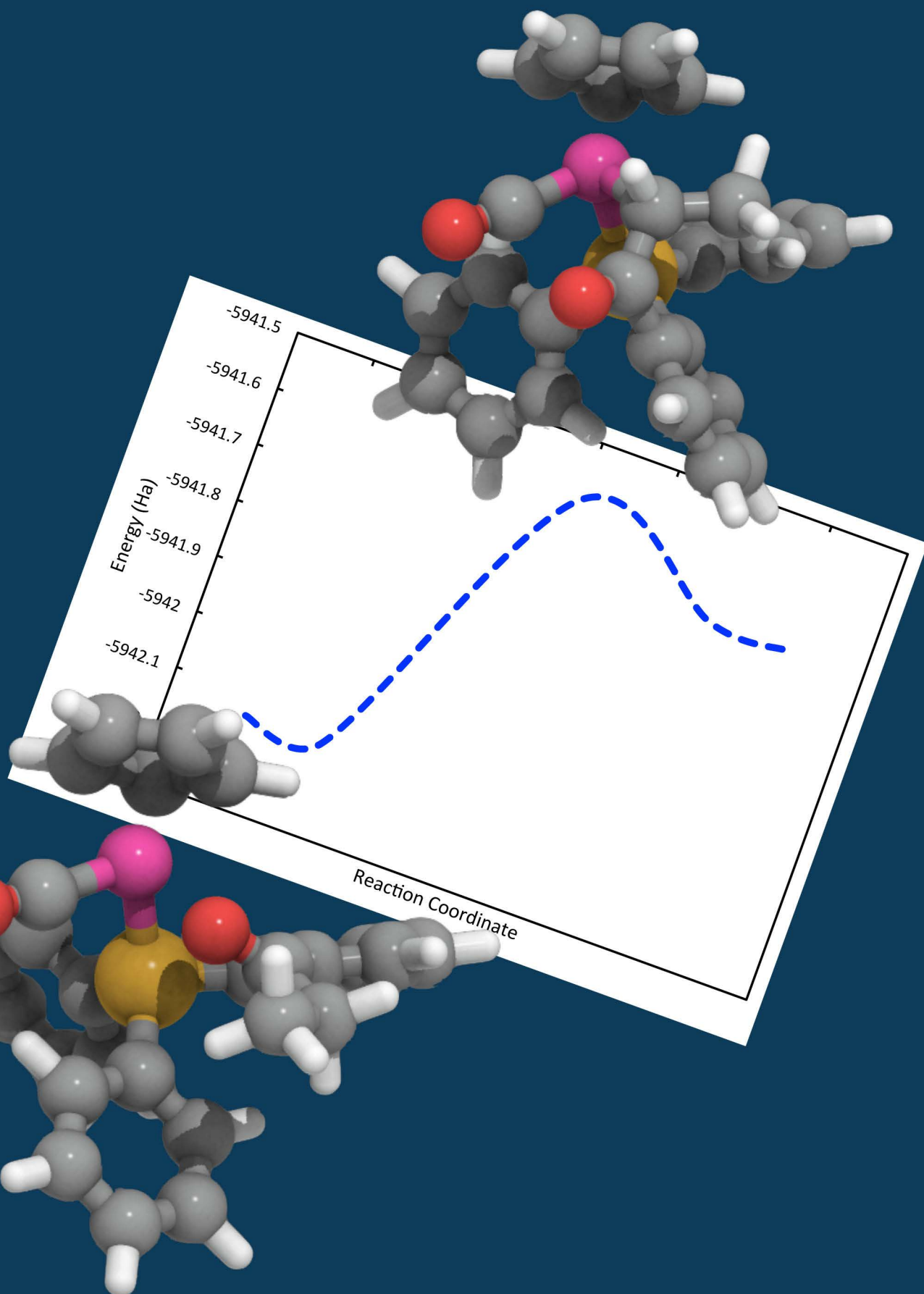




# AlasChemist



## A Note from the Department Chair- William Simpson

The department continues to be a vibrant educator of students and a curious investigator of molecular sciences. This year has been productive, but also challenging for us. The University's budget situation



is tight and worries over budget often dominate discussions. Our department's administrative assistant, Mist D'June-Gussak, moved to a new position in Anchorage, and tight budgets have prevented us from replacing that

position. We wish Mist the best in her new position and hope she enjoys her move in career and home. Mist enjoyed production of the *AlasChemist* and brought its design and look to a new level. Despite these challenges, the department, largely through excellent people, continues to function well. Many in our staff and faculty have picked up administrative assistance tasks to fill the vacancy. Jessica Armstrong took our graduate program coordinator position in the Fall and did an excellent job with recruiting and assisting the faculty in selection of entering graduate students. This has been one of our smoothest and most pro-active graduate recruiting seasons in my experience. Jessica has also filled some of the void made by the open administrative assistant position, taking on extra tasks and helping make the office operate smoothly. Jacy Pietsch has also been critical in increasing her purchasing support and reconciling of budgets. Jacy's increased role there has been on top of her excellent leadership of the Supplemental Instruction (SI) program and her ever-increasing leadership role in the College's Science Potpourri spring outreach event. Emily Reiter continues to keep us safe and to keep the large-enrollment classes' laboratories run smoothly.

During this spring semester, we have enjoyed seminars from candidates for the two positions in organic chemistry. These positions will enhance our ability to teach organic chemistry and also complement our research foci in Biochemistry and Neuroscience as well as Environmental Chemistry. We look forward to completion of the searches and welcoming successful

candidates to our department during next academic year. Although budgets are tight, we are very thankful for the administration's support of our central role in educating science and engineering students in general chemistry through funding of our initiative to enhance instruction through Assistant Professor Christopher Iceman's hire, support of the Chemistry Learning Center and the SI program, and support with teaching assistantships. These resources are greatly appreciated and let us carry out this role. The SI program, coordinated by Jacy Pietsch, and staffed by our excellent undergraduate SI leaders continues to help our students succeed.

Our department houses the only American Chemical Society (ACS)-accredited program in Alaska, and this mark of quality helps our students to pursue further education or find employment. This summer, we are undergoing periodic reevaluation by ACS to continue our accreditation. ACS requires us to have state-of-the-art equipment, requires course delivery by excellent faculty, and values undergraduate research. It is impressive to see the growth in the department over the past five years and the excellence of our faculty and staff. Hopefully ACS will be satisfied with our report and continue to allow us to grant degrees approved by their high standards. I was impressed to see that in the 2013-14 academic year, we taught 877 students in at least one course, as compared to the 2008-09 academic year, when we taught 696 students. That means a 5-year departmental growth of 26%.

I am happy to announce that the department elected Professor Tom Green as our new chair, starting summer 2014. I forward to his leadership and direction for our department. I have enjoyed working with all of our excellent faculty and staff and look forward to having more time for research and teaching in the next years.

**On the Cover:** Endpoints of a transition state search for a ruthenium enolate complex calculated by **Parker Whaley** (recipient of this year's Hyperchem award) from the Iceman lab. Parker has been working with Dr. Rasley and Dr. Iceman to determine the transition state barrier for this complex which isomerizes in the solid state.

## Sarah Hayes - Soil and Water Science/Analytical Chemistry

In the Hayes laboratory, our research is focused on tellurium (Te) used in high efficiency and inexpensive solar panels as well as other high technology devices.

Because of low abundance at the earth's surface, there has been substantial concern about low global Te supply limiting the contribution of CdTe-based

solar cells to growing energy demands. Our goal is to find ways to optimize Te recovery from current extraction processes. We also examine the surficial weathering behavior in an effort to understand its bioaccessibility- directly linked to toxicity- and fate in the environment.

Last October (2013) **Nicole Knight** (formerly Ramos, 2<sup>nd</sup> year Ph.D. candidate), **Amy Skidmore** (2<sup>nd</sup> year M.S. candidate) and I all presented at the national Geological Society of America (GSA) meeting in Denver, CO. It was both students' first big meeting and Amy was lucky enough to be asked to present a talk about her work on tellurium (Te) extraction from copper mining. Nicole's poster on Te behavior in the surficial mine tailings environment was also extremely well-received. I co-presented a poster and talk on a joint project that Rob Root (University of Arizona) and I worked on at the end of my Ph.D. studies. I also co-presented a workshop giving graduate students guidance on writing successful research proposals as part of my role on the review panel for GSA Student Research Grants. I am proud to say that the materials we prepared had a major impact on the quality of proposals we reviewed the following grant cycle. I was also invited to give a talk at the Stanford Synchrotron Radiation Lightsource annual User Meeting, which was a big honor for me. And I was very excited to share the research projects I've started since coming to Fairbanks with many of my long time mentors, colleagues, and friends. I was also asked to participate in a workshop on Te and Se extraction held in Leicester, England over the winter holiday break. The goal was to gather the leading experts on Te, discuss the state of our collective research, identify knowledge gaps, and start planning the needed



Photo by T. Paris

experiments. I came away with a sense of how timely and central our research projects are to group as well as a renewed excitement for my research.

A new addition to our laboratory this spring is **Riley Witte** (undergraduate) who was awarded an URSA grant to assess the potential for Te extraction from an operating gold-silver mine in Montana. She has been a bright and motivated addition to the laboratory and seems keen to continue her project into the summer.

I taught the analytical sequence (Chem 212 and Chem 314) for the second time this year. Both courses are much more developed than the first time, but still evolving. In Chem 212, I continued teaching the course using a flipped method, and worked very hard this year to develop more engaging in-class activities and laboratory experiments. I continued teaching Chem 314 centered around characterizing a consumer product -- this year we studied Easy Cheese(R), lemon candies, and eyeliner -- a total success. I am very excited for the third iteration of both classes next year.

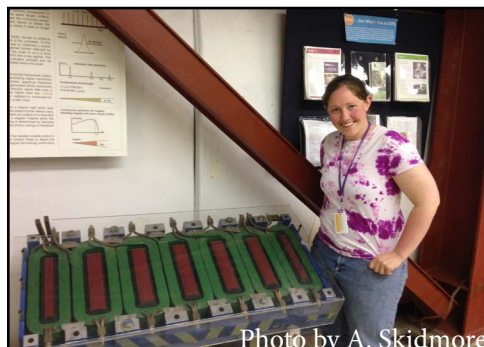


Photo by A. Skidmore

Undergraduate student Riley White standing next to a Wiggler which generates high-intensity X-rays by bending electrons traveling at relativistic speeds.

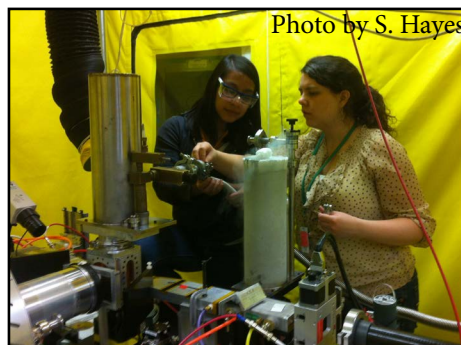


Photo by S. Hayes

Graduate Students Amy Skidmore and Nicole Knight changing a sample of Tellurium mine tailings for X-ray analysis of the local coordination environment at the Stanford Synchrotron Radiation Lightsource.



## Jacy Pietsch- Department Outreach and CLC Coordinator

It is hard to believe that another year has gone by! It slips by so quickly. I guess that means that I have been keeping busy.

We are finishing up our 2<sup>nd</sup> year with the Chemistry Learning Center (CLC) and that is going great. In an effort to help general chemistry students be more successful in the course, we offer one-on-one coaching and Supplemental Instruction (SI) sessions through the CLC. This assistance is voluntary, free of charge, and anonymous, which takes some of the stress out of stopping in for a session. For the past year, I have had the pleasure of working with three outstanding undergraduates in accomplishing this goal. **Stacey Krepel**, **Madison Wilson** and **Marcus Cogley** take a real interest in the success of the students that they work with and are a lot of fun to be around! The good news is that their efforts in the CLC are having a positive effect. Students who get assistance (specifically through SI) have a higher average than the students who do not. It is always refreshing to discover that your hard work is paying off!



In addition to coordinating the CLC, another major highlight of my job is coordinating the department outreach. In August, **Amy Skidmore**, **Tara Craft**

and **Nicole** and **Dallon Knight** participated in the Discovery Science Expo for Kids. They brought slime, UV beads and memory wire to Fort Wainwright and had a blast 'playing' with all of the children. Everyone came back happy and reported a fun and eventful day. In October, the Student Chapter of the American Chemical Society went to the Salcha Fall Carnival, as they do every year. It was a blast!

Finally, in April we held the 21<sup>st</sup> annual Science Potpourri in the Reichardt building. It was HUGE. I don't have the official numbers yet but we had well over one thousand visitors. Franta Majcs, Sarah Hayes, Lori Bogren and Carl Murphy worked as a team to put on the chemistry explosion show. As usual, the auditorium was standing room only. People just love to watch things blow up (in a safe, controlled environment run by well-trained personnel, of course). Tom Green supervised the chemistry tables. Brian Rasley and Brian Edmonds were in charge of liquid nitrogen ice cream, **Julia Duncan** and Madison Wilson made slime, and **Terilyn Lawson** **Stephen** and Fenton Heitzler handed out many, many balloons. These young chemists were assisted by many, many others and I think everyone had a ton of fun. At the end of the day, we all left happy but exhausted.

Well that pretty much sums up the most exciting parts of my year. Next year will bring many more adventures and I am excited to see how it all unfolds!

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## William Howard - Inorganic Chemistry

I enjoyed the privilege of mentoring the research of two undergraduate chemistry majors, **Tavia Casados** and **Cicely Shankle**, this past year. Tavia's project was concerned with the synthesis and characterization of new rhodium – bipyridyl derivatives, and Cicely's project was concerned with preparing and characterizing new transition metal complexes related to our diabetes research.

I have continued to serve as the Chair of the Alaska Local Section of the American Chemical Society (ACS). In this role, I select two ACS speakers each year, who tour Fairbanks, Anchorage, and Juneau and give high quality research seminars. In the 2013-2014 academic year, Dr. Julia Brumaghim (Department of Chemistry, Clemson University) and Dr. E. Gerald

Meyer (retired, Department of Chemistry, University of Wyoming) visited Alaska and gave excellent seminars at UAF, UAA, and UAS. Dr. Beverly D. Barker is the 2014 Chair-Elect for the Alaska Local Section, and she will select the speakers for the 2014-2015 academic year.

It was my pleasure to teach Chem 402 (Inorganic Chemistry) in the fall 2013 semester and Chem 332 (Physical Chemistry II) in the spring 2014 semester. In both cases, there were UAA students who took these courses by distance, in addition to the UAF students.



## Tom Green - Organic Chemistry

This last year has been a rewarding in many respects. I had an opportunity to introduce some new experiments into the organic chemistry curriculum. The students acetylated ferrocene, synthesized macrocyclic porphyrins, and analyzed the constituents of various teas by gas chromatography/mass spectrometer, among several other experiments. The porphyrins are particular cool; they form beautiful, purple crystals and are closely related to structures found in chlorophyll and hemoglobin. I enjoy teaching laboratory because I always learn something new about organic chemistry. I had some excellent teaching assistants this year, including **Terilyn Lawson Stephen, Arianna Demmerly, Anil Damarancha, Jamie McKee,** and **Zhipeng Dai** (known to many as Adai).

On the research side, Zhipeng Dai graduated in December 2013 with a Ph.D. in Biochemistry. His dissertation centered on the synthesis of sphingosines, an important class of lipid molecules thought to control various aspects of cell growth. One of the highlights of his research is the use of enzymes to catalyze reduction of ketoesters to hydroxyesters with high enantioselectivity. Adai was also the lead author on a sphingosine article submitted to Journal of Organic Chemistry. He is now a post-doctoral fellow at ZoneOne Pharma in San Francisco working on drug delivery. All of this, and he still found time to travel back to China to get married. Congratulations to Adai!

Congratulations also go to **Kate Guillemette**, an undergraduate chemistry major who was a co-

author with Adai on the enzyme work. She was recently accepted to an Research Experiences for Undergraduates program, funded by the National Science Foundation, at Montana State University for the summer of 2014. Kate will be studying chemical biology with 9 other students for 10 weeks in Bozeman. Way to go Kate!

**Jamie McKee**, Ph.D. candidate Environmental Chemistry, is synthesizing new types of cyclodextrins (CDs) that form micelles at very low concentrations. He has made some excellent progress in characterizing their micelle-forming properties, and we're submitting an article to the journal Langmuir. We envision that these new CDs may be useful in a variety of circumstances, including sequestration of organic environmental pollutants.

Terilyn Lawson Stephen is an M.S. student and continues her work on the analytical chemistry of adenosine. This research is funded by National Institutes of Health (NIH). Adenosine is an important neuromodulator related to a wide range of neurological processes and diseases. We just purchased a new capillary electrophoresis system for this work, and Terilyn will be busy over the summer as a research assistant using this new instrument.

As always, the coming year will bring new opportunities for me in teaching and research. Additionally, I'll be taking over duties as Department Chair from Bill Simpson. Bill has performed these duties the past 4 years with professionalism, enthusiasm, and skill. I hope to live up to the high standards that he set for the department. I look forward to the challenges.



Photo by M. D'June -Gussak

## Staff and Faculty Awards



**Kelly Drew**

CNSM Outstanding Teaching Award in Chemistry and Biochemistry



**Emily Reiter**

The UAF Safety Spirit Award



**William Simpson**

CNSM Exemplary Service as Department Chair Award

## Chris Iceman - General Chemistry and Chemical Education

This has been a really fun year for me and I am super excited to share with you some of the awesome things going on in the classroom and lab. This year I have been busily teaching a whole bundle of undergraduates in both Chem 105 and Chem 106 introductory courses. I've had the pleasure of meeting some excellent students and have enjoyed seeing so many bright young minds get above 90% on my exams. There were even a few 100% scores throughout the semester! We've also been able to integrate a few new research experience labs into the curriculum this year and worked on a new computational lab emeritus professor Dr. John Keller has been developing recently. Altogether it is great to see students feel like they have achieved understanding of general chemistry principles and I hope they all continue to think about the chemical world around us. At least until summertime!

I had the opportunity to work with **Parker Whaley** (B.S. Physics Major) on a computational chemistry project studying an inorganic complex that Brian Rasley studied some years ago. The molecule is quite interesting and you can view the output from Parker's calculations on the front cover! Parker has done a really nice job thinking through the transition state search we are completing for this ruthenium complex and I am confident we'll soon have an energetic

barrier to compare to Dr. Rasley's kinetic data for the compound. This work has also been an excellent opportunity to test the new computational server in my lab and crank out some CPU hours (photo of cluster on right).

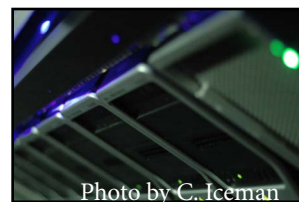
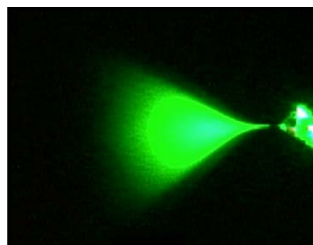


Photo by C. Iceman



Photo by M. D'June -Gussak

Finally I have also managed to extract some preliminary data from an old gas chromatography mass spectrometer adopted into the Iceman lab that was dated new in the mid-eighties. What makes this project so special is that I've been able to resuscitate the instrument with new trimmings...a homegrown electrospray ionization source! The objective is to turn this instrument into a desorption electrospray ionization (DESI) platform to look at environmental and anthropogenic samples of aerosol particulates and other molecules of interest. DESI has gathered a lot of interest lately as a technique for analysis of organic molecules and is quite diversely applied in the mass spectrometry arena. It is a fun project to work on when time permits and hopefully it will have the attentions of a devoted student soon.



### Happy summer everyone!

The homegrown electrospray ionization source (illuminated with 532nm laser light) displays the quintessential Taylor cone and mist field at the mass spectrometer inlet.

## Undergraduate Student Highlight - Stacey Krepel

Stacey is a senior working on a Bachelor's of Science in Chemistry (concentration in Biochemistry). She was born in Anchorage but grew up in Naknek until she moved to Delta Junction with her family 10 years ago. She started at UAF in the Fall of 2011 after graduating from Delta Junction High School.



Photo by C. Iceman

Stacey has loved science for as long as she can remember. During her first biology class as a freshman in high school she realized that, in addition to loving the subject, she was really good at it. When, the class started studying Sodium-Potassium ion pumps and she was the only student that really enjoyed it, Stacey

decided that she wanted to be a Biochemist and has been working toward that goal ever since.

In addition to taking classes at UAF, Stacey maintains an active role in the campus community. She is the Vice President of Service for Circle K and the Secretary for the Honors Student Council. She also has been a Supplemental Instruction Leader for Chemistry 105 and 106 since the Fall of 2012. After she finishes her degree, she would like to pursue a Ph.D. in Biochemistry from the University of Wisconsin Madison with the goal of doing medical research at a hospital research facility.

***Stacey was awarded with a GVEA Continuing Education Scholarship in 2014; a well-deserved honor!***



## Kriya Dunlap - Biochemistry and Nutrition

It has been another eventful year! **Theresia Schnurr** completed her Master's in December 2013, but not without helping us smoothly transition her research on the effects of conditioning on the glucose transporter-4



Photo by M. D'June -Gussak

(GLUT4) in dogs into the human model. This daunting endeavor involved the logistics and recruiting of the UAF ski team and sedentary students, and would most definitely not have been possible without Theresia's boundless energy and resilient enthusiasm.

Also jumping into this project full bore, was incoming Ph.D. student, **Kendra Sticka**. Kendra is a faculty member in the Dietetics program at the University of Alaska Anchorage and we are extremely lucky to have her continue with this as her thesis project. She is also working with a Professor of Immunology at UAA, Cindy Knall, to incorporate an epigenetic piece.

Also joining us in the Fall of 2013 was Ph.D. student, **Aline Collin**. Aline, in short time, has made great headway at understanding the anti-diabetic properties of wild Alaskan *Vaccinium* berries and has outlined

a nice project that should elucidate the mechanistic role of these phytonutrient rich berries. This project is in conjunction with our collaborators at the Plants For Human Health Institute at the North Carolina Research Campus (NCRC). Aline wasted no time forging this relationship by attending a Screens-2-Nature workshop at NCRC within her first month at UAF.

Last Summer (2013), I had the honor of mentoring **Shannon Jimmie**, a graduating high school senior as part of NIH's Short-Term Research Experience for Underrepresented Persons (STEP-UP). Shannon presented her project at NIH in August of last year and I am really excited to have her back in the laboratory this summer. Shannon just completed her freshman year at George Fox University in Oregon.

Also this year I worked with the Chancellor's Innovation in Technology and Elearning Program on a variety of projects for Chem 104, including the introduction of gaming for an exam review, a website and blog, and an augmented reality project. Working with the creative and talented instructional designers at eLearning has been a tremendous experience and I encourage everyone to apply to iTeach. Here's to another exciting year...

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## Kelly Drew - Biochemistry and Neuropharmacology

Regarding news in the Drew laboratory, we eagerly anticipate **Zachary Carlson's** thesis defense this May (M.S. Chemistry) where he will explain how seasonal changes in adenosine receptors may help ground squirrels hibernate. We are also excited to welcome our new Ph.D. student **Sarah Rice** in June; and we look forward to hosting Veterinary Medicine Intern, **Kelsey McClure** from Colorado State University during the summer months. Ph.D. student **Saurav Bhowmick** is defining the role of neuroglobin in ischemia resistance in hopes that it will lead to improved therapeutics designed to decrease the damaging effects of a stroke or cardiac arrest. Ph.D. student **Carla Frare** is advancing our understanding of neural networks that regulate the seasonal control of hibernation. Post-doctoral fellows **Lori Bogren**, **Zeinab (Bahareh) Barati** and **Bernard Laughlin** and undergraduate student **Isaac Bailey** are working to apply what we have learned



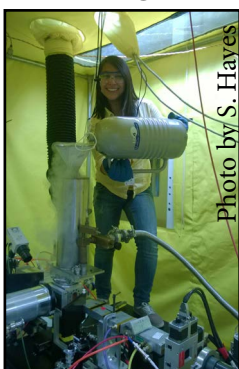
Photo by T. Paris

about hibernation to therapeutic hypothermia. We submitted a patent this year on the use of adenosine agonists as pharmacological adjuncts for therapeutic hypothermia. The group is working to refine application of these drugs to optimize efficacy and minimize side-effects. Dr. Bogren with assistance from undergraduate student **Paula Martin** has also revealed preservation

of bone density in the Arctic ground squirrel with continued disuse during hibernation and during the summer season. This work is important for preventing osteoporosis and for astronauts who suffer loss in bone density during prolonged space flight and brittle bones upon return to earth. We are especially grateful for grant support from the National Science Foundation, the National Institutes of Health and the Alaska Space Grant Program.

## Graduate Student Spotlight - Nicole Knight

**Nicole Knight** is a second year Ph.D. student in the Environmental Chemistry program. Her research focuses on the fate of tellurium (a rare element used in high efficiency solar panels) in the surficial weathering environment as it relates to bioaccessibility and transportability. Her study site is a historic gold mine in southern Nevada, near Las Vegas, where she was raised.



progress with her research. She has been awarded the several grants to support her field campaign and travel for data collection at synchrotron facilities. She presented a poster at the national meeting of the Geological Society of America meeting (October, 2013). Nicole was also recognized as the 2013-2014 Department's American Institute of Chemistry Graduate student of the year.

Since coming to UAF, Knight has become an exemplary teaching assistant, and made substantial

We look forward to Nicole's future achievements and have no question that she will be going a long way.

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## Larry Duffy - Biochemistry and Neuroscience



I am serving as the Director of the Resilience and Adaptation Program (RAP), an interdisciplinary graduate program focused on global-to-local sustainability in times of rapid change. Resilience and adaptation serves as a central concept in exploring the challenges of

sustainability by transcending disciplinary boundaries and focusing on real-world issues. There is a growing demand by students to integrate their science education with a more holistic (and realistic) world view around issues that include policy, economic, medical and other human dimensions. Currently, we are developing a graduate certificate for the RAP program. Additionally, we recently received notification that our NSF S-STEM application to extend RAP to undergraduates will soon be funded.

I am working with **Linda Nicholas-Figueroa**, during the summers, to develop and deliver a Climate Change Science Camp for rural students at Ilisagvik Tribal College in Barrow. Our effort to improve and reform science education in Alaska through the Keck Foundation SciWestNet is growing and the "Alaska Node" has submitted an IUSE application to the National Science Foundation. I am very pleased with the progress we made with the URM Alaska NSF grant which encouraged undergraduate STEM research and I continue to teach Chem 100 each summer for RAHI. Dr. Chris Whittle has taken over the instruction of the

on-line Chem 100 class; her student evaluations have been very good.

I also continue to teach the undergraduate biochemistry, Chem 451, Metabolism. The department hopes to revise the biochemistry undergraduate curriculum over the next few years to reflect the exciting new developments in biochemistry and neuroscience. We are also working with Effie Kokrine Charter School to incorporate a biochemical activity screening component into their summer Ethnobotany course. We will focus on the bioactivity of traditional Alaska Native subsistence plants like blueberries and integrate research activities into the summer component of Effie Kokrine's innovative four year "spiral" curriculum. Next year I will teach Chem 100 and 103 at Effie Kokrine School.

I would again like to thank Alzheimer's Resources of Alaska for their support of Chemistry and Biochemistry graduate students and faculty members. Public and alumni contributions are extremely important as national and state resources dwindle.

My research is still moving in the same directions, but has been greatly enhanced by **Jing Zheng** in developing methodological improvements in the laboratory. Jing successfully defended her thesis last summer before moving on to Long Island University where she began a Physician Assistant's Program. **Theresa Vertigan** has joined the laboratory and has designed an exciting new project to examine the effect of methyl mercury on diabetes using 3T3 adipocyte cells as a model system.



## William Simpson - Physical and Atmospheric Chemistry

This has been the last year as department chair, and I feel like we got a lot done both departmentally and in my teaching and research. I am very glad to be finished with the chair job and have a chance to revitalize research and teaching efforts. As a part of that preparation, I have been writing a lot of grants and working on publication of journal articles. I am also very happy that two new graduate students will join the group in Summer 2014, **Kristian Nattinger** (Ph.D. program) and **Justine Burd** (M.S. program).

Both will arrive in the summer to have a little overlap with the current group members and before I get into Fall semester teaching.



Photo by L. Simpson

In research, **Peter Peterson** (Ph.D. candidate) and **Erin Gleason** (M.S. candidate) are making good progress towards Summer 2014 graduation. Erin has valiantly fought the cold room to get exciting data observing the microscopic behavior of salt aerosol particles melting the surface of ice. This melting behavior spreads ionic impurities that are reagents in heterogeneous atmospheric chemical reactions across the surface. Peter is completing a manuscript that shows that the vertical profile of halogen gases sourced from sea ice depends strongly on atmospheric stability, with strong “inversion layers” trapping the reactive gases closer to the surface. This is an excellent use of the remote-sensing ability of our multiple-axis differential optical absorption spectroscopy technique, and Peter’s paper makes significant advances in how to interpret these data. Peter is working on two other manuscripts for the dissertation, and we hope to get it done this summer. In other research work, we submitted a manuscript from **Patrick Joyce’s** M.S. thesis, which has received good reviews and hopefully will be published fully soon. I contributed to a review article led by Professor Uma Bhatt on impacts of sea ice change, which is an exciting area of research. Uma did a great job leading this manuscript! I’m working on spinning up a couple research ideas that I didn’t have time to pursue while chair, and look forward to that work with the new students.

In Fall semester, I taught the evening section of General Chemistry I (Chem F105X), which was my second year teaching that course and was a blast. I had a really great class, and we tried out a new online homework system that allowed us to experiment with different ways for students to learn the material. The students did great on the ACS exit exam, with our average student scoring better than 69% of nationwide test takers. I really enjoyed this experience and look forward to discussing ideas that I tried with the General Chemistry Best Practices group. In Spring, I had a teaching release, the last benefit of my time as department chair. However, I had fun mentoring **Logan Pitney** on undergraduate research in a project where we explored use of nuclear magnetic resonance (NMR) spectroscopy to probe organic matter in snow. I also enjoyed working with **Sara Marshall** on her seminar presentation, and am glad that Sara will do research on halogen chemistry with us next Fall.

At home, all goes well with the girls growing up fast. Amelia (age 12) is playing piano and having fun with friends. She goes to middle school next year! Layla (age 6) and I had a great time cross country skiing in Junior Nordics, and she loves friends at school. Maggie is expanding her community supported agriculture farm and is looking to sell more veggies from her roadside stand this summer.



Photo provided by S. Hayes

Carl Murphy, Sarah Hayes, Chris Iceman, Cathy Cahill and Tom Green celebrated Halloween in style as Mad Scientists!

## Brian Edmonds - Biophysics and Biochemistry

This year I taught undergraduate Research (Chem 488), our oral-intensive Seminar course (Chem 481/482), and Macromolecules (Chem 450), an upper-division undergraduate course focused on the properties of key molecules in the transfer of genetic information from DNA to proteins. I also taught our graduate Biochemistry Colloquium (Chem 688), emphasizing development of skills and strategies for career success in chemistry.



Photo by M. D'June -Gussak

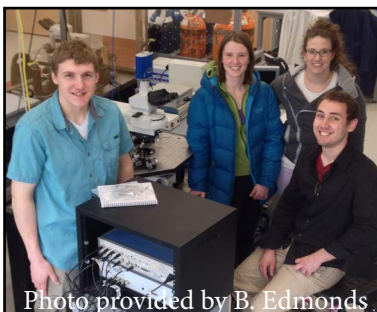
Our research efforts are centered on understanding how nicotinic acetylcholine receptors (neurotransmitter receptors responsive to the endogenous transmitter acetylcholine) transmit signals in the central nervous system. Nicotinic receptors are candidate drug targets for Alzheimer's disease, autism, nicotine addiction, and other disorders that involve signaling errors at nicotinic receptors. A major, current focus of our group is on a recently discovered class of compounds (drugs) that act at nicotinic receptors to increase their responsiveness to acetylcholine. These modulators are expected to boost signals at nicotinic receptors and, ideally, restore transmission in pathologies where signals are compromised (Alzheimer's disease, e.g.). To gain a better understanding of the potential role of these drugs as therapeutics and facilitate the development of additional, better modulators of nicotinic receptors, our work is aimed at understanding the molecular underpinnings of modulation.

**Arianna Demmerly** (B&N Ph.D. student) is finishing up her third year in my laboratory and she continues to make excellent progress defining the mechanism of action of desformylflustrabromine (dFBr), a nicotinic receptor modulator originally isolated from a North Sea bryozoan. Arianna uses a patch-clamp method to measure tiny (picoampere) fluctuations in electric currents that reflect the moment-to-moment activity of the receptor. She has developed models of nicotinic receptor gating that provide a clear picture of how dFBr modulates two important classes (low-sensitivity and high-sensitivity) of human nicotinic receptors. In November of last year, she presented some of her results in a poster entitled "Destabilization of a

desensitized state contributes to potentiation of low-sensitivity  $\alpha 4\beta 2$  receptors by desformylflustrabromine" at the Society for Neuroscience Annual Meeting in San Diego. Arianna is currently writing up these results of her work.

We also now have a second, collaborative research project to investigate the action of the anti-schizophrenic clozapine on nicotinic receptors expressed in the nematode *C. elegans*. Clozapine is the current drug of choice for patients with severe (treatment-refractory) forms of schizophrenia; however, clozapine produces toxic side effects and therefore limits its utility as a therapeutic. Our collaborator (Dr. Edgar Buttner, McLean Hospital) recently found that a particular nicotinic receptor subtype is the likely target for clozapine. **Savanna Chesworth** (B&N M.S. student), who joined the laboratory in January, is studying how clozapine interacts with nicotinic receptors in *C. elegans*. Savanna has already made significant progress and we expect great things from her in the future. Undergraduates **Alfred Wright** and **Jonathan McMahon** made important contributions to the initial phase of this project by developing an efficient method for extraction and preparation of the target tissue, the *C. elegans* pharynx. Alfred and Jonathan both received URSA research awards for their work, and went on to win the CNSM Dean's Choice Award for their UAF Research Day presentation on nicotinic receptors in *C. elegans*.

Finally, **Camden Taylor** is an undergraduate engineering student who just joined our group to develop, together with research affiliate **Adam Cornachione** (M.S. Computer Science), ligand-gated ion channel (receptor) simulation software to be used for research presentations on nicotinic receptors, and as a learning tool in my Cellular and Molecular Neuroscience course (Chem 470/670).



The Edmonds laboratory group: Alfred, Savanna, Arianna, and Jonathan (from left to right).

Photo provided by B. Edmonds

## Thomas Kuhn - Biochemistry and Cellular/Molecular Neuroscience

As the spring semester comes to an end, I enjoy revisiting the past year as the daily buzz of academia gives way to a more harmonious echo. In the spring of 2013, **Lisa Smith** joined my laboratory to pursue her aspirations of a Ph.D. degree. She successfully received a one-year CASE (Changing Alaska Science Education) fellowship, a NSF-funded program pairing graduate students in the sciences with teachers in K-12 classrooms. The goal of this NSF program is to improve science communication by graduate students, and simultaneously expose K-12 students to science and research in a real-world context hopefully inspiring these young students to engage in a science career. She started in the laboratory not only acquainting herself with new research techniques but also mentored a RAHI student during the summer. Together, they started to develop an assay to measure glucosylceramide synthase (GCS) activity in neuronal cells, which is a key enzyme implicated in the sphingolipid metabolism and its activity is greatly diminished in several neurodegenerative disorders such as Alzheimer's Disease.

My long-term research aims at role of inflammatory and oxidative stress in the aging or diseased Central Nervous System largely responsible for the degeneration of neuronal connectivity and ultimate decline and loss of cognitive function. Investigations focus on elucidating the molecular and cellular mechanisms linking actin cytoskeleton dynamics, redox homeostasis (NADPH oxidases), and sphingolipid metabolism (sphingomyelinases) at the plasma membrane/cytosol interface and the consequences for the integrity and plasticity of neuronal connectivity combined with a natural products-guided therapeutic strategy to blunt inflammatory and oxidative damage. Together with my collaborator Dr. James Bamburg (Colorado State University), we made great strides in our research. We were able to demonstrate that soluble, oligomeric amyloid beta dimers/trimmers (the prevalent species in human Alzheimer's brain) as well as several inflammatory cytokines foremost Tumor necrosis factor alpha (TNF $\alpha$ ) provoked the formation of rod-like actin inclusions in primary hippocampal neurons through a common signaling

pathway. Both pathological stimuli cause the formation of oxygen radicals by a neuronal NADPH oxidase, which assembles in coalescing lipid rafts, and require the presence of the cellular prion



Photo by T. Paris

protein. We just published those results in PLoS One aside from several other accepted manuscripts. We disseminated these novel findings the Neuropharmacology Meeting 2013 (The synaptic basis of neurodegeneration) and the Annual Meeting of the Society for Neuroscience 2013.

I taught a graduate course on Cellular Signaling in the spring semester 2013 (Chem 657) as well as the Biochemistry Colloquium (Chem 688). Graduate students work hard in both courses. I started the biochemistry colloquium a few years ago designed to acquaint students with the softer skills of becoming a Biochemist. This time around I challenged the students with translating their research/science ideas into a start-up business. Why? Well I have seen a fair number of graduate students in the past struggling to relate the real-world impact of their research. I was fortunate to get much help from Adam Krynicki (Office of Intellectual Property and Commercialization) and Betty Ross (School of Management). We guided the students through intellectual property development, establishing a business concept, generating a short business plan, and the elevator pitch all wrapped up in an end-of-the-semester presentation in front of a panel. Let's say the outcome was mixed but very interesting. Just this spring, I initiated a drastic revision of the biochemistry undergraduate curriculum, and with considerable help from my colleagues we are nearing final draft.

This spring 2014 with several volunteers, Lisa and I introduced 7th graders both at the Tanana Middle School and Randy Smith Middle School to the brain and its many functions. We dissected sheep brain and looked at its gross anatomy. Responses ranged from AWESOME to EEW – a memorable event for all students. Lastly, I was invited to the Editorial Board of the Journal of Biological Chemistry for another 5-year term, which I accepted. It is definitely work but extremely interesting.



## Carl Murphy - Molecular Imaging Core

In Nuclear Magnetic Resonance (NMR) related news, this spring semester I was able to offer a one credit trial course on NMR spectroscopy. This is a new class that we are trying out with the intent of getting the students more experience in actually operating the NMR spectrometers and applying them to research questions. The projects this semester ranged from just expanding on projects from other chemistry courses, to analyzing complex mixture samples that had past work experience with, all the way to sequencing short peptides. As part of the class all of the students were trained on both the 300 MHz NMR and the 600 MHz NMR. The semester is not over yet, but it looks like the course is going to be a success, and the students seem to be enjoying learning more about the NMR.

This year, the NMR Facility received an upgrade with the addition of a 1.5 Tesla magnetic field strength Magnetic

Resonance Imaging (MRI) scanner, pictured below, that is located in the new Murie Life Sciences Building. With the new addition we are now known as the Molecular Imaging Core. With the new MRI there are plans to work with researchers throughout the Institute of Arctic Biology to build on the current hibernation and metabolic studies being conducted, as well as gain some possible collaborations with psychology and even the Museum of the North. The facility will also offer the first veterinary imaging service in the state of Alaska. This instrument is a great resource to have available and should be ready for research and veterinary clinical applications by mid-summer.



Photo provided by C. Murphy

The MRI acquisition was made possible through partnership with the Greater Fairbanks Community Hospital Foundation, UAF and the Institute of Arctic Biology.

## Celebrating Excellence - Student Awards



Julia



Tara



Yu



Saurav



Kasie

Outstanding Chemistry Student – Julia Duncan  
Freshman Award – Chanachai Charoonsophonsak  
Alaska Chapter ACS Award – Julia Duncan

ACS Undergraduate Award in Analytical Chemistry - Kasie Baker  
HyperCube Scholar Award - Parker Whaley

ACS Undergraduate Award in Organic Chemistry – Yu Miaoyang  
Outstanding Research Paper - Riley Witte and Julia Duncan



Arianna

American Institute of Chemistry Graduate Student Award - Nicole Knight (Chemistry)  
American Institute of Chemistry Graduate Student Award - Saurav Bhowmick (Biochemistry)  
American Institute of Chemistry Undergraduate Student Award - Moriah Hunstiger (Chemistry)  
American Institute of Chemistry Undergraduate Student Award - Isaac Bailey (Biochemistry)

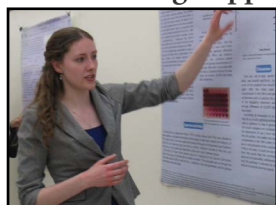
ACS Undergraduate Award in Inorganic Chemistry – Madison Wilson

Outstanding TAs – Arianna Demmerly and Tara Craft

Outstanding Supplemental Instruction Leader – Stacey Krepel



Chanachai



Stacey



Parker



Moriah

## Fenton Heirtzler- Organic Chemistry

Projects in the Heirtzler group involve the synthesis of structurally elaborate organic molecular ligands for transition metal complexes. Some of those complexes are designed to function as frequency doublers. When these complexes are irradiated with an intense laser light source, they emit light at twice the original frequency. A necessary structural property of such molecules is being non-centrosymmetric, either in solution or the solid state. Applications of such materials include creating new laser wavelengths, high-density 3D optical memory, two-photon scanning microscopy, thin-film waveguides, high-speed optical modulation and sensing devices, as well as making possible the encoding of optical carrier waves with high-speed electrical signals.<sup>1</sup> Our group has already demonstrated strong solution-state frequency-doubling effects for cuprous complexes of ligands containing the 7,8-dinitroquinoxaliny fragment.<sup>2</sup> Three current projects in my group all involve the preparation of further new bidentate ligands with this same chromophore.

In the 2013-14 academic year, undergraduate **Julia Duncan**, led the synthesis of the absolutely chiral oxazoline derivative **1**. The oxazoline ring system is derived from chiral amino alcohols, which are in turn prepared from  $\alpha$ -amino acids. Compounds like **1** are designed to form chiral-at-metal complexes with tetrahedral cuprous ion.

The second class of molecules are anticipated to form dimeric supramolecular complexes having electrochemically-activated switches between electron-poor and electron-rich sites in their structures, such

as in structure **2**. From this substance, the dimeric cuprous complex will be prepared. Oxidation of the metal center will interrupt the metal-ligand-charge-transfer transitions between the dinitroquinoxaline- and 4'-methoxyphenyl pyridine ring systems.

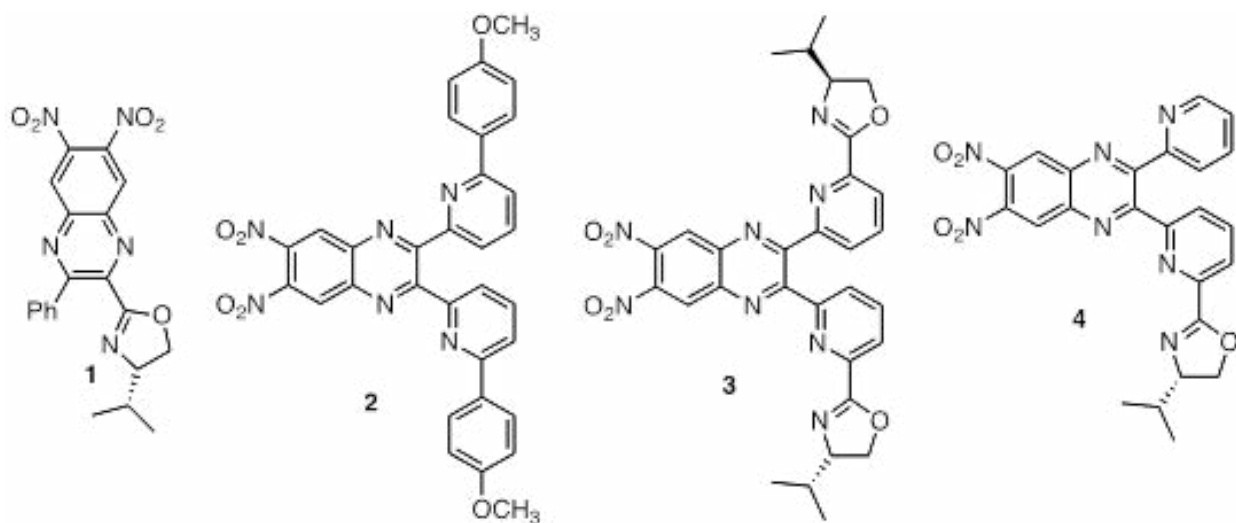
This project is being led by **Anil Kumar Reddy Damarancha**, who has now completed one year in my group as a Ph.D. student.

Finally, over the past twelve months, I have been working in the laboratory towards the synthesis of absolutely chiral ligands to form dimeric, chiral-at-metal metallosupramolecular complexes that we hope will display strong solid-state frequency doubling effects. The target molecules are structures **3** and **4**. The synthesis, coordination chemistry and non-linear optical studies on at least one of these substances is a prerequisite to submission of a funding proposal, which features oxazoline-type ligands which are derived from a variety of  $\alpha$ -amino acids.

To investigate the non-linear optical properties of the cuprous complexes of the preceding compounds, I will be relying on existing collaborations with Professor Grazia Gonella (hyper-Rayleigh scattering at 400 nm, Temple University) and Professor Luke Burke (Theoretical Chemistry, Rutgers University), as well as a new cooperation with the group of Professor Paresh Ray (hyper-Rayleigh scattering at 518 nm, Jackson State University).

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## Commencement for the Class of 2014, held on 11 May 2014

\* Summer degree recipient  
\*\*December degree recipient

### Doctor of Philosophy Degrees

Jennifer Michelle Bell

*Ph.D. Environmental Chemistry*

*M.S. California State University, San Bernardino, 2008*

*M.P.A. California State University, San Bernardino, 2004*

*B.S. California State University, San Bernardino, 2001*

*A.A. San Bernardino Valley College, 1998*

Zhipeng Dai\*\*

*Ph.D. Biochemistry/ Molecular Biology*

*B.S. Zhengzhou University, 2006*

Trang Thu Tran\*

*Ph.D. Environmental Chemistry*

*M.S. Asian Institute of Technology, 2008*

*B.S. Ho Chi Mihn University of Natural Science, 2005*

Shannon Renae Uffenbeck\*

*Ph.D. Biochemistry/ Molecular Biology*

*M.S. University of Alaska Anchorage, 2008*

*B.S. University of Alaska Anchorage, 2000*

### Master's Degrees

Lucero Correa\*\*

*M.S. Environmental Chemistry*

Theresia Maria Schnurr\*\*

*M.S. Biochemistry/Molecular Biology*

Jinghui Zheng\*

*M.S. Biochemistry /Molecular Biology*

### Baccalaureate Degrees

Victoria J. Bills

*B.S. Chemistry: Biochemistry/Molecular Biology*

Tavia R. Casados

*B.S. Chemistry*

Julia M. Duncan

*cum laude*

*B.S. Chemistry: Biochemistry/Molecular Biology*

*Golden Key Honor Society*

Ealum E. Howe

*B.S. Chemistry: Biochemistry*

Scott William Hummel\*\*

*B.S. Chemistry: Biochemistry/Molecular Biology*

Yu Miao\*\*

*B.S. Chemistry: Biochemistry/Molecular Biology*

Kayl Overcast

*B.S. Chemistry*

Cicely Shankle

*B.S. Chemistry: Biochemistry/Molecular Biology*



### Alumni Out and About

**George Bernt** (B.S. 2010) is finishing his Registered Nurse degree. His goal is to become a Nurse Practitioner.

**Trang Tran** (Ph.D. 2013) is working as a Postdoctoral Associate in Atmospheric Science in Utah.

**Maegan Weltzin** (B.S. 2006) working as a Postdoctoral Associate at the Barrow Neurological Institute.



**Laurie (Martin) Kemp** (B.S. 2002, M.S. 2005) and **Scott Kemp** (B.S. 2003, M.S. 2005) send their greetings from Alabama.

**Scott Hummel** (B.S. 2013) is working on a Pharmacy Doctorate degree at the University of Wisconsin.

**Lisa Smith** (M.S. 2012) is working on her Ph.D. program at UAF.

**Sarah Petitto** (former Postdoctoral Associate) and family send their greetings from Minnesota. **Congratulations on being awarded tenure at St. Cloud State University!**





## Cathy Cahill to serve as fellow to U.S. Senate Committee (article by Meghan Murphy)

University of Alaska Fairbanks professor Catherine Cahill has been selected to serve as a fellow to the U.S. Senate Energy and Natural Resources Committee. Starting in January, Cahill will spend up to a year in Washington D.C. learning about public policy while contributing her scientific expertise to a broad range of energy and natural resource issues facing Congress.



“This will give me a completely new perspective on how the science we do gets implemented into policy,” said Cahill, a chemistry professor and UAF Geophysical Institute researcher.

The committee has jurisdiction over energy production and related policies, mining, and management of federal lands, including national parks and refuges. Alaska’s Sen. Lisa Murkowski is the committee’s ranking Republican member.

UAF Vice Chancellor of Research Mark Myers recommended Cahill for the fellowship. “This is a great opportunity for Alaska to have someone with Cathy’s expertise and sound scientific judgment working on the Senate committee,” Myers said. “She cares about the direction her country goes in.”

Cahill researches atmospheric aerosols, which are solid or liquid particles that stay suspended in air. Cahill said most aerosols are microscopic in size and can come from natural or manmade sources.

A physicist by training, Cahill’s research dovetails with atmospheric science, chemistry, biology, geology and nuclear physics. Many of her studies are in Alaska, looking at the relationship between aerosols and the arctic climate.

She often partners with federal agencies like the National Park Service or the U.S. military to investigate aerosols and their effects. She is working with the U.S. Army Research Lab to evaluate air pollution in places like Afghanistan and Iraq, where Americans are stationed.

While Cahill is known for her research, she is also known her ability to help people understand all angles of an issue, the role they play and the actions they can take to improve the situation.

“Cathy can make sense of science in almost any context whether it’s in the classroom, with her colleagues, at a public lecture or in a room full of legislators,” said Paul Layer, dean of the UAF College of Natural Science and Mathematics. “She really has a gift, and she’ll be putting it to good use.”

Cahill said the fellowship opportunity came at just the right point in her life. After 15 years of teaching, she became a full professor last spring and received a prestigious service award for working with state and local government to shape policy on air pollution issues.

“I was at a point where I asked myself, do I sustain or go in a different direction. What’s next in my career?” she said.

The “next” will now take Cahill more than 4,000 miles southeast to the nation’s policy hub, after which she will take a sabbatical before returning to UAF. She’s packing her bags and preparing her six-toed cat, Bigfoot, for the big move.

“I still can’t believe this is happening” Cahill said. “I have a lot to live up to, but I know that I have a lot to contribute as well.”

# Thank you for your support!

Brian and Amber Brubaker - Anchorage, AK

Cathy Cahill - Fairbanks, AK

Diane Phillips - Indianapolis, IN

Ray Loewenstein and Alana Stubbs - Tuscon, AZ

We thank you for your generous support of the Department of Chemistry and Biochemistry. Your gift allows the department to support projects that might not otherwise have been funded; enhancing student learning experiences. Some examples of ways funding was spent are supporting student research, student travel and much needed equipment.

*Your contribution is extremely important to the department and college. Thank you for your generosity!*

If you wish to donate to the department, please contact our department (chemistry.uaf@alaska.edu), the UA Foundation, or use the secure contribution form for donations by credit card at:

<http://www.uaf.edu/giving/gift/giving-form/>

This form includes a place to specify that your gift is to be designated to the Department of Chemistry and Biochemistry (FundID 20372).

Thanks for your support.



The Department of Chemistry and Biochemistry would like to thank **Teck Alaska Inc.** for their donation of a Thermo Scientific Quant'x Energy Dispersive X-ray Fluorescence Spectrometer. This instrument was used at the Red Dog Mine to evaluate approximately 250,000 ore samples over the course of 10 years. We are excited that our students will have the opportunity to use it for years to come!

## Chemistry and Biochemistry Faculty and Student Outreach



At Science Potpourri

Photos by S. Hayes



Photos provided by M. D'June-Gussak

At Salcha School





## Publications:

- Bogren, L. K., J. M. Olson, J. Carpluk, J. M. Moore and K. L. Drew** (2014). "Resistance to systemic inflammation and multi organ damage after global ischemia/reperfusion in the arctic ground squirrel." *PLoS One* 9.
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Photos provided by K. Drew  
Alaska INBRE faculty at the Western Regional Meeting of IDEa states held in Honolulu in October 7-8, 2013



Zeinab (Bahareh) Barati, Terilyn Lawson and Kelly Drew at the AIMES 2013 conference





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## Our Department at a Glance:

- The only American Chemical Society (ACS) approved programs in Alaska
- 32 current Graduate Students
- 16 Publications during the 2013-14 academic year
- 96 Undergraduate majors and pre-majors
- 10 new Graduate students (6 M.S., 4 Ph.D.) entered in 2013-14 academic year
- 8 B.S, 3 M.S., and 4 Ph.D. students graduated in 2013-14
- 877 unique students took at least one undergraduate Chemistry course in 2013-14
- 15 Faculty members, 2.5 staff, 3 Postdoctoral associates

## Department of Chemistry and Biochemistry graduates, we would like to hear from you!

Please feel free to email [chemistry.uaf@alaska.edu](mailto:chemistry.uaf@alaska.edu) with the subject line ALUMNI UPDATES or you can print out this form and mail it to us. All news will be published in the next issue of the AlasChemist.

Name (include maiden name if applicable): \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_

Year Graduated: \_\_\_\_\_ Degree Received: \_\_\_\_\_

Please include any news for the next edition of the AlasChemist Alumni Out and About section (employment, further schooling, travel, family etc.). Please feel free to send pictures as well.



Photo by J. Gussak

This spring the Chemistry and Biochemistry Department bid farewell to Mist D'June Gussak. We all wish her luck with her position at the University of Alaska Anchorage.

Mist was the Department's Administrative Assistant from 2007 to 2014 and her presence is certainly missed by students, staff and faculty.



Photo by J. Gussak

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*Managing Editor: Jessica Armstrong*



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