CHEM MAJOR NEWS

In Conjunction with the American Chemical Society
Student Affiliates at the University of Pittsburgh

Volume 28, Issue 6 March 8, 2019

Fall Term (2201) Registration

March 22 Deadline for applying for August 2019 graduation (140 Thackeray Hall).

March 25 Fall Term (2201) Registration begins **based on credits earned**.

You will be notified of your registration time on your my.pitt.edu page.

Advisees who already have a permanent advisor should make their registration appointments with that advisor on or after March 18 for Fall Term (2201).

Advisees who were asked to select their permanent advisors (via an email sent Feb. 4) should schedule their Fall term registration appointment with their new advisor after March 18.

New advisees who have declared chemistry as his or her major within A&S should make an appointment with Dr. George Bandik, Dr. Ericka Huston, or Dr. Michelle Ward after March 18 for Fall Term (2201) in 107 CHVRN.

Departmental Honors? Here's How...

Students who wish to graduate with Chemistry Department honors must satisfy four departmental requirements. Students must have:

(a) an overall QPA of 3.00 or better

(b) a chemistry QPA of 3.25 or better

(c) have completed at least 2 credits of

Chem 1710-Undergraduate Research

(d) completed Chem 1711-Undergraduate Research Writing.

Good luck as you strive towards academic excellence!

2018-2019 ACS-SA Officers and Staff

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Visit us at http://www.chem.pitt.edu/acs-sa/

ACS-SA Schedule for the Spring Term

MARCH	**01**	**Chemistry and Art**
	08	**Open Meeting**
	15	**SPRING BREAK**
	22	**Spring Term Celebration Lunch and Trivia**
	29	**Officer Nominations for the 2019-2020 academic year**
APRIL	**05**	**Officer Elections for 2019-2020**
	12	**SENIOR SEND-OFF**

CAMPAIGN! VOTE! WIN!

Have you ever wanted to lead a nationally acknowledged award winning student group? If you aspire to such things why not consider running for an office with our ACS-SA group. We boast some 100+ members and have been recognized for the past 27 years by the national ACS for outstanding programing.

Nominations for our 4 elected positions: president, vice president, treasurer and secretary will be held on March 29th at our weekly meeting, 12:00 Noon in 150 CHVRN, and elections will be held on April 5th.

Caitlin Giron has agreed to be our Green Chemistry Contributor for next year. Michael Kane and Logan Newman have agreed to serve as Outreach Coordinators next year and Dale Erickson and Luke Persin have agreed to continue to serve as Newsletter Editors. We will need someone to volunteer to be our Technical Wizard since Justin Maier is graduating after several years of taking care of our website. If you are interested, please let George know.

SMALL GRANTS FOR YOUR PROJECTS.

The A&S Office of Undergraduate Research, Scholarship and Creative Activity is offering small grants for your individual research or teaching projects, presentations or creative endeavors. These grants of up to $500 are available for the following kinds of expenses:

research/project supplies
travel if you are going to present a paper at a conference or perform in an artistic endeavor.

To apply for a research/creative endeavors or travel/ presentation grant, you must:

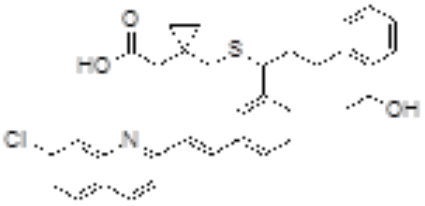
1. Find a faculty sponsor for your project.
2. Complete the application form. Include a detailed description of your project or travel plans and budget.
3. Return the signed form to the Office of Undergraduate Research, Scholarship and Creative Activity, 209 THACK.

Happy St. Patrick's Day!!

Try Something Different…

Need something new and exciting in your life? Tired of the same old thing? How about some new (or not always offered) courses for the Fall term? Three elective courses being offered this fall may bring that zing back into your life! May we suggest:

For example: **Montelukast** (Singulair), Merck ($3B / year sales), anti-inflammatory agent for asthma



Chemistry 1310-"Organic Synthesis of Drug Molecules"

CHEM 1310 (Chevron Science Center 132 on Monday and Wednesday from 11:00-11:50 am in the Fall 2018) is a 2-credit, advanced undergraduate course that builds onto sophomore organic chemistry by applying the learned principles to the synthesis of FDA-approved drug molecules. The emphasis of the course will be on analyzing the molecular structures of drugs in a retrosynthetic fashion, followed by developing suitable synthetic routes to these molecules. The reaction mechanisms of select key steps of theses syntheses will be discussed in more detail. Further concepts to be learned include fundamental functional group interconversions, chemoselectivity and protecting group use, stereoselective synthesis, and organometallic chemistry. Students will learn about the complexities of modern drug molecules and their assembly in a highly interactive classroom environment, where you will have the freedom to design your own syntheses and discuss them with your fellow classmates. If you are interested in pharmaceutical research and development, this is a highly recommended course. Please contact the instructor, Dr. Alex Deiters, with any questions: deiters@pitt.edu (http://www.deiterslab.org).

CHEM 1620 – "Atoms, Molecules, and Materials – Introduction to Nanomaterials"

This will be a course designed to increase students' knowledge and understanding of emerging field of nanotechnology. Nanotechnology deals with materials in nanometer scales, typically one to 100 nanometers. One nanometer is one billionth of a meter; approximately the length of five silicon atoms placed side-by-side or the width of a single strand of DNA. On nanometer scale, materials may possess new physical properties or exhibit new physical phenomena. For example, band gaps of semiconductors can be effectively tuned by adjusting their nano-dimensions. For nanomaterials, number of surface atoms becomes a significant fraction of the total number of atoms and the surface energy starts to dominate. This changes thermal stability and catalytic properties of many materials as we know them.

During the course, the students will gain a sound appreciation of different techniques and instruments involved in the preparation and characterization of nanomaterials. Current and future applications of nanomaterials in medicine, defense, energy production, and computation will be also discussed.

Chemistry 1810-"Chemical Biology"

Revolutionary transformations in chemistry and biology have led to a merging at the boundary of these disciplines where contributions from both fields impact our molecular and quantitative understanding of biology. Rapid growth in this area has been driven in part by researchers applying synthesis, quantitative analysis, and theoretical reasoning to the study complex cellular processes. This course focuses on enzyme mechanisms in biological pathways, kinetics and thermodynamics, and chemical tools to probe and screen components of the cell. Other topics that will be discussed include DNA/RNA processing, macromolecular interactions, chemical signaling, posttranslational modifications, chemical syntheses of biomolecules, and the development of assays for high throughput drug screening.

This course is ideal for students interested in the interface between biology and chemistry. You will first learn to recognize sufficient unresolved problems in biology that will benefit from a whole system chemical and molecular approach to analysis. Chemical tools from all areas of chemistry (analytical, inorganic, organic, and physical) will be employed to characterize and elucidate biological processes. This course will be taught from both a "top down" and "bottom up" approach to characterizing cellular responses. Individual interactions and mechanisms of biological pathways ("bottom up") will be discussed in addition to and in context with the analysis of a global cellular response ("top down") to chemical agents such as drugs, inhibitors, or chemical probes.

Chem 1810 fulfills one of the two elective biological courses for the chemistry bioscience option. Prerequisites include both Biosci 160 and Chem 320. Students can only receive credit for one of the following courses: Chem 1810, Biosci1000, or Biosci 1810. **So as you can see, there is something for every chemical taste available to you this upcoming Fall Term!!**

Green Chemistry

by: Seth Brody, *ACS-SA Topic Newsletter Editor*

Synthetic economy of industrial chemical processes is directly characterized as relative product yield. *Green syntheses* maximize this output, while minimizing energy activation and byproduct waste. However, their residual environmental and health consequences are comprehensively assessed in terms of *sustainability metrics*. Current quantitative methods have been developed to measure various resource-process efficiencies (i.e. byproducts, energy, mass balance). But future analytical methodologies suggest active monitoring *during* synthesis, to control hazardous pollutant formation, before being generated.[1]

Applied sustainability metrics include *in situ* spectroscopy, which allows molecular transformations to be elucidated through evolution of *intermediate* chemical species. Such living behavior supports greener, mechanistic design (e.g. catalysis), fundamentally. In the pharmaceuticals industry, the *Friedel-Crafts* acylation of aromatic compounds maintains prevalence in synthetic production. Replacement of conventional and toxic *1,2-dichloroethane*, with non-volatile *1-methyl-3-butylimidazolium chloride*, showed no mechanistic differences through *in situ* analysis. This method therefore successfully characterized the critical acetylium-ion reaction intermediate $[CH_3CO]^+[MCl_4]^-$ as present in both reaction pathways (Figure 1). Such analysis also determined that substitution of the hazardous solvent involved in this synthesis, with an environmentally benign one, did not adversely affect the reaction mechanism.[2]

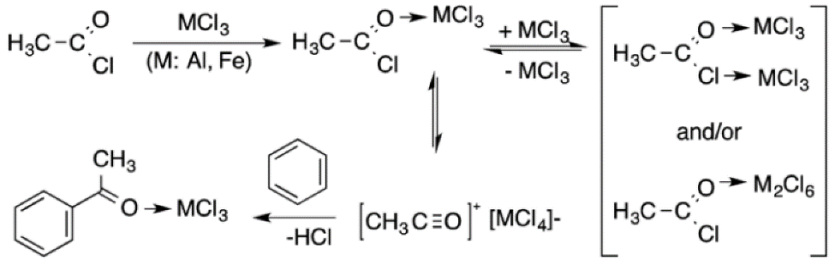


Figure 1. *Friedel-Crafts* acylation of benzene, with mechanism proposed via *in situ* spectroscopy[2]

Another example of effective *in situ* spectroscopic analysis is the DMSO-solvated ^{13}C-isotope labeling technique of the acid-catalyzed dehydration of *D-fructose* to *5-HMF*, present in key biomass utilization (Figure 2). The resultant, proposed mechanism contained multiple intermediate (header, right) transformations, from initial isomeric forms of D-fructose, through dehydration and deprotonation, but was resolved into intended 5-HMF product and *Humin* byproducts.[2] In conclusion, *in situ* analyses model hazard and waste sources in terms of *living* reaction economy, enabling earlier, and thusly greener, prevention practices.

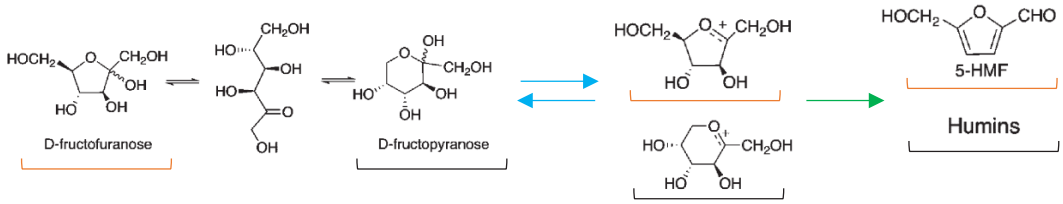


Figure 2. Summarized cyclic pathway of mapped acid-catalyzed dehydration of *D-fructose*[2]

1. ACS. Green Chemistry and Engineering Metrics. https://www.acs.org/content/acs/en/greenchemistry/research-innovation/engineerings-metrics.html (accessed February 16, 2019).
2. Náray-Szabóa, G. et al. *Green Chem.* **2018**, *20*, 2171.

Just What Can You Do With That Chemistry Degree?

by: Kaila Simcoviak

Are you interested in sharing your passion for chemistry to others? You can help shape the lives of future chemistry lovers, by becoming a high school chemistry teacher! Your bachelor's degree in chemistry and proficiency in science and math is perfect for this job!

Science and math subjects are in high demand in many high schools. Some areas of the United States are expected to increase in student enrollment and projected retirements should give rise to a favorable job market for teachers. An average day of a high school chemistry teacher would be to facilitate student learning and chemistry via guided instruction, investigations, and laboratory experiments to a group of four to six classes each with twenty to thirty students, depending on district size. Teachers are responsible for class room preparation, classroom managements, developing and grading assessments and laboratories, and meeting with students and parents. Curriculums are developed using state and national teaching standards.

To become a high school chemistry teacher a bachelor's degree in chemistry is needed first and foremost. At the University of Pittsburgh, you can pair this chemistry degree with the education option. This option allows students who earn a Bachelor of Science in Chemistry to then apply to a one year professional certification program through the University's School of Education. Depending on the state you wish to teach in, a master's degree may be required. Pairing the education option with your chemistry degree, however, also prepares one to enter the Master of Arts in Teaching Program at the University of Pittsburgh. Courses required to complete the education option are in addition to the chemistry major requirements which include: Foundations of Biology I and Lab, either Educational Psy or Adolescent Psy, Foundations of Special Education, and either biochemistry, environmental science, or geochemistry. In addition, with this option the student can elect to take Introduction to Physics I and II with Lab (algebra based) versus the Physics I and II and Lab (calculus based).

Employment opportunities as high school chemistry teachers are expected to grow by 8% between 2016 and 2026, which is as fast as the average employment opportunity. The median pay for a high school chemistry teacher as of 2016 was $58,030. Employment opportunities for chemistry teachers exist in both public and private educational institutions ranging from 9th to 12th grade for high school.

High school chemistry teachers should feel enthusiastic about chemistry and have a sincere interest in student development. Teachers should create an environment that enables all students to have the opportunity to learn in chemistry in a comfortable environment. Teachers should enjoy working with adolescents and have flexibility, fairness, and humor. Excellent chemistry teachers in high school prepare the future of chemistry for students at the college level and can be responsible for inspiring them to follow their passion.

So, does the thought of shaping the lives and minds of students at the high school level sound like the job for you? Are you willing to share your passion for chemistry with others? Then being a high school chemistry teacher could be the career for you!

Sources:

https://www.acs.org/content/acs/en/careers/college-to-career/chemistry-careers/high-school-chemistry.html

http://www.chem.pitt.edu/undergraduate/degree-options/education-option

https://www.bls.gov/ooh/education-training-and-library/high-school-teachers.htm

PITTSBURGH CHEMISTRY

by: *Max Bair, Class of 2018*
University of Pittsburgh

Sixth in a series

Hey there fellow chemists! I'm back for the sixth article in the series on the chemical industry in and around Pittsburgh. The company I have chosen for today is Sherwin-Williams Paints. This company is one of the biggest I've covered, with a presence in over 100 countries, and a staggering 4,900 company-operated stores and facilities. In 2017, Sherwin-Williams brought in a net sales figure around $15 billion. This high revenue lead to Sherwin-Williams current spot on the Fortune 500, as it is currently listed as #190. As you probably already know, Sherwin-Williams built this hugely successful company through paint sales and dominating large sectors in paint innovation and strategic acquisitions.

Sherwin-Williams goes far beyond creating and selling paint, as they have expanded into coatings of all types. In addition to paints, Sherwin-Williams also specializes in protective marine, aerospace, and automotive coatings. This allows many opportunities for material chemists and engineers to produce creative and innovative coatings that solve several unique problems. Sherwin-Williams also has research facilities and manufacturing plants all around the Pittsburgh area. Even if manufacturing isn't your interest, quality control chemists are present at each plant. The Sherwin-Williams headquarters isn't far either, as they are located in Cleveland, Ohio.

Sherwin-Williams employs over 60,000 people globally, and they provide standard benefits to their employees. They offer 401k contribution matching, and some employees can qualify for tuition reimbursement. They have health insurance options, including vision and dental, HSA options and more. Sherwin-Williams offers around eight paid vacation days to new employees. Sherwin-Williams also offers employees a unique perk, being discount on paint of up to 40%. Positions in all of these fields range from entry level to PhD level.

Thanks for reading friends! Keep chugging along, your school year is coming to a close! Check back in April for my last edition in the series.

Hail to Pitt!

Max Bair

The Chemical Network of Humans

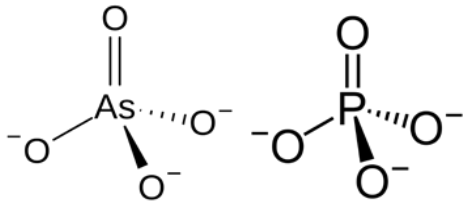
By: Dale Erikson, Co-Editor

Man and machine aren't quite as different as people think. In fact, there is a beauty in the parallelism between computers and biochemical systems such that they both take inputs, apply some sort of internal process, and produce an output. For better or for worse, humans are just as fragile as machines as well. Similar to the common crack on a phone screen, the smallest change in a biochemical process can cause catastrophic effects that can result in disease or even death.

As some of you might be unfortunate enough to know through a notoriously famous course at Pitt, our body is made up of large networks of metabolic pathways. I recommend you pause right now to search the internet for a map of the human metabolome. You can see through this map that the necessary processes of our body can be simplified to a subway-like network of chemical reactions. Further, all that it takes to cause disease and incapacitate a human is to cause defect in one of these chemical pathways.

For instance, one common process to human respiration is the conversion of glucose (i.e. sugar) into pyruvate during the glycolysis pathway. An enzyme in this pathway called glyceraldehyde-3-phosphate dehydrogenase allows for the attachment of a phosphate group to a sugar. This phosphate group will become important in making ATP, the energy "currency" that we all use to drive unfavorable chemical reactions. However, this critical pathway can be disrupted by arsenic.

Arsenic and phosphorus have similar chemical properties as they are both part of group 15. Even more so, you can see the great similarity between the phosphate and arsenate groups shown below. Arsenate competes with the phosphorus in the dehydrogenase enzyme discussed previously. Normally, the phosphate would be attached to the sugar and be used later within the pathway. In the case of arsenate, it successfully gets attached to the sugar but due to subtle chemical differences, the arsenate group can easily be removed by water. In the end, this disrupts the glycolysis pathway and can kill a human if high enough levels of arsenic are ingested. Hopefully this example serves as a lesson on how highly-specific individual chemical reactions are necessary for life to subsist. On that high note, have a great spring break!



Until Next Time!