WINTER TERM
2014

Chemistry & Biochemistry

The Chemistry and Biochemistry Department faculty look forward to sponsoring students in Winter Term projects. Some of our ideas for on-campus projects are listed below. Projects indicated (LAB) involve experimental work.

If you are interested in more information on any of these projects, see the faculty member. If you have ideas of your own, discuss them with any of us.

Students who elect to do on-campus experimental work will be assigned a place in one of the laboratories in the Science Center and issued equipment appropriate to their projects. Instruments normally used in the introductory chemistry course (Chemistry 101 and 103) will be available, and access to other instruments will be possible with special permission. The cost of common chemicals and expendables will be borne by the Chemistry Department. A $25.00 breakage allowance will be in effect. Students are responsible for the use of resources in other departments.

All laboratory participants must check into the laboratory by the end of the second day of the Winter Term.

This information is posted on our Webpage:
http://new.oberlin.edu/chemistry
Laboratory Research (Full Credit)

Projects in the area of atmospheric chemistry. The projects focus on kinetics measurements of chemical reactions related to air pollution and climate change. In particular, we are interested in investigating the mechanisms of reaction of isoprene-related species (an organic compound emitted by trees) on aerosol particles (liquid droplets small enough to remain aloft in the atmosphere). This project involves the identification of reaction products, and measurements of the rate orders and rate constants of the aerosol phase reactions via NMR spectroscopy. The determination of this mechanistic information will allow the chemical reactions that occur on actual atmospheric aerosols to be predicted, which will aid in understanding the role of isoprene in air pollution and climate change.

Prerequisite: Chem 102 or 103. (LAB)

Readings in Environmental Chemistry (Half or Full Credit)

Individually designed program of reading. The participant may choose to read text(s) on scientific or public policy aspects related to environmental chemistry. Short written report(s) are required.

A journal or paper about the books read will be required at the end of Winter Term. (0.5-1.0 WT credits)

2. **Laboratory Research in Organic Synthesis.**
My lab is currently investigating the use of amines to catalyze the Nazarov cyclization. This reaction starts with acyclic dienones and produces cyclopentenones. The project will involve multi-step organic synthesis, conducting reactions in an inert atmosphere, column chromatography, gas chromatography, $^1$H and $^{13}$C NMR and IR spectroscopy. (1.0 WT credit)

Prerequisite: Chem 205 required; (limit 2 students)
Chelsea Martinez  Winter Term 2014

Chemistry/Science Writing, Podcasting, and/or Pecha Kucha

I will be off-campus in Los Angeles over Winter Term, but am interested in sponsoring students who are interested in gaining experience writing and discussing chemistry in current research and current events. Students will use Oberlin’s electronic reserves of chemistry journals and other periodicals to choose stories of interest and develop short-format written, audio, or visual (PowerPoint or Prezi) pieces aimed at a general audience. Interested students would agree ahead of time on a target amount of pieces and post them on a blog during the Winter Term. Learning to use Microsoft Word to revise, audio recording and editing software, and/or graphic design software are potential practical skills students would gain.

This project can be done for ½ or full credit, and can be done anywhere. It will work best with multiple students contributing so that the blog has a variety of voices and topics represented. For example, my particular areas of interest (but not expertise!) are research and news in alternative feedstocks, quorum sensing, government science policy and appointments in advance of inauguration day and the new Congress, mechanochemistry, ocean chemistry and STEM education. It would be excellent to have students on board who have non-overlapping interests.
Winter Term 2014     Mr. Thompson

1) Laboratory in forensic analytical chemistry #1 (2 participants)  
Develop and validate experiments that involve the determination of ethanol in blood by headspace gas chromatography. Adapt procedures from the research literature for use in an undergraduate laboratory setting.  
On-campus, full-time, laboratory work  
Prerequisite: Chemistry 211

2) Laboratory in forensic analytical chemistry #2 (2 participants)  
Develop and validate experiments that involve the identification of powdered, illicit drugs and their cutting agents by vibrational spectroscopy. Adapt procedures from the research literature for use in an undergraduate laboratory setting.  
On-campus, full-time, laboratory work  
Prerequisite: Chemistry 205

2) Readings in forensic analytical chemistry  
Choose a topic to explore in the chemical literature and/or a set of books to read related to forensic analytical chemistry.  
On-campus or off-campus, half-time  
Prerequisite: Chemistry 211

3) Readings in forensic science  
Choose forensic science topics to explore or true crime novels to study. Write a set of in-depth, science questions and answers to accompany the readings.  
On-campus or off-campus, half-time or full time  
Prerequisite: college chemistry course
Winter Term Project 2014
Jesse Rowsell

3-D Printing of Molecular Models

Rapid prototyping, also known as 3-D printing, is now a mature and affordable technology for the construction of models to aid visualization. This technique is widely used by engineers to build solid objects that can be examined by hand, rather than simply evaluated on a computer screen. The educational merit of tactile models in the chemical sciences has been firmly established and famously used by researchers to understand the structures of complex molecules such as DNA. Despite the fact that the atomic coordinates of more than half-a-million compounds are available in crystal structure databases, a user-friendly software application that can translate this information into a suitable format for desktop 3-D printing has not been distributed.

Recently, we have begun writing an interface that makes use of freely available software to extract information from standardized crystal structure coordinate files and prepare the input files for printing molecular models. This project is in collaboration with Oberlin's new 3-D Print Lab: http://3dprintlab.oberlin.edu/otw-portfolio/converting-filetypes-to-print-crystal-models/

The overarching goal of the project is to create an easy-to-use interface for students and researchers to build their own models. Working versions of this code, along with instructional guides, will be broadly distributed through the WWW. Short-term technical goals include: an extension of the available print formats to include ball-and-stick models, identification and resolution of challenges presented by structures having cavities or overhanging fragments, printing in two or more colours, development of techniques for modifying printed structures (surface finishing, painting, “snap-together” assembly of multi-component models), and coding an attractive graphical user interface. The production of educational models to support research projects in the Rowsell laboratory and illustrate concepts in core science courses is also anticipated.

This project is ideal for students interested in working at the interface of chemistry, computer science, studio art, STEM education, or a subset of these. Individuals or small teams able to bring together multiple skills in these areas are welcome to apply.
Project Descriptions (Winter Term 2014)
Rebecca Whelan

Project 1: Developing user guides for new lab instrumentation
The Chemistry and Biochemistry Department has recently been the recipient of several pieces of valuable lab instrumentation, including a preparative liquid chromatograph, a microwave-enhanced solid-phase peptide synthesizer, a FT-IR spectrometer, and a capillary electrophoresis instrument. To use these resources to their fullest potential, their current performance will need to be assessed, any necessary repairs will need to be done, and a detailed user’s guide will need to be written to enable any individual to walk up to the instrument and get it running in a reasonable amount of time. This Winter Term project will offer an unparalleled opportunity for interested students, working closely with a faculty mentor, to become familiar with the inner workings of one or more pieces of lab equipment. The knowledge and skills acquired may be useful in future research endeavors at Oberlin and beyond. The ideal candidate(s) will have completed analytical and organic chemistry (Trace Analysis is highly desirable), be fearless regarding troubleshooting, and be able to write clearly.

Project 2: Improving analytical teaching labs
This year in Chemistry 211 I introduced a new acid-base titration lab that encountered some practical challenges in implementation. I am interested in working with a student to help troubleshoot this experiment and rewrite the instructions for greater clarity and learning potential for future students. Highly motivated candidates will also be encouraged to seek out examples of successful labs from the Journal of Chemical Education, the Analytical Digital Archives, and other sources. The ideal candidate for this project will have recently completed Chemistry 211, be willing to work independently, and be excited about optimizing teaching labs through systematic testing of experimental parameters.

Project 3: How a bowerbird gets the ladies: analysis of bowerbird paint
This project is a collaboration with Professor Gerald Borgia of the University of Maryland Biology Department. As part of the mate selection process, male Satin Bowerbirds build elaborate structures (bowers) out of sticks and decorative objects. Females decide on their mates based on the awesomeness of the bowers. A poorly understood aspect of bower construction is the use of “paint” in decorating the bower sticks. The paint appears to be derived from plant material, and females have been observed to taste the paint as part of the assessment process. The goal of this project is to examine sticks collected from bowers in Australia and develop analytical methods to determine the composition of the paint. Laboratory skills that will be developed include sample preparation, LC-MS, GC-MS, and UV-vis spectrophotometry. The ideal candidate will have completed organic and analytical chemistry, have interest in evolutionary biology, and be comfortable with troubleshooting.