

# CHEMISTRY NOTATIONS

A publication of the Chemistry Department at Washington State University

2011

## *A Message from the Chair*



I recently learned that chemistry, math, and biology are not only important, but actually are the backbone of an undergraduate education. Based on the number of credit hours taken by ALL undergraduates at WSU, Math is number 1 with 30,000 credit hours taken, Biological Sciences is number 3 with 23,000 credit hours, and Chemistry is number 6 with 19,150 credit hours taken this last school year. Number 2 is the entire College of Liberal Arts (24,500 credit hours), and numbers 4 and 5 are almost the same as Chemistry (Psych - 23,000; English - 21,500). To further put this in perspective, there are a total of 130 different departments, colleges, and schools on the list! While many of your friends may comment about how they didn't like, or didn't do well in, chemistry, they probably did take it! And they took it because they needed it - almost no one takes chemistry just to fulfill a science requirement for graduation. As the ACS is fond of saying - Chemistry is the Central Science.

This has been a year of opposites and sharp contrasts. We have experienced two cuts in state support and are anticipating what may be an even larger cut for the 2011-2012 academic year. On the other hand, our grant and contract support continues to grow and our graduate program is larger and healthier than ever before. We have been unable to hire needed additions in organic and inorganic faculty, but we have been blessed with promotions (and raises!) for five of our existing faculty members. Although direct state support for WSU declined about 25% this biennium, we are told that we may see a 50% increase in Freshmen students this Fall. Thus, we will have our largest ever undergraduate student body. We have lost some important support staff, but the remaining staff are working harder than ever to keep services to students and faculty at an extremely high level - we are blessed with a wonderful group of support people! As I said, a year of contrasts. Overall, I am very proud of this department and the way it has responded to adversity and grown stronger during hard times.

I would like to give my special thanks to a few people who have worked especially hard for the department as a whole this last year. Scot Wherland and Kirk Peterson (see their articles that follow) are my

associate chairs of undergraduate and graduate affairs, respectively. Without Debbie Arrasmith (budget), Lori Bruce (grants and confidential issues), and Trent Amonett (Assistant Director) everything would stop.

If you are going to be in Pullman this year, please come by. It is always good to see our old chemistry family members. If you are uncomfortable just stopping in, email Nikki Clark ahead of time and tell her who or what you would like to see ([nikki\\_clark@wsu.edu](mailto:nikki_clark@wsu.edu)). She will do her best to arrange something appropriate.

With my warmest regards,

K W Hipps, Professor and Chair

## Undergraduate Education

by Dr. Scot Wherland



The Chemistry Department continues to maintain certification by the American Chemical Society for our Bachelor of Science in Chemistry degree. Our most recent approval was granted in April of 2010 and is valid through 2014. The ACS certified degree path is a rigorous one, and most chemistry degrees given in the U. S. are not ACS certified. For example, in 2008-2009 our colleagues in Seattle, one of the largest programs in the country, gave 238 non-certified degrees and 22 certified degrees while we gave 10 certified degrees. Some years we have given more certified degrees than they have given. This highlights two issues. One is that our degree program is of high quality but it is also rather small. Our number of graduates has been around 12 per year for many years. While we work to attract majors to the ACS certified path, this will continue to be a challenge in a university that offers a variety of other paths, including Chemical Engineering, for those with high motivation and abilities in the physical sciences. The second issue is that there are many students who would be

attracted to a chemistry degree that was somewhat less rigorous, and which allowed room in the curriculum to pursue other areas for which chemistry provides the foundation. An especially important group in this category includes students preparing to teach chemistry in high school. The popular media are replete with articles about the need to improve public education in the “STEM” fields (science, technology, engineering and mathematics). One way for us to contribute to this effort is to provide a path toward the Chemistry Endorsement required to teach high school chemistry in the state of Washington. Students pursuing the B.S. in Chemistry can certainly also go on to earn the endorsement, but this requires further years of education courses and most of the students pursuing the ACS certified degree are preparing for Graduate School or the job market. Another group that would be interested in this other degree is those students who currently earn a General Studies in the Physical Sciences degree. Such students are interested in a broader background than any particular degree provides. A further current example is students interested in forensics, who need room in their curriculum for more biology and criminal justice courses.

Our proposal to meet these interests is the development of a Bachelor of Arts degree in Chemistry. The “Bachelor of Arts” category is being proposed to distinguish clearly this path from the ACS certified one. We have noted that one of the primary barriers to success in our current degree is the requirement for three semesters of calculus and calculus based physics. These courses are prerequisites for physical chemistry in the third year of the 4 year B.S. degree and are certainly appropriate. However, some students, for a variety of reasons, delay their math or take the one semester calculus survey appropriate for biological sciences. When they then get interested in a chemistry degree, perhaps after taking organic, they are missing at least two years of prerequisites for physical chemistry and cannot afford to spend this extra time. Thus the B.A. degree will allow students to use a one semester survey of calculus, along with linear algebra, a statistics course, and algebra based physics as their supporting courses in these areas. There would then be a one semester physical chemistry course for students with this background. Students would also take two semesters of organic chemistry, quantitative analysis, which is being enhanced with more instrumental methods, and we are proposing adding an inorganic chemistry course at the junior level which would emphasize the periodic table and properties of the elements and their most important compounds, using physical principles developed in general and in analytical chemistry. We envision a capstone experience could be a laboratory research project, as in the B.S. curriculum, or it could be final literature based research project, or a service learning experience in the community. Such an experience could include working at the Palouse Discovery Science Center, or working in lab development in our general chemistry program, or working in outreach to regional schools. This proposal is still being developed, but we hope to have a program that will attract students who wish to go into many areas for which chemistry provides a solid foundation.

## Exciting Opportunities for Undergraduates at the Nuclear Radiation Center

by Dr. Donald Wall



Did you ever consider a fascinating, high-paying and stable career in nuclear science and technology, while getting a chance to work with the world’s largest source of non-greenhouse gas emitting energy? The Chemistry Department, in cooperation with the Nuclear Radiation Center, is offering a truly unusual and exclusive opportunity for undergraduate students at WSU.

CHEM 490, Nuclear Reactor Operations, is a step in the direction of getting a Nuclear Reactor Operator License, granted by the United States Nuclear Regulatory Commission. In fact, two WSU students (both of whom are women) have recently obtained their Reactor Operator (RO) licenses in January, 2011. Both of them performed exceptionally well on their examinations—so much so that the U.S. NRC examiners have commented repeatedly on the high quality of WSU student Reactor Operators.

The number of universities with credible nuclear chemistry programs has steadily declined since the late 1970’s. The decline of interest in nuclear science has also been accompanied by a large reduction in the number of universities that operate teaching and research nuclear reactors, with the most recent shutdown of a research reactor facility taking place in the summer of 2007. In contrast to this unfortunate national trend, WSU has continued to operate its one megawatt TRIGA nuclear reactor at the Nuclear Radiation Center. As a result of the national decline in nuclear science education, there is now a large disparity between supply and demand for professionals with experience in nuclear science. The Nuclear Reactor Operations course that is offered through the Department of Chemistry in cooperation with the Nuclear Radiation Center offers students a rare opportunity for an advanced and challenging educational experience that will complement their educational portfolio and further augment their desirability in the job market.

Nuclear Reactor Operations is focused on the middle part of the nuclear fuel cycle, i.e. utilization of the fissile properties of uranium and plutonium. The course focuses on the following areas: radiation safety, nuclear reactor theory, nuclear reactor operation and control, nuclear fuel composition and behavior, plant operations, standard operating procedures, and accident analysis, including an in-depth examination of the accident at Chernobyl. Radiation safety includes discussion of biological effects of ionizing radiation, measurement of radiation fields, dose and dose rate, shielding and safe handling of radioactive materials. Nuclear reactor theory includes energetics of fission and other nuclear reactions, nuclear reactor physics, nuclear reactor kinetics, and nuclear fuel behavior. For example, the composition of the fuel in the WSU TRIGA reactor is discussed in the context of how the chemical and isotopic composition influences its nuclear behavior. Nuclear reactor operation and control includes manipulation of reactor control systems to start-up the reactor, achieve criticality, increase and decrease power levels, to shut down the reactor, and the maintenance of reactor control and support systems. It is at this point in the course that students, under

supervision of a licensed Reactor Operator, get to start the reactor and bring it up to full power—one million watts. Plant operations include examination of auxiliary building and reactor systems, such as ventilation, reactor cooling system, and the pool water chemical control system.

The Nuclear Reactor Operations course includes classroom lectures and hands-on experience. The classroom session meets for 3 hours per week; the laboratory sessions meet for 1.5 to 2 hours per week. There is more time in the classroom and less laboratory time at the beginning of the semester, gradually transitioning to less classroom time and more laboratory time as the semester progresses. The earlier part of the course focuses more on reactor design and behavior so the students can readily understand exactly what is happening when they, later on, spend more time working with the reactor. The classroom sessions are highly interactive between the students and instructor, with much emphasis on question and answer and discussion. The laboratory/hands-on sessions are also highly interactive, and give the students ample opportunity to work with all of the reactor and auxiliary operations and control systems.

Since 2008, about 40 students have taken the class; some of these students have decided to continue to prepare for the U.S. NRC licensing examination by working with Nuclear Radiation Center staff members, who provide the additional hands-on training that is needed. We have found that the best predictors for success in the education and training program on the way to earning a U.S. NRC Nuclear Reactor Operator License are the same qualities that are most important for success in any endeavor, namely, dedication, hard work, reliability, positive attitude, and trustworthiness. Any student who is interested to learn to operate a nuclear reactor—a noteworthy accomplishment that looks terrific on any resume—should take advantage of this once in a lifetime opportunity at WSU.

## Graduate Education

by Dr. Kirk Peterson



So how is the graduate program in Chemistry faring these days in the face of the current and looming budget crises? By all accounts it is actually thriving—at the start of this year there were about 90 students working on their Ph.D. in Chemistry at the Pullman campus. Each of the last two years we have seen incoming graduate student classes of more than 25 students. The origins of this growth can be easily understood by the increased research activity of the faculty in the department. The amount of extramural grant expenditures have been steadily rising, as have been faculty awards, both local and national.

As part of our yearly graduate student recruiting efforts, a visitation weekend was held from April 1st - 3rd. We had 13 students participating from as far away as upstate New York. This was actually a smaller number than in past years but was indicative of a smaller overall number of Chemistry applications that were received. The students arrived in Pullman on a remarkably sunny and warm Friday afternoon and attended a faculty poster session and reception in the Jr. Ballroom of the CUB. This was a relaxing format and a great way

for the faculty and current students to meet and mingle with the prospective graduate students.

After discussing some great science over posters, members of the recruiting committee (Profs. Kirk Peterson, Jeanne McHale, Peter Reilly, Ken Nash, and Nathalie Wall) walked the visiting students up to dinner. This year dinner was held in the Friel House, which is managed by WSU and is located near the top of C Street. The house made for a relaxing atmosphere, and both faculty and students were able to chat over some excellent food brought in by the CUB caterers. The next morning the visiting students and recruiting committee met for breakfast at The Breakfast Club in Moscow. This was also a small break from the traditional breakfast at Old European in Pullman, but it provided an excellent opportunity to give the prospective students a little flavor of downtown Moscow. The rest of their morning was spent taking tours of the Chemistry department with lunch being held with various faculty at Dupus Boomers Restaurant in the CUB. Most of the afternoon was then taken up with individual meetings with faculty. These were followed by afternoon tours of the Institute for Shock Physics, the WSU nuclear reactor, and the university recreation center. The visitation weekend finished with dinner with current graduate students at Basilio's in Pullman. As a department we are indebted to all the hard work that went into this event from the students of the GCS (Graduate Chemical Society).

## Faculty Highlights

### Funding

**Cliff Berkman**, National Institutes of Health, "Probe Optimization for Prostate Cancer Detection," \$462,741.

**James Brozik**, Department of Energy—LANL, "Probe Optimization for Prostate Cancer Detection," \$50,000.

**James Brozik**, National Science Foundation, "Chemical and Physical Characterization of Biological Systems," \$75,642.

**James Brozik**, Neon, Inc., "Biosensor Graduate Research Collaboration," \$61,451.

**James Brozik**, Department of Energy—LANL, "Model Membrane Assemblies and Membrane Proteins," \$50,000.

**James Brozik**, Department of Energy—SNL, "Genomics Enabled Sensor," \$24,000.

**Aurora Clark**, Department of Energy—ANL, "Origin of Actinide Ion Partitioning in Biphasic Systems," \$400,000.

**Sue Clark**, Department of Homeland Security, "Origin of Actinide Ion Partitioning in Biphasic Systems," \$183,033.

**Sue Clark**, Department of Energy—ANL, "Controlling Actinide Hydration in Mixed Solvent Systems: Towards Tunable Solvent Systems to Close the Nuclear Fuel Cycle," \$300,000.

**Sue Clark**, Department of Energy—NNSA, "Controlling Actinide Hydration in Mixed Solvent Systems: Towards Tunable Solvent Systems to Close the Nuclear Fuel Cycle," \$592,862.

**Sue Clark**, Department of Defense—DTRA, “Rapid, Ligand-assisted Capillary Electrophoresis Methods for Actinide Determinations by Mass Spectrometry,” \$674,761.

**Sue Clark**, Battelle Labs, PNNL Subcontract, \$68,500.

**Sue Clark**, Department of Energy—LANL, “Nuclear Forensics Summer School at Washington State University, \$193,060.

**Herb Hill**, Science Applications, Int’l., “Ion Mobility Spectrometry Constants for Standards and Chemicals of Interest,” \$71,250.

**Herb Hill**, Science Applications, Int’l., “Reducing False Alarms in Ion Mobility Spectrometry Detectors—Determination of Accurate and Precise Ion Mobility Spectrometry Constants,” \$30,000.

**Herb Hill**, Department of Energy—SRNL, “Evaluation of the Electrospray Ionization Ion Mobility Time-of-flight Mass Spectrometer,” \$60,000.

**Herb Hill**, Pfizer, Inc., “The Use of IMS for Reaction Monitoring, Reaction Screening, and Chiral Analysis,” \$100,000.

**KW Hipps**, National Science Foundation, “Scanning Probe Microscopy Facility Upgrade—LEED, Auger and Sample Preparation,” \$299,872.

**KW Hipps**, National Science Foundation, “Scanning Tunneling Microscopy of Temperature Dependent Molecular Processes at the Solution-Solid Interface,” \$125,000.

**James Hurst**, Department of Energy—ANL, “Membrane-Organized Chemical Photoredox Systems,” \$130,000.

**Jeff Jones**, National Institutes of Health, “Predicting Rates and Regioselectivity in Cytochrome P450 Mediated Reactions,” \$315,029.

**Ken Nash**, Department of Energy—INL, “Sigma Team for Minor Actinide Separations,” \$170,000.

**Ken Nash**, Department of Energy—NEUP, “Advance Aqueous Separation Systems for Actinide Partitioning,” \$1,289,409.

**Peter Reilly**, National Institutes of Health, “Accurate Mass Analysis of Complex Mixtures of Singly-Charged Proteins,” \$489,622.

**Nathalie Wall**, Department of Energy—BER, “Influence of Organic Ligands on the Stability and Mobility of Reduced Tc and U,” \$101,743.

**Ming Xian**, National Institutes of Health, “Chemical Approaches for Detecting S-nitrosothiols,” \$255,398.

**Ming Xian**, Oregon State University, NIH Flow-through, “Pacific Northwest Undergraduate Student Research Symposium,” \$5,640.

## Other News

**Sue Clark** and **Herb Hill** were both promoted Regents Professors, the highest rank a professor can attain at WSU.

**Aurora Clark** and **Ming Xian** were both promoted to Associate Professor with full tenure.

**Louis Scudiero** was promoted to Clinical Associate Professor.

## Matteson Symposium

The Division of Organic Chemistry at WSU will hold the fourth annual Matteson Symposium on September 17, 2011, at WSU’s new Compton Union Building. This year’s theme is *Chemistry and its Application to Biological Systems* and will feature lectures by the following distinguished presenters:

- John Vederas, Professor of Chemistry, University of Alberta
- Laura Kiessling, Professor of Chemistry and Biochemistry, University of Wisconsin, Madison
- Ronald Raines, Professor of Chemistry and Biochemistry, University of Wisconsin, Madison
- Wendy Kelly, Assistant Professor of Chemistry and Biochemistry, Georgia Institute of Technology
- Michael Marletta, Professor of Chemistry, Biochemistry and Molecular Biology, University of California, Berkeley.

For more information, visit the Symposium website at [organic.wsu.edu/symposium2011](http://organic.wsu.edu/symposium2011).

## Awards and Achievements

**Kirk Peterson** was not only named the Meyer Distinguished Professor, he also received the Distinguished Faculty Award.

**Scot Wherland** received the Thomas E. Lutz Teaching Excellence Award.

**Herb Hill** and **Ursula Mazur** were both named Fellows of the American Chemical Society. In just the first three rounds of this award, WSU Chemistry now has six ACS Fellows: Emeritus Prof. Glenn Crosby ('09), and Profs. Sue Clark ('10), Herb Hill ('11), KW Hipps ('10), Ursula Mazur ('11), and Ken Nash ('10).

## Graduate Program News

**Lisa Wu** received a \$98,015 grant from the US Army titled Prostate Cancer Cell Capture Using Immobilized Inhibitors of Prostate-Specific Membrane Antigen. Lisa works in Dr. Cliff Berkman’s lab.

**Bryan Wiggins**, a PhD candidate in Professor KW Hipps’ lab, won the Crosby Award with his seminar titled, *Organic Solid State Sensors*. **Candy Mercado**, a PhD candidate in Professor Jeanne McHale’s lab, received honorable mention for the Crosby Award for her seminar titled, *Electron and Hole Trap Distribution and Transport in Titanium Dioxide Nanotubes*.

Pictured below is Dr. Hipps presenting Bryan with his award.



**Chris Rich**, a PhD candidate in Professor Jeanne McHale's lab, won the Dodgen Award for his seminar titled *The Effect of Solvent Isotopic Substitution on the Spectroscopic Properties of Hierarchical Porphyrin Aggregates*. **Yasaman Ghadarghadr** won honorable mention for the Dodgen Award. Yasaman is a PhD candidate in Professor Aurora Clark's lab.

A 2011 U.S. Department of Energy Innovations in Fuel Cycle Research Award has been granted to graduate student **Derek Brigham** (Nash Lab). Derek's \$1500 award was for his paper titled *Extraction of Trivalent Lanthanides and Americium by Tri-n-octylphosphine Oxide from Ammonium Thiocyanate Media*.

**Jenifer Braley** was awarded a 2010 U.S. Department of Energy Innovations in Fuel Cycle Research Award for her paper, *Partitioning of U, Np, Th, and Eu Between Acidic Aqueous Al(NO<sub>3</sub>)<sub>3</sub> Solutions and Various TOPO Extraction Chromatographic Materials* and that **Travis Grimes** received an award for his paper *Lactic Acid Partitioning in TALSPEAK Extraction Systems*.

## The 6th Summer School on Actinide Science and Applications

Every two years the JRC-ITU (Joint Research Commission-Institute for Transuranic elements) organizes Summer Schools on Actinide Science at its laboratories in Karlsruhe, Germany. Young researchers from all over the world have participated in lectures, laboratory visits and demonstrations. This year the 6<sup>th</sup> Summer School was held in June, and two radiochemistry PhD candidates were invited to attend: **Jane Holly Hines**, who works in Professor Sue Clark's lab, and **Jessica Drader**, who works in Professor Ken Nash's lab.

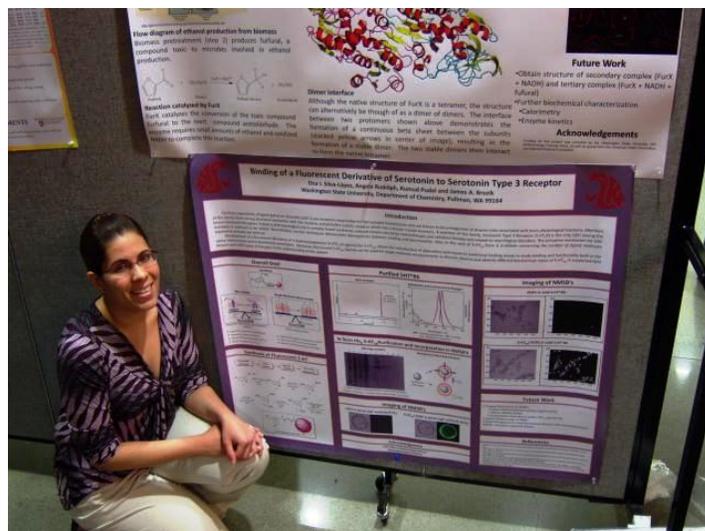
The Summer School on Actinide Science and Applications is suitable for students and young researchers who have an interest in basic actinide chemistry, physics and material science. The lectures, featuring experts from international organisations and JRC-ITU, addressed the following topics:

- Basic Actinide Science
- The Nuclear Fuel Cycle
- Nuclear Safeguards, Security and Forensics

The school gives participants a glance at the science of the 5f elements and their application in modern society.

## Graduate Poster Session

Each summer, graduate students who pass their preliminary exams present a poster showcasing their work, and it's a great way for other students and to see what fellow students are working on, and for faculty to see what's happening in other labs. This summer we had 26 posters presented. Below is Elsa Silva-Lopez with her poster titled, *Binding of a Fluorescent Derivative of Serotonin to Serotonin Type 3 Receptor*.



## Doctoral and Master's Chemistry Graduates

- Jenifer Braley**, PhD, Professor Ken Nash
- Jacinda Do**, MS, Professor Cliff Berkman
- Ben Friesen**, PhD, Professor Ursula Mazur
- Duvano Garnes**, MS, Professor Alex Li
- Travis Grimes**, PhD, Professor Ken Nash
- Mustafa Hussein**, MS, Professor Jim Brozik
- Kimberly Kaplan**, PhD, Professor Herb Hill
- Maria Kriz**, PhD, Professor Ken Nash
- Hiromu Kurosaki**, PhD, Professor Sue Clark

Yang Li, PhD, Professor Jim Bruce

Krista Nishida, PhD, Professor Ursula Mazur

Wenyun Ooyang, MS, Professor Jeff Jones

Chung-Min Park, PhD, Professor Phil Garner

Cody Sandquist, MS, Professor Jeanne McHale

Ric Schumacher, PhD, Professor Sue Clark

Lillian Wong, MS, Professor Jim Brozik

Chunxiang Zheng, MS, Professor Jim Bruce

The Graduate Chemical Society held their annual banquet at Ban-yans in Pullman, and this year's recipient of the Professor of the Year Award was shared by Professors Herb Hill and Bill Siems, pictured below with their awards.



Pictured below are the outgoing and incoming Graduate Chemical Society officers. From left to right are: William Bott, Secretary (2011/2012); Dane Tomasino, Vice President (2010/2012); John Geruntho, Treasurer (2011/2012); Jessica Drader, Secretary (2010/2011); Jane Holly Hines, Historian (2010/2012); Seth Wall, President (2011/2012); Mihindra Dunuwile, Treasurer (2010/2011); Chris Rich, President (2010/2011).



## Undergraduate Program News

### Chemistry Graduates

The Chemistry Department graduated nine undergraduates in May. These students are:

Benjamin Barlow

Tommy George

Jacob Johanson

Evan Laiho

Troy Loeffler

Samuel Lomasney

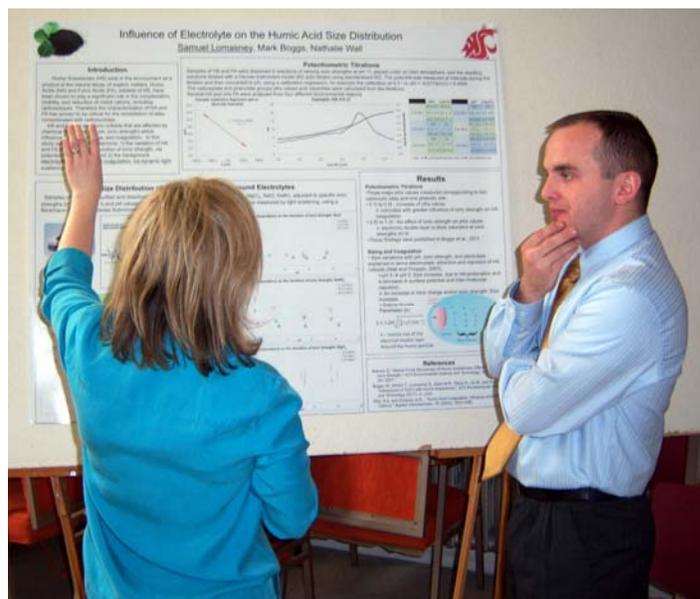
Sarah Miley

Trafton Moeller

Rianne Pajari

### Undergrad Spotlight

**Samuel Lomasney** is a US Marine Corps reservist and a howitzer section chief in the Reserves. Sam is also a recent graduate of the Chemistry Department at WSU. Sam was honored at a luncheon by Greater Spokane Incorporated as one of four Armed Forces Persons of the Year. Sam completed his work in Professor Nathalie Wall's lab. Below, Sam explains his poster titled *Influence of Electrolyte on the Humic Acid Size Distribution* to Nikki Clark, Undergraduate Academic Coordinator.



**Graduate and undergraduate alumni, we'd like to hear from you!** Please use the alumni form at [chem.wsu.edu/alumni](http://chem.wsu.edu/alumni) and tell us what you've been doing since leaving Pullman!