

Ventura College Sabbatical Leave Final Report for Fall 2013

Organic Chemistry 12A & 12B Laboratory Manual Development, Modern Instrumentation Implementation, & Curriculum Enhancement

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Final Summary

I was able to successfully complete my sabbatical project, which included the development and writing of two lab manuals for my organic chemistry courses. This was a large undertaking and I was only able to complete the books in a timely manner as I was on maternity leave prior to my sabbatical. The first organic chemistry lab manual needed to be ready for Fall semester 2013 when my sabbatical was to begin – I wanted to ensure that the instructor taking over my course while I was gone had an efficient, easy-to-navigate, and safe lab manual to use with the first semester organic chemistry course. Therefore, I wrote the first lab manual and created a new laboratory website for students during the summer of 2013 – thank goodness my newborn daughter took lengthy naps! The lab manual and website were utilized with the start of the semester and the new instructor had no problems using either. The second lab manual and further website/curriculum development were completed in Fall semester 2013 during my scheduled sabbatical. When I returned for Spring semester 2014, I implemented the second semester lab manual.

In addition to the development of new lab experiments and alterations of some existing experiments, I also made sure each experiment utilized modern instrumentation including the use of our ‘newer’ Spectrum 65 Infrared Spectrophotometer. Still being developed is the use of our brand new Gas Chromatographs (mini-GCs) with our existing labs – but they need to be calibrated and made sure to function well before implementing them into the coursework. Also, we just received in May, the donation of a industry-grade Gas Chromatograph and I am currently being trained on it – I plan on using this GC with existing labs as well in Fall 2014.

The lab manuals are all downloadable (free) on our class website: www.venturacollegeorganicchemistry.weebly.com. This saves students a lot of money as they don't have to purchase an expensive organic lab manual. Also, most students have been simply printing the prelabs and postlabs, which are completed as part of their experiments, and instead of wasting paper to print the lengthy labs, they utilize their iphones, ipads, and laptops. This is a great benefit to the environment and student costs.

The website also includes an important Technique page where students receive training on all of the major techniques they will use throughout the entire year including distillations, recrystallizations, NMR, etc.... I was able to include real

pictures of apparatuses that I came in and set-up during my sabbatical – now students can see what a set-up truly looks like. This has been really beneficial to students and time-saving for faculty as well - students can always refer back to the website at anytime – they don't need to have their instructor set it up every class or repeat their lecture constantly (which is definitely not possible due to tight time constraints in an organic lab).

In essence, I thoroughly enjoyed my sabbatical project – it was a lot of work, but positive-work, which needed to be completed. It would not have been realistic to only write one lab manual now and wait 7 years for another sabbatical to write the second manual – the organic chemistry courses would not be fluid that way and there would have been a ton of confusion. Now I feel better about having other instructors teach the course (when I am gone) as they have an appropriate model to follow and use. I am also very happy with the project and it definitely lessens the teaching load with an efficient manual for students to use – now I can spend more productive time answering students questions and helping them with the concepts, rather than trying to navigate and alter our old manuals.

Thank you for this opportunity and I am truly excited to develop another project that can benefit our college in the future.

-Michelle Hagerman

Background of Sabbatical Project

General Organic Chemistry 12AL and 12BL (Chem V12AL & V12BL) comprise a full year of transferrable laboratory courses in conjunction with the lecture portion of the course (Chem V12A & V12B). Organic Chemistry is the reactionary study of life as it involves detailed analyses of carbon-based molecules (including amino acids & proteins, as well as other biological functional groups); students learn the reaction mechanisms that support life, the syntheses of important molecules and medicinal drugs, techniques of isolation and purification, and the theories of instrumentation that allow the discovery of unknown molecules. The course has more than doubled in size since I began teaching it 4 years ago, and would continue to grow if we had more available courses/instructors. We currently offer 1 lecture course (50 students) and 2 lab sections (each 6hr lab with two 3hr days). This course is very popular – we have undergraduate and graduate students from Ventura, Oxnard, Moorpark, Simi Valley, CSUCI, UCSB, CSUN.

It is a very time-consuming course, yet rewarding, as course success translates into a more competitive academic resume for those students trying to earn admission into medical, pharmacy, dental, veterinarian, and other graduate/research degree programs. It is considered an upper division course at state 4-year universities (ie: CSUCI, CSUN), and our VC organic courses are fully transferrable to all CSUs, UCs, and most private institutions. However, some of these schools are still wary of the level of instruction received at community colleges and require students to pass an organic assessment exam to waive the course on their

campuses. Therefore, it is imperative that our course maintains it high level of instruction, all our SLOs are implemented in the instruction, current safety standards are upheld, and the curriculum is updated to support our expanding modern instrumentation – all of which needs to be provided in an accessible student-friendly format to increase learning potential.

At present, our lab manual is a collection of experiments from a variety of publishers that is failing to meet our curriculum standards and requiring me to compile constant handouts on experimental changes, new set-ups, and new protocols. I took over the course 4 years ago - the first year I had the course, the students were required to use a \$200 lab book (novel style) in which they only used half of the book – I got rid of this immediately the second year. With limited time, I was able to pull together a Pearson Catalyst “collection-style” \$50 lab manual where I was able to hand-pick labs (however, very limited with respect to organic chemistry).

The major problem is that organic chemistry is very complex and the amount and variety of equipment to be implemented is astounding – each university varies in the type of glassware and equipment they have – there is not a “one size fits all” lab manual to be implemented. I have been trying to “make do” with this “hodge-podge” of labs, but the complications are endless: The experiments call for equipment/glassware that is not consistent with what we have available; the labs lack experimental background detailing any of the reaction mechanisms; there are no preparatory pre-lab questions; there are a few post-lab exercises, but most are not used as they do not have anything to do with modern organic curriculum; the procedures are written in a paragraph/novel style which is very difficult to decipher when an experiment has up to 25 steps; and finally, there are no technique or instrumentation protocols or diagrams.

I have looked at several schools state-wide and out-of-state (CSUCI, UCSB, Moorpark, CU Boulder) and all of these colleges have their own developed lab manuals consistent with curriculum, and consistent with the equipment/glassware/and chemicals available on each campus. It is important that I develop our lab curriculum and lab manuals to fit our college while meeting all transferability and SLO requirements.

Purpose of Sabbatical Project

The purpose of this sabbatical is to develop two lab manuals – for Organic Chemistry 12AL and 12BL, that will be available online for the students to download free of charge. These lab manuals will incorporate newly developed curriculum (IR, NMR, qualitative analysis, and other researched “green” experiments to replace health hazardous labs), will incorporate remote instrumentation via CSUCI, and will completely modify all existing lab experiments that ultimately pass the safety test.

This is a fairly large, but truly necessary task comprising 32-34 lab experiments each entailing: prelab questions, postlab questions, MSDS chemical safety data sheets, experimental background (theories of lab, reaction mechanisms, equipment set-up diagrams/photos), instrumentation protocols, and a step-by-step

experimental procedure. Currently, our lab manual lacks all of the above, except MSDS information (however, current MSDS information has indicated the need to cancel several labs due to safety which I have done, and in place implemented additional assignments I have created.)

Components of Sabbatical Project

1. **12AL & 12BL curriculum development:** I need to catalog the safety of all current experiments by obtaining the MSDS data for all chemicals involved and will decide which experimental topics will make it into our lab manual.

In the past two years, I have already spent some time with our lab technician, Lynda Smith, removing all labs consisting of teratogenic and other harmful chemicals that affect reproductive health. I have replaced them with labs I have personally developed myself or thru working with CSUCI – none of which I have had the time to formally write up which limits the course to having only myself capable of teaching it.

2. **Write 32-34 lab experiments** (16-17 for 12A & 16-17 for 12B), written in a step-by-step protocol that will work with our...
 - a. current laboratory instrumentation(Paragon IR, Spectrum 65 IR, GCMS, GCMS and NMR Instrumentation). Currently, I am the only instructor that knows how to function the IRs , and the only one trained by CSUCI to use the remote GCMS & NMR instrumentation – I individually train each student since there are no written protocols to follow. I need the opportunity to formally write up instrumentation protocol so any instructor or student will have sufficient direction.
 - b. current laboratory glassware (we have basic micro kits without common Hickmann stills and gas traps; we have limited macro distillation glassware)
 - c. our lab-room (our lab has only 6 fume hoods which can only support 12 students working in them – thus, I've had to manipulate existing labs and develop new ones that will allow a class of 24-26 students the ability to safely perform an experiment outside of the fume hoods.)

- d. available chemicals (we are limited in our supplies budget – we must develop experiments that work with what we have.)
3. **Write Prelab and Postlab questions** for 32-34 experiments.
 4. **Write Lab Background Curriculum** for 32-34 experiments – our current labs lack any sort of presentation of the reaction mechanisms (mechanisms are a detailed picture of an entire reaction showing the electron flow between reactants and intermediates, generally taking anywhere from 2-10 steps) that the students are performing in class – they only receive this information from me as we spend up to an hour lecturing on the concepts of each lab. In addition, I am constantly having to provide students with additional information that I have researched in order for them to perform a lab – for example, the qualitative analysis of unknowns lab in the current manual does not give the students information on how to perform all the actual qualitative tests an organic student is required to know.
 5. **Additional Lab Development** – the existing curriculum does not have labs on two of the most important theories and types of instrumentation that all organic students are required to know – Infrared Spectroscopy and Hydrogen Nuclear Magnetic Resonance – two topics present in our SLOs for both the lecture and laboratory portions of organic chemistry. In addition, both topics are required for transferability.
 6. **Free Student Access** – all lab experiments will be scanned and uploaded to my Organic Chemistry website (www.michelledavidsonchemistry.weebly.com). This site is available to any student and instructor. In the future, it would be fantastic to expand our basic departmental website on the VC server to include all chemistry course information – Moorpark College does an excellent job of this and all of their chemistry labs are available to the students free online. Sciences courses are very expensive – students already spend up to \$200 on the required organic textbook by UCSB professor Paula Bruice (truly a well-written and much used book) – as such, I would prefer our students to have \$0 in lab costs (with the exception of safety goggles \$5).

Value of Sabbatical Project to VCCCD and Ventura College

The development of current organic chemistry lab curriculum and lab manuals is vital to the transferability of the course to four-year institutions. It is expected that the students are receiving the appropriate level of instruction at the community colleges– some universities are still require transferring students to pass an organic entrance exam (ie: UCSB); if our students are not adequately

prepared, they will find themselves repeating an entire year of organic chemistry (a complete loss of time and money).

Therefore, with the necessary curriculum being displayed in our lab manual and increased student performance, Ventura College will continue to be looked upon as a community college that develops the learning skills of its students and prepares them appropriately for higher educational studies.

Value of Sabbatical Project to Ventura College Students

An appropriate lab manual to use in this course will allow more students the opportunity to be successful in the course. Not only will the student receive more quality time and positive learning hours with the instructor, but student frustrations will be greatly alleviated by not having to follow constant instructional changes due to the current lab manual's improper equipment, hazardous chemicals, and poorly written procedure.

In addition, the students will become more prepared and proficient in the material and equipment by completing pre-lab and post-lab questions – our students perform better when they know what is expected from the beginning of the course to the very end – we are developing young scientists in our labs whom need the appropriate level of curriculum and necessary lab/instrumentation skills as they will be attending graduate, medical, pharmaceutical, veterinarian, and dental schools in the not-to-distant future. Our students will ultimately be more prepared to transfer into these programs as well as the upper division courses (biochemistry, physical chemistry, inorganic chemistry, etc) at any four-year university.

Value of Sabbatical Project to the Instructor

The creation of this lab manual will allow the instructor quality time to spend teaching the concepts necessary for students to be successful in the course – lab instruction takes a minimum of 45 minutes and additionally, the experimental organic chemistry syntheses are very time consuming - a 6 hour lab period is not sufficient when time is wasted due to lack of an appropriate lab manual.

In addition, a proper lab manual will provide other instructors the opportunity to smoothly transition into teaching the course – one instructor teaching a course without anyone available to substitute or teach due to the lab complications and complexities limits the department and the students greatly.

Finally, the safety of all students and instructors needs to be of utmost importance due to the amount of time spent in the lab (instructor: 12hrs/wk; student: 6+hrs/week) – more “green” labs will be implemented, important missing curriculum (IR, NMR) will be developed, current and available organic glassware and equipment will be incorporated, procedures will be written in a step by step fashion to prevent mishaps and complications, pre/post questions developed for

increased learning, and all labs will have the most current MSDS data (material safety data sheet).

Thank you for your time and consideration.
Respectfully yours,

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