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Chemistry & Biochemistry Newsletter

Chemistry & Biochemistry

Fall 2010

Chemistry & Biochemistry Newsletter

Department of Chemistry & Biochemistry, South Dakota State University

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The Avera Health and Science officially became the home of the SDSU's Department of Chemistry and Biochemistry on September 9, 2010.

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South Dakota State University

Chemistry & Biochemistry

Fall 2010



The Avera Health and Science Center was dedicated on September 9, 2010 officially marking its long-awaited debut on the SDSU campus. It gives the Department a much-needed platform to physically confirm what nearly everyone else on campus already knows: chemistry is one of the fundamental disciplines in a liberal arts and sciences university education.

The Department and the College of Pharmacy share the 144,600-sq.-foot research and instructional complex. Avera South, a 96,000-sq.-foot new building, is the instructional home for the Department and pharmacy. Meanwhile, what was known as New Shepard Hall, a 48,600-square-foot structure, has been completely renovated. It is now referred to as Avera North and serves as the facility's research wing. Approximately 60% of the assignable space in the facility is assigned to the Department, and work on our assigned space is complete. And, although the Department's faculty and the building are still "getting to know each other," the facility is exactly what we had in mind. In the design phase, we wanted a building that conveyed a feeling of substance so that when you entered it, you immediately got a sense that this was home to a dynamic and exciting body of knowledge with exciting and groundbreaking activities taking place. I think we came pretty close to what it is that we as a Department actually wanted to create.

The Avera Health and Science Center puts our facilities and infrastructure on par with any of our peer institutions and exceeds the quality of most of them. It is a critical component to expanding our department's ability to contribute to the University's growth as well as South Dakota's workforce and economic development initiatives.

Stay in touch!

Jim Rice



Career Award Will Help Build High-Tech Microscope

Where does a young scientist get the impulse to build a better microscope for studying proteins in living tissue?

For assistant professor Adam Hoppe in South Dakota State University's Department of Chemistry and Biochemistry, the nudge may have come from growing up on a farm near Crookston, Minn., with a father and a grandfather who were backyard inventors.

"What really got me started in science is that I really liked tinkering with things," Hoppe said. "Both my dad and my grandpa were both great mentors in terms of solving problems on the farm. Both of them loved to tinker, loved to make contraptions, machines to do something on the farm. So our farm was full of little inventions they had built. That created a 'tinkering' interest. I inherited that."

It has served him well. Hoppe recently won a National Science Foundation career award of \$785,000 for his work improving an instrument of his own design that could result in the highest resolution ever in an instrument for observing dynamic molecular interactions in living cells. The NSF career awards are awarded to new or young investigators through a competitive application process. Researchers are allowed three attempts to get one of these grants. Hoppe landed it on his first attempt for his on-going work improving an instrument to study protein-to-protein interactions inside the living cell.

Hoppe credits a few good teachers, starting with his high school biology teacher Ardell Knutsvig, with first getting him thinking about science. But the thought that he might make science a career didn't crystallize until he attended Concordia College in Moorhead, Minn., a four-year liberal arts college where he earned his bachelor of arts in physics and mathematics in 1997.

"It wasn't until college that I was really on fire about science," Hoppe recalls. "I really had an excellent mentor at Concordia. My physics instructor there was phenomenal—Bryan Luther. He was a real inspiration to me. Coming out of college I really thought I wanted to do something applied and make an immediate difference. That's what got me started doing medical physics."

Hoppe earned his master of science degree in medical physics at the University of Wisconsin-Madison in 1999. He credits professor R. Jerry Nickles for channeling his youthful enthusiasm in new directions.

"He got me interested in diagnostic work, functional brain imaging, trying to understand what areas of the brain are active as people are thinking. I got involved in what's called positron emission tomography, PET imaging. It's a very sophisticated way of looking at what's happening inside the cells in the brain by imaging. But it also involves radiation."

It was an interdisciplinary experience. Hoppe had to run a cyclotron, or particle collider, then harvest the radio isotopes from the reactions and perform organic synthetic chemistry to make the compounds that could be used in the lab. "We had to do this at the level of generating injectable drugs in a completely sterile environment, a class 2000 cleanroom. We were trying to develop tools that could be used for human studies, and we were working with pigs, mostly, for those experiments. In the end you were looking at physics, human anatomy and physiology. We literally went from nuclear physics to medicine in the span of one day."

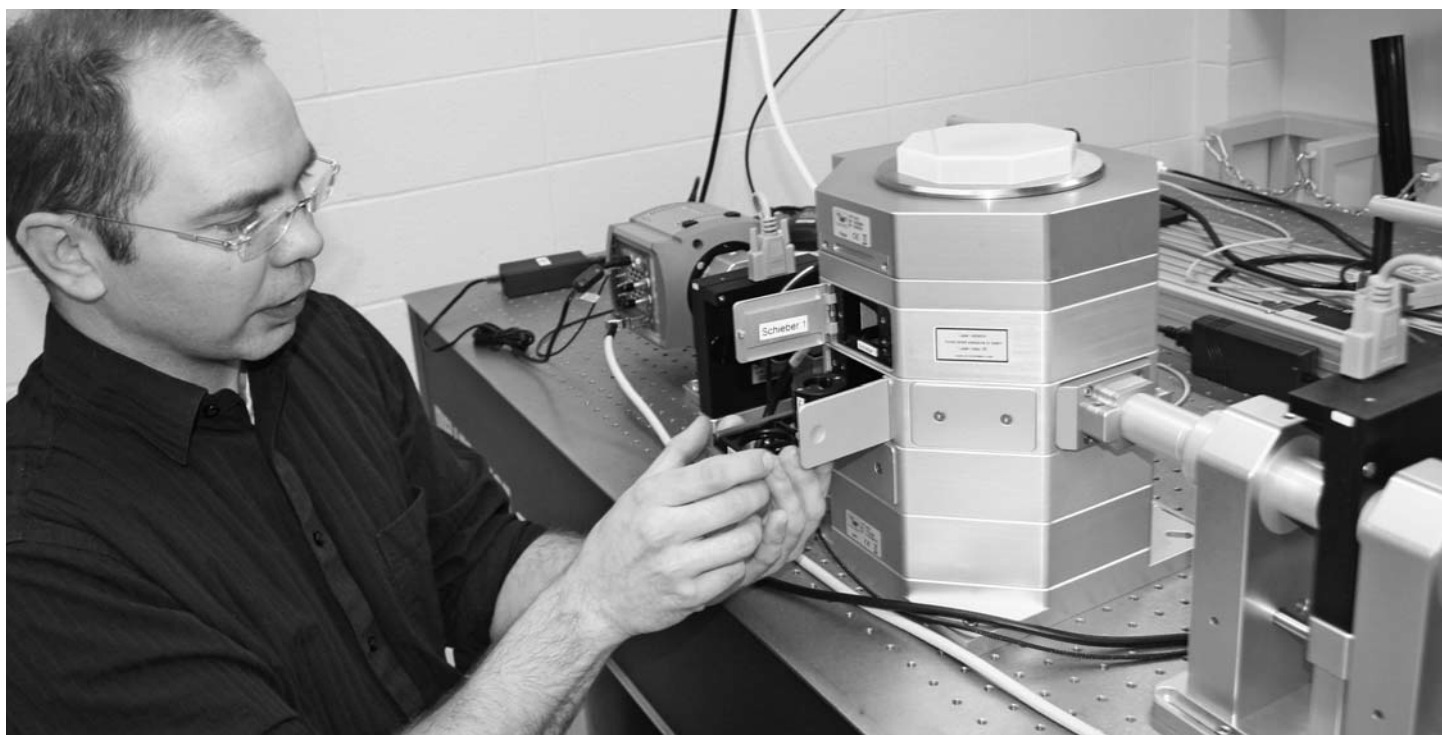
As part of that experience, Hoppe started learning more about cells, cellular biology, and cell biochemistry. That's what got him into the field he's in today. He went on to the University of Michigan, where professor Joel Swanson took him on as biophysics student. He stayed 10 years—first as a Ph.D. student, then as a postdoc, then as a research faculty member.

While at the University of Michigan, Hoppe began working with an optical phenomenon called fluorescence resonance energy transfer, or FRET. That phenomenon depends on special molecules called fluorophores that absorb energy and re-emit energy at a different wavelength, causing the molecule to be fluorescent.

"This phenomenon allows fluorophores of two different colors, say a blue one and a yellow one, to exchange energy. And that exchange process happens only over very, very short distances, approximately 5 nanometers—five times 10⁻⁹ meters, or a billionth of a meter. What was very clear to me and some others in the field was that you should be able to take this phenomenon and extend it to high-resolution imaging to map when and where the protein interactions are inside the cell. That notion of mapping protein-protein interactions is analogous to what I was doing in my master's degree work, which was mapping where particular parts of the brain are active during thought."

In Swanson's lab, Hoppe started learning about how immune cells regulate their shape.

"One of their main jobs is to engulf and eat particles, eat objects, eat invading microorganisms, eat dead or dying cells in the body. They internalize them and then they degrade them. That happened to be the process that Joel Swanson studied," Hoppe said. "So the first application of this technology, for me, was, can we develop an imaging method that will tell us about the biochemistry, in particular the protein-protein interactions, that are regulating the process of cell eating, or phagocytosis? That study was a spectacular success. We learned things that we had never expected about how some of these very fundamental cell chemistries that regulate cell shape are organized both in space and time within a living cell."



Hoppe now has his own lab as part of South Dakota State University's 2010 Center for Biological Control and Analysis by Applied Photonics, or BCAAP. The center is made up of researchers who use light as one of the tools either to control biochemical processes, or—in the case of Hoppe's project—to analyze biochemical processes. That's where the work of improving the design of his existing microscope comes in.

“What really motivates the development of this microscopy tool for me is, if you want to understand cellular biochemistry, you've got to study it in the cell. You can't simply do it all in the test tube,” Hoppe said. “If you took a car apart and looked at each piece individually, that's what classical biochemistry has done, and we've learned a tremendous amount by doing that. But if you want to know how the car runs, you have to understand how the pieces are put together, how they're organized, and how the organization works together. That's what I think this kind of technology is going to do. It is going to let us watch the machinery operate in its environment.”

The microscope will shed light on something strikingly simple yet important regarding molecular pathways, or the interactions among molecules in a cell that lead to a certain result or accomplish a specific cell function.

“When biologists draw pictures of how a molecular pathway works inside of a cell, they're usually drawing arrows between multiple proteins. Those arrows usually represent some kind of biochemical event,” Hoppe said. “What you find is that the majority of them actually represent something very, very simple, something very fundamental, and it is simply one protein touching another protein. You can have two proteins that are

sitting there doing nothing in the cell. However, if they touch each other, then one or both of them can become active, that is, do something biochemically significant in the cell. It's a theme that reoccurs in biology, that proteins are regulated by their contact with other proteins.”

Compared to Hoppe's current design, the improved instrument will roughly double in size and resolution will improve by a factor of three in all dimensions. Hoppe and his assistants will add two more cameras, three more lasers, and a variety of optics for “structured illumination”—basically making different patterns of light that can be manipulated—followed by mathematical reconstruction to improve the microscope's resolution.

Hoppe added that in addition to building the new instrument, his NSF project includes an education plan that includes training graduate students and bringing in high school teachers to provide laboratory experience that can make them better science teachers. The third part of that education plan is to use the Web to disseminate information about the research.

The improved instrument would open up new possibilities for research, including Hoppe's own possible collaborations with SDSU colleagues on influenza virus.

“The questions that they are asking about viral assembly are, surprisingly, not that distant from the questions we ask about signal transduction in macrophages. Both of these processes involve macromolecular assemblies, biochemical reactions that involve many proteins coming together, touching each other, and then doing more sophisticated biochemistry than the individual proteins by themselves would,” Hoppe said.

Classroom Changes

New technology Enhances Classroom Experiences

If you're of a certain age and think back on your experiences in college, you'll recall that technology in the classroom usually meant that the instructor was using a slide projector that day.

Or, if he was feeling particularly frisky, he may have had the audio-visual department bring in a television with a video cassette player to show a movie.

Most classrooms are high tech

They couldn't have been more wrong. Currently 95 percent of the classrooms at State have fully enhanced systems that incorporate a sound system, a control system, and video. Each system includes a document camera, VHS, DVD, and a computer. The instructor can run the system through his own laptop.

There are other room options as well. Recently Rotunda D was converted to a dual projection room able to provide video from two independent sources. The new Avera Health and Science Center has two dual projection rooms.

Three interactive learning environment rooms across campus provide a smart board in addition to the video screen. The smart board allows an instructor to navigate the computer screen with his finger or write on it with a special pen.

As many as six small groups, each with a laptop, can work together in the interactive rooms. The instructor can then choose which group's work will be projected from their laptop to the screen for the entire class to see.

"It gives them a lot more options for things they can put on the screen," Clark says.

Computers drive chemistry labs

One of the people pushing new technology is Ron Hirko, an assistant professor of chemistry. Faced with a lab full of computers that "were on their last legs," and the prospect of moving into new facilities at the Avera Health and Science Center, the Chemistry Department secured a grant for new technology.

Hirko researched various companies and settled on Vernier Software and Technology of Beaverton, Oregon. "I said send me one of everything to evaluate, and they did," Hirko recalls.

For the chemistry labs, Hirko chose the LabQuest mini computer, a handheld device that can do calculations and regressions and comes with ports for a variety of attachments.

Hirko requested to teach a section of chemistry during summer school to get familiarized with the new computers and see how students reacted to them.



Ron Hirko, an assistant professor of chemistry, demonstrates the LabQuest mini computer during a July chemistry class in the renovated Shepard Hall. The students are prepharmacy majors Ashley Potter and Anthony Fiegen.

The initial reaction from students and their professor has been very good. Hirko, who spent thirty years in industry before becoming a professor, has nothing but praise for the new computers of which he purchased forty-eight as well as various probes, enough to furnish four labs in Brookings and one at University Center in Sioux Falls.

Krsnak wins Oz Memorial

The men's and women's cross country team finished second and fourth at the Oz Memorial in Minneapolis, Minnesota, on September 10. Leading the way was junior Chemistry major Michael Krsnak, winning for the second straight week with a time 19 minutes, 13.82 seconds in the men's 6,000 meter.

"Mike controlled the race from the front from the gun and looked very comfortable doing that," said head coach Rod DeHaven.

Editor's note: This article was written by Dustin Veurink and first appeared in the SDSU's *The Collegian* on November 17, 2010.

Chemistry Major John Lee is Academic All-American

A 4.0 grade point average is a commendable achievement for any college student, athlete or not. Hitting .400 facing division-I pitching is also a formidable accomplishment.

John Lee bordered on each of those lofty successes, a single point from completing each.

He hit .399 his senior year and graduated with a 3.9 cumulative GPA, with a major in chemistry. Enough to earn First Team Academic All-American status by ESPN the Magazine and the male Summit League Scholar-Athlete of the year out of a competition of thousands.

“It’s probably my proudest individual moment of my college career,” said Lee, a Mason City, Iowa, native and transfer student from the University of Nebraska. “Being an academic all-american and a scholar athlete is an accumulation of all five years . . . it’s just kind of nice to be recognized.”

He flourished on the baseball field, hitting an eye-catching .399 his final year with SDSU, a year in which the Jacks baseball team broke several offensive team records under head coach Ritchie Price.

“He (was) such a hard worker in practice,” said Price, who Lee credits for tweaking his swing that boosted his batting average 94 points from his junior year. “He led by example by working hard, both on the field and off the field.”

SDSU played a grueling road schedule in the spring, traveling to 11 different cities for 34 total games in the span of only 58 days. They played two home games at Erv Huether Field during that time. That’s two games out of 36 at home. John Lee’s grade point average that semester was a 4.0.

“It was pretty tough, especially last year,” said Lee, who completed his bachelor’s degree in chemistry last spring. “I had found enough time to do both the schoolwork and baseball, but the part I didn’t have much time to spend on was my social life.”

The hard work and dedication he needed to be recognized as an outstanding scholar. He instead described some research he did while working with Brian Logue, an assistant professor at SDSU. Logue’s research project tried to determine a quicker method of gauging the level of cyanide in the body. Cyanide has been used in warfare as an occasional biological attack intended to harm potential enemy. Lee’s research group tried finding a way to measure varying levels of cyanide by examining blood protein in an attempt to optimize tests for examining the warfare tactic.

“It was kind of interesting to be working with cyanide and stuff and do something that could actually be used in the

John Lee at bat on his way to an .399 batting average and 3.9 cumulative GPA.



military and other aspects of life,” said Lee, who wants to attend medical school and become a doctor.

Lee also played baseball with resounding effort and hard work, making first-team all-Summit League as a right fielder by accumulating 91 hits—32 for extra bases—in only 59 games. He also struck out only 19 times in 228 at-bats and coupled that with a .991 fielding percentage for a 39-21 Jacks team that was among the best hitting lineups in Division-I.

“My parents had a lot to do with it,” Lee said of his athletic and academic success. “(They) always said ‘school first—make sure you get that education because you probably won’t be playing baseball the rest of your life.’”

The Mason City High School graduate spent a portion of his summer volunteering at Opportunity Village, a housing establishment in Clear Lake, Iowa, for handicapped people that can receive outside assistance along with having their own living space. More examples of a student and person poised to make an impact with others.

“Throw in the fact that because of baseball we missed 19 days of class last spring, but he’s still able to get a 4.0,” said Price. “That shows how responsible and disciplined he is—it’s a pretty good indication of how successful he’s going to be in life.”

Editor’s note: This article was written by Drue Aman and first appeared in the SDSU’s *The Collegian* on September 8, 2010.

Program to Addresses Shortage of Medical Lab Scientists

A redesigned South Dakota State University program is targeting a state and national shortage of medical lab technicians — a need that will continue to grow as baby boomers retire.

Eleven SDSU seniors who want to become lab techs are working through mid-July as interns at regional hospitals. The experience is the final step in the medical laboratory science program.

The senior class is the first to go through the internship format. The longstanding program used to involve three years at SDSU and one year in an accredited hospital program.

“But the shortage is so big in the state that we’re in the middle of seeking our own accreditation,” said Pat Tille, the program’s director. “It’s considered a higher need than nursing.”

An accreditation site visit is scheduled in October. The program has three faculty members who are responsible for the lecturing and training of students at SDSU. In their senior years, students will be placed in 27-week internships, which include three weeks at the South Dakota Public Health Laboratory.

This year’s class has 11 interns—10 working in South Dakota and one in Minnesota. Four are at Avera McKennan Hospital and University Health Center. Sanford Health isn’t involved because it has its own lab tech program.

SDSU will have a capacity of 24 interns after the program completes its transition. The sophomore class has 22 members.

The federal government expects the need for lab technicians to grow dramatically over the next several years because of retirements. Techs do laboratory testing of blood, tissue, urine, spinal fluid, basically any type of specimen that’s collected. The starting pay in South Dakota is \$23 per hour.

At Avera, students work side by side with full-time lab technicians.

“They’re kind of getting one-on-one training,” said Michael Zwart, an Avera medical laboratory scientist.

Leo Serrano, the hospital’s director of laboratories, said each intern works in each area of the lab to get experience. In microbiology, that means looking at a culture plate alongside an experienced microbiologist.

“The students are getting one of the best clinical educations,” Serrano said.

Serrano said the SDSU program will be good for hospitals, students and patients.



Seniors Whitney Harris, left, and Brittney Rozeboom working in the new Avera Health and Science Medical Laboratory Science Teaching Laboratory. Both will start clinicals in January — Harris at Brookings Hospital and Rozeboom at Avera McKennan in Sioux Falls.

Hospitals will gain a high-quality hiring pool, students will get hands-on training and the public will get more lab technicians to help overcome the expected shortage.

It also is cost-effective because it’s expensive for a hospital to have its own training program and clinical professionals who do nothing but teach, he said. Avera contributed to SDSU’s program.

“We view it as the ultimate win-win. We get top-notch students who become our employees. We get to pick the best of the best,” he said. “By the time students leave here, they can work in any lab in the country.”

Serrano predicts SDSU’s program will be one of the top 10 in the country within 10 years.

Editor’s note: This article was written by Randy Hascall and first appeared in *Sioux Falls Business Journal* on June 16, 2010.

The graduated senior class that was address in this article is 100% employed, and all passed the National Board Exam. The SDSU student average on the board exam was higher than the National Average for all University based programs.

New Graduate Students



Abduirhman Alsayari

I'm from Saudi Arabia and graduated in Pharmaceutical Science from King Saud University, in Saudi Arabia. I taught and did research for three years in the Pharmacognosey Department of the School of Pharmacy at Khalid University, also in Saudi Arabia. Currently, I am a grad student with a specialization in Organic Chemistry.



Justine Debelius

I graduated from Bishop Kelly High in Boise, ID, and received a B.S. in Chemistry from Saint Mary's College in Notre Dame, IN, with a minor in Biology. I am excited to be at SDSU and working in the Hoppe lab on signal transduction in Macrophages. I hope to work as a principal investigator in an immunology lab.



Cyndey Johnson-Edler

I'm a Brookings native and graduated from SDSU with Bachelors' degrees in Chemistry and Clinical Laboratory Science (Industrial Emphasis). After SDSU, I worked at Valero Renewable Fuels as a QA/QC Laboratory Tech and as an Environmental, Health & Safety Specialist. I have returned to pursue a Ph.D. My interests are analytical and environmental chemistry.



Francisca Egyir

I am a Ghanian and have a BSc. in Biochemistry, from Kwame Nkrumah University of Science and Technology (KNUST) in Ghana. My dream is to get a doctorate degree. I am currently a trainee graduate student at the BCAAP center. I love to listen to music and live life a day at a time, making maximum use of the present.



Devinder Kaur

I'm from India and came to SDSU for a Ph.D. after completing a Master's at Western Illinois University. My basic interest is chemical education, in which I can help the students to learn more from new techniques. I'm a fun-loving person and want to enjoy each moment of my life. I'm also a hard worker, believing in the strength and knowledge of team.



John Kiratu

I was born and raised in Nairobi, Kenya. I am University of Nairobi graduate with a B.Sc. in chemistry and a M.Sc. in chemistry. I joined SDSU in July, 2010, where I am pursuing a Ph.D. in chemistry. My research interest is in analytical chemistry — specifically green chemistry.



Patrick Lee

I am from Rapid City. Prior to joining the graduate program in Chemistry and Biochemistry here at SDSU, I was a chemist and part-time instructor at Oglala Lakota College in Kyle, SD.



Maria Moutsoglou

I grew up in Brookings, the daughter of two lovely people: a Greek and a Missourian. My interest in science began as an intense hatred in high school, but shifted to love after I realized that science is pretty cool. I received bachelor's degrees in biology, microbiology, and chemistry from SDSU. I chose chemistry because it is clearly the superior discipline, and am part of Dr. Robinson's lab working towards my Ph.D. in biochemistry.



Jackie Nelsen

Good day, all. My name is Jackie and I grew up on a farm outside of Flandreau, SD. I graduated from Flandreau Public High School in 2005 and continued my education at SDSU the following fall. I'm a spring 2010 graduate, obtaining a bachelor's degree in both biology and chemistry. I am currently pursuing a Ph.D. in Chemistry Education with Dr. David Cartrette serving as my advisor. When I am not studying or teaching, I enjoy listening to music, attending concerts, and spending time with my family and friends



Brandon Scott

In May, I received a B.S. in Chemistry with concentrations in biochemistry and forensic chemistry from Slippery Rock University in Pennsylvania. I am pursuing my Ph.D. in the biochemistry track working for Dr. Hoppe and my interest is in live cell imaging using multispectral FRET microscopy to study signal transduction in macrophages.



Michael Stutelberg

I was born in Woodbury, MN. I received my undergraduate degree in chemistry from Augustana College in Sioux Falls in 2010. I am pursuing a Ph.D. in Analytical Chemistry working with Dr. Logue. I enjoy watching baseball (Minnesota Twins), being outside, and running or cycling in my free time.

Recent Publications and Grants

Jihong Cole-Dai

Publications

Cole-Dai, Jihong, Volcanoes and climate, *Wiley Interdisciplinary Reviews: Climate Change*, 1, 824-839, doi:10.1002/wcc.76, 2010.

James Rice

Grants

US DoED GAANN, Graduate Assistantships in Chemistry, \$525,060, 08/10 to 08/13

NSF Environmental Chemical Sciences, Mechanism of Natural Organic Matter Self-Assembly, \$479,845, 09/10 to 09/13

Adam Hoppe

Grants

NSF, CAREER: Simultaneous 3D-Imaging of Multiple Molecular Interactions within Living Cells. 0953561 PI: Adam Hoppe \$784,966 (total) (April 2010-April 2015)

Brian Logue

Grants

“Cyanide Diagnostics: Assessment of 2-amino-2-thiazoline-4-carboxylic acid (ATCA) as a diagnostic marker and development of a fluorometric sensor for rapid analysis of cyanide exposure,” NIH/DOD (ORISE), PI, \$204,342 (2010-2011).

“Enhancements of Raman Detection Minerals and Biomarkers Using Advanced Plasmonic Nanomaterials Analysis of CBRN filter devices,” NASA EPSCoR, Co-PI/campus coordinator, \$172,501 of \$1,125,000 (2010-2013).

“Analysis of CBRN filter devices,” DOD/3M, PI, \$250,076 (2010-2011).

Where are you? What are you doing?

We gladly publish updates on our alums' careers and lives — if we receive them. It's a great way for all of us to keep in touch!

If you would like to share something send us a note and we will include it in the next issue. You can also Fax to us at (605) 688-6364, or e-mail us at James.Rice@sdstate.edu.

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