

AUGUSTANA

DEPARTMENT OF CHEMISTRY

NEWSLETTER



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THE DEPARTMENT CHAIR

Barrett (Barry) Eichler
This is my second year as the Chair of the Department of Chemistry. Our Department has been busy! We have spent much of the last two years in meetings, planning for the Froiland Center construction and the Gilbert Science Center remodel. Early last summer, much of our time was spent preparing and submitting our 5-year report to the American Chemical Society. We have also undertaken an addition of a two-semester General Chemistry sequence, in order to help with student retention across disciplines, to be implemented starting fall 2014. We are undergoing a number of searches for faculty for our Department, and I am particularly excited about hiring my replacement for sabbatical for 2014-15! As I said, we have been busy.

I taught both General Chemistry (Chem 120) and the Trustee's Fellowship in Chemistry (Chem 102) with some of our freshmen. I taught Inorganic Chemistry (Chem 222) this interim. This spring, I am teaching my upper level Advanced Inorganic Chemistry (Chem 341). Later this semester, we will be undergoing a research project to better control the synthesis of CdSe nanoparticles (quantum dots). Based on the work we had done in our Chem 120H honors section, the Department published a book chapter in the ACS Book "Developing and Maintaining a Successful Undergraduate Research Program." The title was "Developing and Sustaining a Research Program at a Traditionally

Undergraduate Liberal Arts College: Research, it's our thing! Experiences in establishing a research culture at Augustana College, Sioux Falls, SD." I would like to especially thank Gary Earl and Duane Weisshaar for their hard work on crafting the chapter.

My BRIN student, Shelby Duffield, worked with quantum dots, DNA and colorimetric polythiophenes to find a better way to detect prostate cancer. She won first place at the Sioux Valley American Chemical Society undergraduate poster competition. Garret Heiberger and Eric Habbe, worked on a project that had them improving dye-sensitized solar cells (DSSCs). They took third place at the Sioux Valley poster competition. Maddy Pfeiffer worked on a new project to develop metal-organic frameworks (MOFs) for hydrogen storage materials in collaboration with Rick Wang at the University of South Dakota.

My wife, Kathy, continues to work as Division Coordinator in the Humanities Division here at Augie. My daughter, Maddie, started kindergarten this year in Brandon. We had an Eichler family reunion at Leech Lake in northern Minnesota last July and Maddie took in her first Twins game. She also got Adrian Peterson's autograph at Vikings training camp! We fished a lot over the past year and Maddie went ice fishing for the first time this December. We may go to San Francisco next August to visit my brother, which happens to coincide with the National ACS meeting!

RESEARCH

Last summer we had 22 students perform research in the Chemistry Department. We trained 20 students this summer and it was a lot of fun. The students' productive summer resulted in the top 3 spots at the Sioux Valley ACS undergraduate poster competition. Fourteen students attended the Midwest Regional ACS Meeting in Springfield, MO last October. As I write this, nine of our students are presenting their work at the 2014 National Spring ACS Meeting in Dallas, TX.

INSTRUMENTS

ESCoR funds provided us last summer with a new high-performance liquid chromatography (HPLC) with gel-permeation chromatography (GPC) capabilities, which will allow us to determine the molar masses of polymers. We are currently ordering a hand-held X-ray fluorescence (XRF) device that will allow us to determine the elements in materials easily. We are also purchasing a microwave reactor, so we will have fun trying new reactions (no food in this one, please).

PERSONNEL

We welcomed one new face for the 2013-2014 academic year. Dr. Abbas Shilabin. He comes to us most recently from teaching at the University of Maine. He has been teaching General and Organic Chemistry for us. Please read his section in this newsletter.

We lost Diane Pullman in February 2013 to a long bout with cancer. We will miss her love of chemistry jokes and potluck dinners.

DR. SVEN G. FROILAND SCIENCE COMPLEX



After many years of talking about remodeling GSC, ground will be broken next fall on an addition and remodel of GSC, to be called the Dr. Sven G. Froiland Science Complex. The faculty have spent countless hours in meetings with and without architects. They will continue this spring and summer and the building project will take roughly one and a half to two years. If you are interested in joining forces with Augustana to make the new facility a reality, visit www.augie.edu/science.



FROM THE FACULTY

Abbas Shilabin
I joined Augustana College as a visiting assistant professor of organic chemistry in August 2013. I received his Ph.D. in organic chemistry from the institute of Organic Chemistry at Clausthal University of Technology, Germany, completing my dissertation on pyrrolizidine alkaloids derived from natural products Circumdatin A and B. I have performed several postdoctoral research studies at the university of Mississippi, Temple University, and Wesleyan University and served as an assistant professor at the University of New Haven, Wesleyan University and the University of Maine before coming to Augustana. My current research interests is focused on the synthetic/medicinal chemistry and drug discovery of new β -lactam antibiotics *via* design, synthesis and evaluation of inhibitory activity on

β -lactamases and DDpeptidases inhibitors.

During my first academic year in Augie I taught several courses including Introductory and advanced *General Chemistry, Survey of Organic and Biochemistry, Organic Chemistry*, and instructed their associated Labs. In order to deliver high quality lecturing based on Augie teaching expectations, I was treated with great deal of support and guidance through administration and senior faculty members.

Although my primary task was teaching, I have had opportunity to keep my collaborative research with Prof. Howard Patterson from University of Maine to synthesize and grow single crystals of $[\text{Ag}(\text{CN})_2]$ with organic electron acceptor for photophysical studies. The results are submitted to *J. Chem. Soc., Dalton Trans.* for publication.

FROM THE FACULTY

Duane Weisshaar
This marks my thirtieth year at Augustana. Through that time academic year activities continue to be exciting and enjoyable times, but in a routine sort of way. In other words, there are few highlights to distinguish one year from another. The two things I mentioned last year, planning a new building and studying the Gen Ed Core, continue, and both are moving a bit slower than we had hoped. Planning for the new building continues, but fundraising is still slow. The President Rob Oliver recognizes that the need for additional space for the Natural Science Division has to be balanced with assuring that any incurred debt is manageable. We are proceeding carefully on the Gen Ed Core to ensure any changes are an improvement over what has served us well and also reflects best practices.

The main highlights each year come from the research we do with students. This summer I shifted away from dimethyl carbonate and quaternary ammonium compounds and initiated new collaborations with Barry and Jetty. I worked directly with four students this summer (Figure 1).

The electrochemical study collaboration with Jetty continued. Joe Keppen (Sr - Sioux Falls) was back for part of the summer and trained his replacement on the project, Lee Stadem (Fr - Windsor, CO). My part this summer was mostly helping with experimental details.

Barry and Jetty both had need for molecular weight determinations for their polythiophenes. Since we didn't have an appropriate column for Barry's water soluble cationic polymer, Trevor Sandgren (So - Redwood Falls, MN) focused on analysis of several of Jetty's polymers. With EPSCoR funding we purchased a new Agilent 1260 Infinity GPC (Figure 2) which was installed at the end of June along with a couple of new SEC columns. Trevor put the

new instrument through it's paces and used the new columns to get a better analysis of four of Jetty's polymers. Jetty has several more in the pipeline and we plan to get a column appropriate for

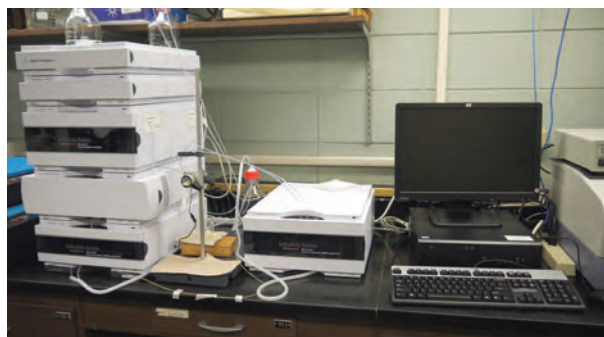


left to right - Duane Weisshaar, Kim Stallings, Trevor Sandgren, Rachel Anderson, Blake Woockman

Barry's polymer as well, so this collaboration will continue.

Barry also needed a supply of his cationic polymer for potential use in a quantum dot/DNA-based sensor, but the four step process his crew had used previously needed to be optimized. He and I helped supervise Rachel Anderson (Jr - Belgrade, MN) and Blake Woockman (Sr - Crofton, NE) in that endeavor. During the summer they made a some progress in optimizing the steps, but most importantly they produced several grams of polymer, enough for at least a feasibility study.

The basis of Barry's sensor is a CdSe/ZnS core-shell quantum dot. For this work he needs to know the dimensions of the core and shell. The diameter of the core is determined spectroscopically, but determination of the shell thickness requires an elemental analysis of the dots. Kim Stallings (So -



Our new toy (Agilent GPC)

Sioux Falls) worked on an atomic absorption spectroscopic analysis for Cd and Zn. This turned out to be a frustrating analysis. She followed a literature procedure with erratic results. We tried a variety of sample prep variations, but nothing gave consistent results. What were we doing wrong? None of the references gave results and toward the end of the summer we found out why. Kim found a master's thesis that did present results that were just as erratic as ours. The thesis conclusion was that the method needed more developmental work. We were relieved to know that we were not the problem, but we still needed a working analysis. After a closer look

at the acid base and redox chemistry of the components, we think we have devised a strategy for a good analysis procedure, but we ran out of summer, so testing our idea will have to wait.

Kim and Trevor will present their work at the Midwest Regional ACS Meeting in Springfield, MO, in October. This meeting coincides with Viking Days this year which prevented Rachel and Blake from attending.

The students from last summer (Rachel Anderson, Niki Altena, and Riley McManus) published their results in *The Journal of Undergraduate Chemistry Research* this fall (2013, 12(3), 75-78). A second publication in that journal (2013, 12(3), 65-67) described the work that Connor Lamberson (now in graduate school at Vanderbilt U.) and Bethany (Zogg) Kaemink (now in medical school at U. North Dakota) did in the summer of 2008 exploring solvent effects on the reaction of dimethyl carbonate with tributylamine.

This summer I played softball again with the St. John/St. Mark's Saints. Our record was nothing to brag about, but we had a great time. My annual fishing trip to Michigan had to be cancelled this year because we just couldn't make our August schedules mesh.

FROM THE FACULTY

Jared Mays
It's hard to believe that five years have gone by since I joined the faculty in the Department of Chemistry at Augustana! With the combination of teaching, research, and committee work keeping all of us sufficiently busy and moving from one task to the next, it's no wonder that time passes by so quickly.

Since its inception and approval by the Augustana faculty in 2009, the ACS Biochemistry major continues to draw many talented students toward careers in interdisciplinary science. Over the past several years, we have had between 26-37 students declared as an ACS Biochemistry major on campus and it continues to be a joy to work with these students in exploring topics at the interface of chemistry, biology, physics, and mathematics. Recent Augustana graduates with an ACS Biochemistry degree have pursued medical, graduate, and professional degrees at a wide variety of institutions or have found employment in (bio)chemical industry. With the recently announced joint programming opportunities between Augustana College and Sanford Health and the upcoming expansion/renovation of the Augustana science facilities, it is certainly an exciting time to be an interdisciplinary scientist in Sioux Falls!

With this in mind, it's been wonderful to be a member of the Program Steering Committee this past year and to have helped develop the vision and spaces for the future of science at Augustana. This has been my first opportunity to work on a building committee and to see all of the moving pieces and roles that are required to complete such a massive construction and curricular undertaking. Now that the design phase is nearing completion, much of the work will be handed off to the architect and construction teams and, before we know it, we will all be enjoying and utilizing the fruits of our combined labor!

Outside of my normal instruction in General Chemistry, Survey of Organic

and Biochemistry, Organic I-II, and Biochemistry & Medicinal Chemistry, I have been able to co-instruct a senior capstone course, titled: "Harry Potter: Exploring Ethical Themes in Light of Contemporary Issues." Together with Dr. Laurie Jungling in the Department of Religion, Philosophy, and Classics, we have offered this unique course three times in the past four years; with each group of students, our discussion of Hogwarts, ethics, and pertinent real-life



Jared Mays' Research Group

issues has delved deeper and become richer in content. On a slightly different front, I am looking forward to offering a new course for the Civitas Honors Program. While still early in development, the course will address Bonhoeffer's theme of Pertinence through an exploration of the many facets of the Pharmaceutical Industry.

Largely over the past four summers, my research group has continued to investigate novel glucosinolates and isothiocyanates and their potential uses in combating cancer. These two classes of compounds are naturally found in cruciferous vegetables (e.g. broccoli, cauliflower, Brussels sprouts) and are some of the primary agents responsible for the anticancer effects which result from diets rich in these foods. Although this topic serves as the overarching theme to the work conducted in my laboratory, individual student researchers have worked on a variety of specific sub-projects that contribute to the larger goal.

One facet of this project has involved the synthetic preparation and evaluation of isothiocyanates, the ultimate biologically active substances

in this pathway. In my time at Augustana, the combined efforts of Cody Lensing '12 (Moundsview, MN), Jordan Clark '12 (Owatonna, MN), Elle Tornberg '14 (Harrisburg, SD), Zachary Erickson (St. Olaf College, class of '12), Amanda Johnson '14 (Sioux Falls, SD), Taylor Yseth '15 (Sioux Falls, SD), Michaela Bunde (Mount Marty College, class of '14), Genevieve Tillotson '15 (Rapid City, SD), and Sarah Fisher '15 (Chamberlain, SD) have resulted in construction of a library of 110 synthetic isothiocyanates, methodologies to evaluate these compounds in parallel for both chemotherapeutic and chemopreventive application, and the identification of many key structure-activity relationships. Together, this represents a very significant amount of progress and, in all likelihood, between 3-4 peer reviewed manuscripts (which will hopefully be submitted in the very near future).

A second aspect of the research conducted in my group has involved the synthesis and kinetic evaluation of non-natural glucosinolates, the metabolic precursors of the synthetic isothiocyanates which we have identified. This project hit the ground running through the efforts of Kayla Vastenhout '12 (Dell Rapids, SD), Jordan Clark '12 (Owatonna, MN), Joseph Keppen '13 (Sioux Falls, SD), Elle Tornberg '14 (Harrisburg, SD), Amanda Johnson '14 (Sioux Falls, SD), Ethan Pauley '15 (Newell, SD), and Collin Noldner '15 (Sioux Falls, SD). The first phase of this project was completed last January and an account of our work has been drafted and submitted for publication in the journal *Phytochemistry*. This paper, titled, "Synthesis and parallel kinetic evaluation of *Sinapis alba* myrosinase-mediated glucosinolate hydrolysis using UV-visible spectroscopic and HPLC analytical methods" will likely be the first manuscript published by my research group and has three undergraduate student authors!

The final major project in my research group has involved the development of non-glucosinolate precursors of isothiocyanates. The major aim of this work is to develop

FROM THE FACULTY

Continued from page 4

techniques and methods which expand the utility, scope, and potential applications of synthetic isothiocyanates. Still in its (relative) infancy, Michael Amolins '07 (Sioux Falls, SD), and Ethan Pauley '15 (Newell, SD) have spent significant time on this project, generating promising results that encourage our continued efforts in the coming years.

On a personal note, life outside the confines of Augustana continues to keep me on my toes! My wife, Jennifer, and I are privileged to be the parents of three wonderful children: Elliot (almost 5), Aurelia (almost 3), and Rosalind (4 months). Life at home with the five of us is rarely uneventful and provides new meaning to the phrase, "busy." However, despite the tantrums, fighting over toys, running, yelling, scabbed knees, and inability to go 5 seconds without a barrage of questions, we are very lucky to have three such wonderful children and to watch them grow up before our very eyes.

Jetty L. Duffy-Matzner
Greetings to the Augustana Chemistry Department alums, friends and family. I have been keeping fairly busy, our group has three major research topics. For the first are of interest we are still involved in the production of novel biologically active molecules. There are several different research projects but in general this work involves the production of heterocycles that have either anti-microbial and/ or anti-fungal properties and can be produced from 1,3 -dipolar cycloadditions with nitrile oxides or nitrosilones as intermediates via intramolecular cycloadditions. The anti-fungal project that Kale Merrell and Lee Stadem (summer of 2013, funded by BRIN and departmental) was based on the work of Jenna Kuhle (summer 2012, funded from BRIN) and Anne Pfeiffle (summer 2010). This work is trying to develop a synthesis for a novel class of compounds, lacto-isoxazoles, that have been previously attempted tried by a variety groups without success since the early 1900s.

A second project examines the synthesis of polymers to include the

production of heterocycles as comonomers for the development the next generation of fluorescent polymeric organic/inorganic hybrid chemosensor materials based on a molecular wire approach. These new materials will be developed to be highly specific and selective for metal contaminants in aqueous solutions such as ground water or biological systems. This work combines recent advances in polymer synthesis and coordination chemistry, a new approach to develop selective metalopolymer chemosensors that uses photoinduced electron transfer and energy transfer to create a "turn-on" and "turn-off" fluorescent sensor response. We will be specifically working on turn-off chemosensors that



Jetty Duffy-Matzner's Research Group

are sensitive for iron and mercury ions. In time we would plan to further this research from in-solution to solid-state detectors of these toxic and environmentally important metal ions. This summer Manar Alherech (from Binghamton University, NY - funded by SPUR, 2nd summer), Lee Stadem (ESPCoR) and part-time before graduation Joe Keppen (EPSCoR) worked on different aspects

of this research.

A third project investigates the design, synthesis, and characterization of a novel dioxypyrrrolopyrrole-difurano-thiophenyl-diethynyl polymers for use in organic photovoltaics. The novelty of these polymer systems is derived from the incorporation of an ethynylene spacer that will hopefully reduce steric hindrance within the polymer itself, as well as, create a better interface between donor and acceptor layers. Alteration between furan and thiophene based monomers has been previously reported to greatly increase solubility, allowing for shorter alkyl chains to be inserted, thus decreasing steric hindrance. Our final polymer was shown to be extremely soluble in most organic solvents and believe it or not – a beautiful cobalt blue solution when dissolved in chloroform. Katie Smith (NSF EPSCoR) and Dannah Miller (ESPCoR) headed this project based on the previous work of Alan Julius and Peter Ruppelt.

Katie and Dannah participated in the Midwest Regional ACS meeting by presenting their work. They will also be presenting in Dallas for the Spring National ACS meeting along with Kale and Lee. I will also be giving a presentation in Dallas summarizing some of the advances in our group on the polymer ends.

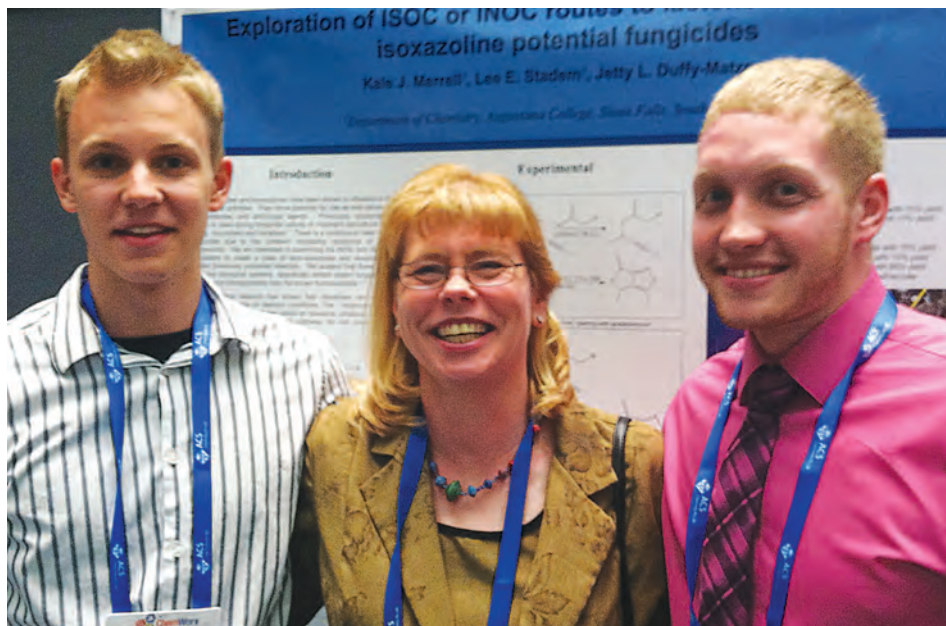
On a personal note our oldest son is now a freshman at Augustana College. Our middle son survived a fairly bad case of pneumonia, we really do appreciate the expert medical staff that reside in Sioux Falls. Our youngest son is an enthusiastic member of the Patrick Henry Middle School Marching Band. I also had two journal articles published recently and well as my first book: *Advances in Teaching Organic Chemistry*; Duffy-Matzner, J., Pacheco, K., Editors.; ACS Symposium Series 1108. My husband and I are also continuing our interest in ballroom dancing, we have built in date nights once a week. As always I would be more than happy to welcome back any alumni, please keep in touch – we love to hear from you!

FROM THE FACULTY

Brandon Gustafson
I earned my bachelor's degree from North Dakota State University in 2004 and did research studying Indium-mediated ene-yne cyclizations. Then in 2008, I earned my masters degree (from NDSU) with a focus on organic synthesis and methodology. My thesis centered on Lewis acid catalyzed enantioselective Diels-Alder reactions using a novel isoxazolidinone template. While in graduate school, I developed an interest in Nuclear Magnetic Resonance spectroscopy and since coming to Augustana College (Fall 2008), have become the NMR Lab coordinator. In addition to operating the instrument for lab courses, I also train summer research students how to conduct their own experiments. Several regional colleges and universities have also gathered data using the instrument and recently I worked with the Sioux Falls Crime Lab to identify drug samples and better characterize them.

Aside from the NMR, my primary focus is to coordinate the lab preparations for each experiment, manage the Chemistry stockroom and handle most of the department supply ordering. Starting last year I've also been teaching a couple labs a semester—I've enjoyed getting back into a lab setting and interacting with the students.

My wife Ann and I have two kids, Daniel (4) and Abigail (18mo) and live in the southeast part of Sioux Falls.



Dr. Duffy with Lee Stadem and Kale Merrell at the ACS meeting in Dallas



Bijoy Dey's Research Group



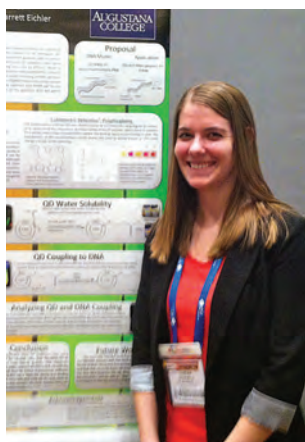
Barry Eichler's Research Group

AMERICAN CHEMICAL SOCIETY MEETING

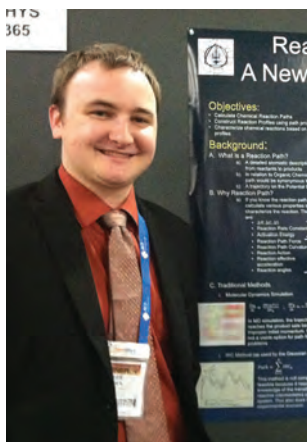
Nine students and three chemistry faculty members attended the 247th annual American Chemical Society Meeting in Dallas, Texas, the week after Spring break. There were two faculty oral presentations by Jetty Duffy-Matzner and Jared Mays. We also had 8 posters presented by faculty and students. Students who went to Dallas and presented include: Shelby Duffield (Eichler), Kale Merrell (Duffy-Matzner), Kaleb Brown (Dey), Dannah Miller (Duffy-Matzner), Katie Smith (Duffy-Matzner), Ethan Pauley (Mays), Lee Stadem (Duffy-Matzner), Maddie Pfeiffer (Eichler) and Sarah Fisher (Mays). While in Dallas the student officers of the Augustana College Chapter of the Student Member Association of the American Chemical Society (SMACS) were on hand to receive the chapters' 2013 award for Commendable Student Chapter (silver) and yet another year as a Green Chapter. We also caught up with Manar Alherech who worked with Dr. Duffy for three summers. The students stayed at the historic Joule hotel and we had a great Mexican dinner on Tuesday evening. We also got to see several alumni students including Matthew Grandbois '04 (chemist at Dow) and Trent Anderson '11 (graduate student at NDSU).



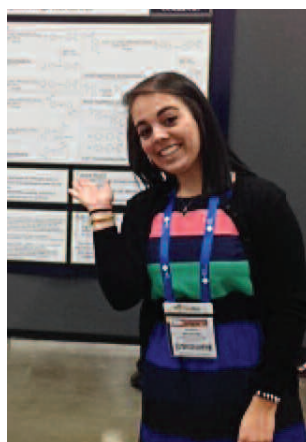
Dr. Duffy and students at the ACS meeting in Dallas



Shelby Duffield



Kaleb Brown



Maddy Pfeiffer

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DEPARTMENT OF CHEMISTRY

2014 CHEMISTRY ALUMNI FILE UPDATE

What's ν (nu) With You? Fill us in on what's happening in your life. If you find that any of the information mentioned in this newsletter is inaccurate, please let us know.

Name: _____
 FIRST MAIDEN MARRIED

Year Graduated: _____ Phone: _____

Address: _____

Email: _____

Occupation/Place of Employment: _____

Graduate/Professional School Preparation in Progress or Completed: _____

Personal News/Professional News you want us to know: _____

If you know of potential students for Augustana College, please provide us with their name, address and phone number so that we may contact them.

Name: _____

Address: _____

Phone: _____

Name: _____

Address: _____

Phone: _____

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