of brackets for the cyclohexyl side chain will result in the following IUPAC name: 1-(3-chlorocyclohexyl)-2-butanone.

The naming process for compounds **G** and **H** can be done in the same way, resulting in the following IUPAC names:

Compound **G**: 1-chloro-4-cyclohexyl-2-butanone
Compound **H**: 4-butyl-3-chloro-1-cyclohexanone

With the examples presented, and using the sheets of information described above, your students should now be capable of naming hundreds of different organic molecules. The use of a nomenclature computer software package like Beaker will also assist them in mastering this necessary skill. In Part 2 I will examine how the various types of isomeric structures possible for the same molecular formula may be classified.

LETTERS TO THE EDITOR

Dear C3 Colleagues:

During the last few years, several institutions like my own have undergone the transition from community college to university college. Though such a change opens up new opportunities and challenges, it can also have negative attributes. I would like to gather the opinions of C3 members at other colleges on both the positive and negative effects on their chemistry departments, where the mandate has changed. If I receive enough comments, I will put together a summary for C3 News. All comments will be treated in confidence. If I wish to quote from any communication, I will contact the individual and ensure that the quote can be used without compromising their anonymity.

Thanks,

Geoff Rayner-Canham
Sir Wilfred Grenfell College – Memorial University of Nefwfoundland
grcanham@swgc.mun.ca

The Appearance of Favouritism in College Programs

By: Bill Blann

Keyano College, Alberta

The appearance of favouritism is an important consideration in programs involving a high level of student-instructor contact, as is found in many small college situations. This note was written in response to a suggestion of favouritism raised on a student assessment of one such program, and offers some thoughts and ideas on the problem.

In a program involving a wide range of student contact (in the case in point from 51/2 hours per week for one group up to 14 hours per week for the other) there is always the attendant danger that getting to know the individuals of one group much faster than those of the other may register in some students' minds as the result of preferential treatment. Beyond being aware of the potential problem of apparent favouritism, and being attendant should any student raise a concern, one can only really guarantee against actual favouritism in a way that is consciously built into the methods of assessment and grading schemes.

I do not worry about the effects of open door consultation, in which students who show up at the office more frequently get more attention - the door is equally open to all and the amount of attention a student gets is thus in the hands of the student. It is essential that official office hours are chosen so as to equalize the chances of student access - I maintain 2 hours at good times for the engineers, 2 for the scientists and one that fits both timetables - although this differentiation is cosmetic with the open-door availability. Most of the student assessment in my courses is comprised of exams and lab reports: these are easily dealt with by grading schemes that break the mark for each report or exam into fragments covering the individual details required, coupled with the grading of short sections of a submission across the whole class rather than grading paper by paper. Strict rules governing late submission penalties are generally followed, carefully advertised in the published course outlines. Although excuses are individually assessed and more often than not allowed, nobody abusing the system would gain significantly. (Even so, this may be a source of apparent favouritism.) Exam dates and conditions are advertised at the beginning of courses, and if modifications are required to meet any individual student need these are carefully reported and cleared with an immediate supervisor. (In the light of Freedom of Information and Protection of Information this constitutes being as open as possible with the actions.)

The perception of students may also be affected if a student should succeed in abusing the system without giving any clear evidence to warrant action. Students have seldom brought such concerns to me. On one occasion this term a student did raise a complaint (indirectly, during conversation, and when it was too late to look into the matter or take any justifiable action) of a fellow student seeming to gain unfair advantage through my leniency with her submissions. In discussing the matter I tried to reassure the plaintiff that I could do nothing, having seen no sufficient cause for suspicion; and that although the object of her complaint was seeming to get away with it, that person could not gain any real advantage. The problem at this stage results from the absolute necessity of not disclosing information about student performance to others, regardless of perceived injustices. One can only advise the plaintiff of the proper channel: to carry the complaint to higher authority - which in this case was done. (Students seldom have the nerve to approach auuthorities with complaints.) In the event, the student thought to be gaining unfair favour was already reaping penalties accorded by the marking schemes and managed thereby to drop her final grade point significantly. In fact I am still uncertain whether this student was trying to take advantage, or whether she was put at a disadvantage by her adverse conditions, but the grading methods did deal with her fairly according to what she produced.

RENEWALS

IF YOU WOULD LIKE TO CONTINUE RECEIVING C_3 NEWS, PLEASE REMEMBER TO RENEW YOUR ANNUAL MEMBERSHIP. FORWARD A $20 CHEQUE MADE PAYABLE TO "COLLEGE CHEMISTRY CANADA" TO THE TREASURER, JACKY MCGUIRE.

ONLINE ?

VISIT THE C_3 WEB SITE AT www.c3.douglas.bc.ca FOR MORE INFORMATION AND ARCHIVES.

Notes From the Editor

Norm Reed
University College of the Cariboo

A warm welcome to all C3 members to this issue of C3 News, my first issue as editor. No doubt this note finds you swimming (drowning?) in work as the term is coming to an end and exams are fast approaching or already underway. Indeed, it never ceases to amaze me how, 'in the fullness of time' (a phrase often repeated by a colleague of mine here at UCC!) everything that really needs to get done, gets done. One can always use more time for just browsing the library, contemplating professional development activities or research and tinkering in the lab. This term finds me with two excellent and very keen fourth year research students (called 'directed studies' courses here at UCC), both of whom are working on synthetic methodology projects. Their obvious anticipation and hunger for good experimental results is encouraging. We all wish we could spend more time in the lab. For future issues of C3 News I plan to write a series of articles on the historical background and current developments related to my research interest, which is aromatic directed lithiation. Later parts of the series will discuss how I am incorporating the experimental and theoretical aspects of directed lithiation into some of the regular upper level labs and lectures here at UCC, in addition to the student directed studies projects mentioned above.

Now that I am on the topic of submitting something to C3 News, I want to strongly encourage all C3 members to be always contemplating what they can be preparing for submission to this newsletter. This issue contains a variety of excellent submissions: an article from Bob Perkins (Kwantlen University College) on using the discovery approach with students for teaching organic nomenclature, an interesting commentary by Bill Blann (Keyano College) on perceptions of student favouritism in the classroom, and a letter by Geoff Rayner-Canham (Sir Wilfred Grenfell Colege – MUN) encouraging discussion on the changes some departments face as they move from being part of a College to the University College model. I have placed Geoff's article under the title 'Letters to the Editor', and I would like to encourage further submissions in the form of such short letters on any topic you feel appropriate for C3 News. I see one purpose for C3 News being a place where all college chemistry instructors can participate in any number of dialogues on subjects related to the teaching and learning of chemistry.

As editor I will welcome any and all articles that are relevant to chemistry and, of course, in particular, chemical education. I encourage you and your colleagues to let the college community of chemists know about: a particular good demo you use, excellent problems and examples you use in your teaching, cool historical facts you mention to your students, software you find useful in teaching chemistry, important activities going on in your department and college/universities, a summary of a visiting speakers talks that you heard recently, your students' successes in careers, scholarships etc., an interesting research paper, monograph, or other chemistry related article you have seen recently, any good web sites you have seen....the list of possibilities is endless and the articles need not necessarily be long. If you are considering or have a longer article on hand I will be more than willing to publish it in parts over a couple of issues. In addition to written articles we can use any relevant photos. Photos and articles may be submitted as email attachments, or as plain text in an email. Photos are best submitted as jpeg files in black and white that have been scanned originally at a minimum of 100 dpi on a flatbed scanner. If you are submitting an attached text document (particularly with chemical structures), it is best submitted in Word97 or Word2000 format. I look forward with anticipation to some interesting reading! I also look forward to any ideas you may have at any time for improving C3 news. I am contemplating also sending out an electronic copy of every issue to those who would like to receive it. If you are interested in receiving an electronic copy (Word97 or Word200 format), please let me know by email. Our next issue will be in early January and will feature some details on the up coming CIC/C3 conference in Montreal.

Best in Teaching and Chemistry to you all!
J. Norman Reed

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