Spring 2011

Chemistry & Biochemistry Newsletter

Department of Chemistry & Biochemistry, South Dakota State University

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

Spring 2011

Greetings from the Department!

The 2010/2011 academic year flew by in a whirlwind, but looking back, the number of things we accomplished is amazing. It is a tribute to the faculty and staff who have invested so much of themselves in serving our students and the state of South Dakota.

The Department's Medical Laboratory Science (MLS) program achieved NAACLS accredited status this past spring. The NAACLS Board of Directors' official accreditation award was based on the initial accreditation review process that included a site visit of our program on October 11, 2010. The program accreditation will continue until April 30, 2016.This is major milestone and I'd like to acknowledge the efforts of Pat Tille and Heather Hall and thank them for all the work they did. Now that accreditation is in place, the MLS program is finalizing its plans to offer an on-line "upward mobility" degree track to allow laboratory professional who currently have a 2-year medical technology degree to complete a 4-year, Bachelor of Science in MLS. While we are not ready to "officially" announce (though I guess I just did!) and enroll students (the first cohort would enroll no earlier than Fall 2012), you may contact Dr. Tille (patricia.tille@sdstate.edu) to learn more about it.

The construction and renovation of the Avera Health and Science Center has entered its last phase with the start of the demolition of Old Shepard Hall. We've been taking some pictures and will have a look back in the Fall 2011 newsletter. I have to say that we've enjoyed our first year in the new and renovated facility!

The spring's newsletter also highlights some of the accomplishments of the Department's Chemistry and Biochemistry (CBC) faculty, research staff and graduate students (p. 2-4, 6). They are a talented group of scientists whose recognitions reflect the commitment that the department's faculty have to graduate AND undergraduate education, and the commitment of the department's staff to supporting those endeavors.

Many of you have heard about the state's 10% budget cut to higher education that was passed on to SDSU and ultimately to the department. Though its affect on the department was ultimately moderated by the FY12 tuition increase, we did have to make some adjustments to how we will do business next year. Having said that, I think we have weathered it without any major negative effects; no faculty or staff will be laid off (e.g., the first paragraph, this was my number one priority!), classes will be fuller and there will be fewer of them, we'll defer some new research core facility equipment acquisitions and instructional laboratory equipment upgrades, etc. I am optimistic that the cuts that the faculty approved to meet the necessary budget reductions will actually place the department in a stronger position to be able to continue its growth once the state's budget difficulties are rectified.

This is a positive note to end on, and a good way to move into summer.

Enjoy the summer! Stay in touch!

Jim Rice

Chemistry Professor Recognized for Instructional Excellence: Studies How Students Learn

David Cartrette proceeds cautiously when he meets a stranger. If he's asked what he does for a living, he says he's a teacher. Pressed about what subject he teaches, he'll admit it's organic chemistry. "At the high school?" the stranger may ask.

Only then does Cartrette disclose that he's an associate professor at the university level. "The usual reaction is, 'Oh, you must be so smart,'" Cartrette said. "I'm not any smarter than they are; I just get it."

What Cartrette "gets" are the intricacies of organic chemistry. He also gets how to teach that subject, earning the Edward Patrick Hogan Award for Teaching Excellence at South Dakota State University.

Cartrette says he's humbled by the honor. However, a look at the record shows that an award for excellence in teaching was probably in his future.

While other chemistry professors are busy in the lab researching biopolymer synthesis, affinity chromatography, polyurethane degradation or post-translational modification, Cartrette's research centers on how students learn about chemistry.

Cartrette didn't hit on his research subject without taking a few detours in his career. His first job out of college was as an analytic chemist. He saw early on that in order to move up the corporate ladder he would need to get his master's degree. "I never, ever intended to get a Ph.D.," Cartrette said.

At Western Carolina University, master's degree students were expected to teach chemistry labs. Cartrette's experience with the students in his first lab proved to be transformative. "I still remember most of their names, actually," Cartrette said.

He also recalls his sense of pride and wonder at seeing his students "get it." "I think I was hooked at that point," Cartrette said.

His adviser took note that Cartrette was more comfortable at the head of the classroom than he was in the laboratory and suggested an advanced degree in chemistry education. Cartrette earned his doctorate in that field at Purdue University in 2003.

As a researcher, Cartrette wants to know how students learn about chemistry. "My primary focus is on student learning," Cartrette said. "How students learn chemistry and how they apply it in new ways."

In receiving the Hogan Award, Cartrette was honored for promoting "higher level thinking skills" in the classroom. That fits with his philosophy that students need to know how to use the knowledge they gain in his classes.

SDSU biology major Caitlin Forman, left, from Pierre, associate professor David Cartrette, and pre-pharmacy major Karen Zahradnicek, from Pierre, discuss a project in a sophomore chemistry lab. The class uses faculty-driven projects to introduce students to the research underway in the department, as well as to enhance their laboratory skills in chemistry. The course is part of SDSU's new freshman/sophomore sequence for chemistry/biochemistry majors and Honors College students.

"It's not enough, in my opinion, to know facts," Cartrette said, explaining that if that's all a student does "you're just amassing a grade for being able to read a book."

An example of pushing students' thinking skills takes place in the second semester of his organic chemistry classes where the final exam is replaced by a group project. In the project, students examine molecular groups that may be used in pharmaceutical or agricultural compounds.

Their assignment is to provide a paper synthesis, a cost analysis, a background study of the manufacturer and an explanation of what the compound is supposed to do. "It puts into motion the culmination of everything that they know," Cartrette said.

The cost analysis adds a real-world component to the lesson. "It teaches them why some prescription drugs are as expensive as they are," Cartrette explained.

Student reaction to the project has been positive and enthusiastic. "They like the challenge," Cartrette said. "This is exactly what you'd see in a lab setting."

And some of Cartrette's students will be headed for laboratories. His classes are taught to chemistry majors, with many of them going on to graduate school, medical school or pharmacy school.

Some may even emulate their professor if they hit a few career detours along the way and find themselves back in the classroom.

CBC Scientist Decorated for Service in Antarctica

Dave Ferris isn't the first SDSU staffer awarded a military decoration for serving his country in a foreign land.

What might be unusual is that the foreign land was Antarctica, and his service consisted of helping out over several seasons as teams of scientists drilled an ice core deep into the frozen continent. Meter by meter the team removed an ice core 3,331 meters deep — 10,928 feet — from the West Antarctic Ice Sheet so that hundreds of scientists in laboratories elsewhere can study the ice for what it can tell them on questions such as climate change.

For that work — nine- to 10-hour shifts, sometimes seven days a week, in often frigid temperatures — Ferris was awarded the Antarctica Service Medal "in recognition of valuable contributions to exploration and scientific achievement under the U.S. Antarctica program."

"It's a military award," said Ferris, a postdoctoral research associate in SDSU's Department of Chemistry and Biochemistry. "Antarctica was originally run by the military although the only military presence now is with the flights in and out.

The Antarctica Service Medal was first awarded in 1960 to troops who had participated in what was called Operation Highjump which established the research base known as Little America IV in 1946-1947. And in recent years, it's been given to people such as Ferris who pursue America's scientific interests in Antarctica.

Ferris works in SDSU professor Jihong Cole-Dai's research group, the Ice Core and Environmental Chemistry Lab, or ICECL. Cole-Dai, a chemist, is a specialist in analyzing the chemicals trapped inside ice cores to understand what was in the atmosphere when each season's snow and ice was deposited.

Ferris said he first got hooked on Antarctica when he accompanied Cole-Dai to the South Pole on a research trip. He liked it enough to go back for four additional seasons to help out at the West Antarctic Ice Sheet Divide Ice Core project — as a core handler the first year, and a driller for three seasons after that.

"Everybody's there for the same reason, ultimately — the science," Ferris said. "So there's a sense of camaraderie. It's a small camp and we all experience the same things – working in the cold, sleeping in tents, the lack of showers. Antarctica is a unique place. Everybody says it's flat and white. It's still extremely beautiful. The skies are amazing."

When each winter's drilling season ended, Ferris returned to SDSU to work in Cole-Dai's lab to analyze the ice — work that is also fascinating for a chemist. The National Science Foundation funded the ice core drilling project and funds much of the work at labs analyzing the ice core, including at Cole-Dai's lab.

Dave Ferris displays his Antarctica Service Medal.

"We measure the major water-soluble ions that are dissolved in the ice core," Ferris explained. Currently, the laboratory is one of three U.S. labs that are working to date the core year by year so that scientists pursuing other research questions can determine exactly when certain events or changes took place.

"We date the ice core with by ocean emissions. They vary with sea ice extent around Antarctica between summer and winter," Ferris said. "We're averaging about four and a half years per meter and we count those for hundreds and hundreds of meters."

Two other teams of researchers elsewhere are using other methods to date the ice core, so that ultimately there will be a reliable meter-by-meter timeline of when the snow and ice was deposited.

Ferris said the SDSU lab has a particular challenge now because it is dating what scientists call "the brittle zone" — a portion of the ice that is notoriously difficult to work with because the ice has shattered under pressure. "Our portion starts at meter 578 and goes to meter 1,300 which by our estimate would be maybe 6,500 years old."

Ferris notes that where scientists are particularly interested in the ice core is where analyses of the ice core suggest the earth was entering cold or warm periods. There's enough interest in the ice from those periods that scientists may go back to the WAIS Divide to drill a "replica core" right next to the original one so that more researchers could work with the ice.

"If they needed a driller for that replica core, I'd be in line," Ferris said.

Department of Defense Graduate Fellowship Awards Will Help Fund Cyanide Research

Four research fellowships awarded to SDSU chemistry students by the U.S. Department of Defense could help generate new knowledge to keep soldiers and civilians safe from cyanide exposure.

The awards went to Randy Jackson, Brendan Mitchell, Raj Bhandari, and Chakravarthy Vinnakota, all Ph.D. students studying with assistant professor Brian Logue in South Dakota State University's Department of Chemistry and Biochemistry.

The graduate research fellowships will help the students as they work with Logue on understanding different aspects of exposure to cyanide and its metabolites. Metabolites are the breakdown products of a parent compound.

Cyanide exposure can be deadly because it makes the cells of an organism unable to use oxygen.

"Each of these fellowships generates $32,820 over the course of a year for these graduate students," Logue said. "This funding allows them to focus on research important to the Department of Chemistry and Biochemistry, SDSU, South Dakota, and the nation. The research these students are conducting is in the area of cyanide toxicity and therapeutics and is ultimately sponsored by the Department of Defense."

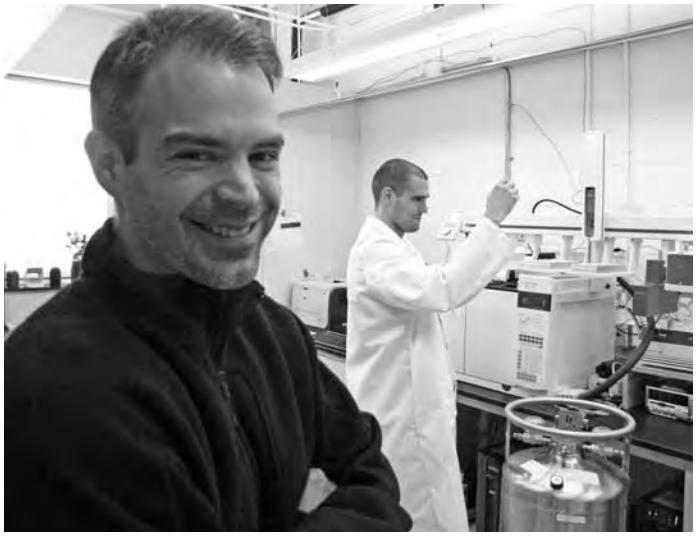
Industry figures say about 1.1 million metric tons of hydrogen cyanide—a compound widely used—are produced annually worldwide. Logue's research not only could help the military prepare to detect and treat exposure to cyanide if it is used as a chemical warfare agent, but could also help industry respond in cases where someone is accidentally exposed to cyanide.

Logue said the research fellowships are important because they allow graduate students to focus solely on their research instead of dividing their time between research and teaching. That allows them to finish their Ph.D. work faster, and it also allows the lab to produce research results faster.

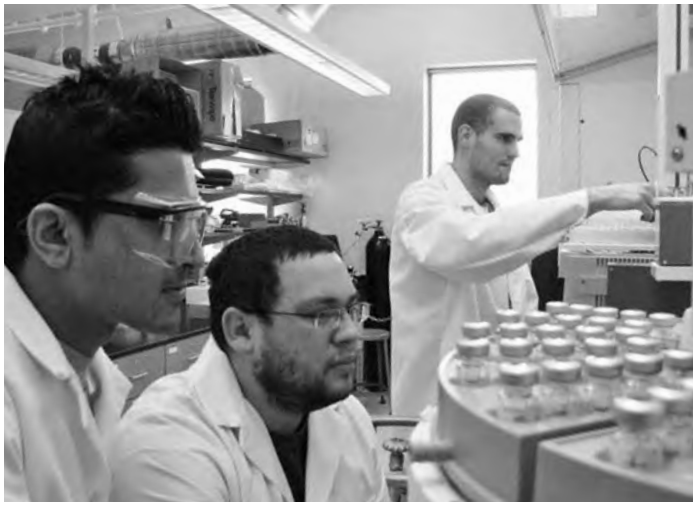
Logue's lab is developing analytical methods that use different metabolites of cyanide to determine if someone's been exposed to cyanide and if so, how long ago was the exposure.

"We are also moving more into therapeutics — if someone has been exposed, how well something can counteract the effects of cyanide in a person."

Logue's lab helps with the analysis of some drugs that researchers elsewhere have developed for treating cyanide exposure.



Assistant Professor Brian Logue in his laboratory as graduate student Brendan Mitchell conducts an experiment.



From left to right, Raj Bhandari, Randy Jackson, and Brendan Mitchell are among the SDSU students in SDSU's Department of Chemistry and Biochemistry who have won research fellowships to help them continue their studies in assistant professor Brian Logue's laboratory. Not shown is Chakravarthy Vinnakota.

Logue, who earned his bachelor's degree in chemistry from SDSU and his Ph.D. at Oregon State University, came to his research topic in part because of his active duty experience in the U.S. Army. He spent two years as a platoon leader, deploying to Middle East about a month after the September 11, 2001, terrorist attacks as part of a biodefense unit. He finished his military service at the Aberdeen Proving Ground in Maryland as a captain at the U.S. Army Medical Research Institute for Chemical Defense.

3M Foundation invests $250,000 in Freshman Chemistry

3M, a worldwide diversified technology company that employs nearly 1,400 people in the state of South Dakota, has made a $250,000 investment in the Avera Health and Science Center at South Dakota State University.

Mike Magnuson and Mark Shoup of the Brookings 3M facility presented the gift to SDSU President David L. Chicoine and other university leaders on February 11. Shoup is a 1995 mechanical engineering alumnus. As a student, Shoup studied chemistry in the lower level of the renovated portion of the facility.

Magnuson is manager of the Brookings 3M plant; Shoup is production manager for the Tape Converting Department at the Brookings facility.

The university will name the chemistry & biochemistry freshman laboratory after 3M in recognition of the company's leadership gift.

"This gift from the 3M Foundation is not only an important investment in our facility, it is an important philosophical investment in science," said Dr. James Rice, head of the Department of Chemistry and Biochemistry at SDSU. "South Dakota has very few chemical industries and this gift gives our students a very clear vision into a career path for those who major in chemical molecular sciences."

"It shows that 3M values and is willing to invest in the long-term education and commitment to students who are interested in a career in science," Rice said.

"3M is pleased to invest in SDSU and to support efforts to prepare students for future success," said Bob MacDonald, president of the 3M Foundation. "It is important that all students have an understanding of science, and we are excited that students from all disciplines will benefit from courses in this building."

Company Continues Long Partnership with SDSU

President Chicoine thanked the company's local leaders for 3M's long-standing partnership with SDSU. Nearly 200 SDSU graduates have worked or continue to work for 3M.

Pictured at the February 11 presentation (left to right) are: Dean Dennis Hedge, College of Pharmacy; SDSU President David L. Chicoine; Brookings 3M representatives Mike Magnuson and Mark Shoup; Jim Rice, head of the Chemistry and Biochemistry Department; and Dean Jerry Jorgensen, College of Arts and Sciences.

"We rely on these partnerships to move the university forward and expand our capabilities in the health sciences," Chicoine said. "3M's investment will have a long-range impact on our campus, the city of Brookings and the state of South Dakota."

3M built its plant in Brookings in 1968. It now employs more than 700 people.

The 3M Freshman Chemistry Laboratory is dedicated to general chemistry, including courses required for pre-nursing, pre-engineering, pre-med, pre-dentistry and pre-allied health. The laboratory is used from 8:00 a.m. to 8:00 p.m. most every day and serves nearly 400 students every week.

Interested in keeping current on happenings in the Department?

Scan this code with a smart-phone QR code reader app to go directly to the latest departmental announcements.

Recent Publications and Grants

David Cartrette: Cartrette, David P., & Mayo, Provi M. (2011). Students' understanding of acids/bases in organic chemistry contexts. *Chemistry Education Research and Practice*, 12, 29-39.

Jihong Cole-Dai: Collaborative Research: Replicate Coring at WAIS Divide to Obtain Additional Samples at Events of High Scientific Interest ($120,873, for 4 years).

Brian Logue: "Analysis of CBRN filter devices," DOD/3M, PI, $324,254 (2010-2011). Original funding was $250,076. Two funding supplements (contract modifications) totaling $74,178 were granted after successful development of novel methods for filter analysis.

NIH RO1 Grant Will Address Congestive Heart Failure

A grant of about $1.8 million over five years will help scientists better understand congestive heart failure, a condition that affects 5.7 million Americans annually.

John Robinson, a medical doctor and a CBC biophysical chemist at SDSU, has been awarded the funding by the Heart, Lung and Blood Institute of the National Institutes of Health. The research could supply new knowledge about heart failure that could lead to new treatment strategies.

The risk of congestive heart failure increases sharply with age, doubling every 10 years among older adults. At younger ages, blacks are disproportionately affected compared to whites by a ratio of 20 to 1.

Robinson is especially interested in heart failure in connection with impaired function of the myofilament, a protein assembly regulated by calcium that makes the heart contract.

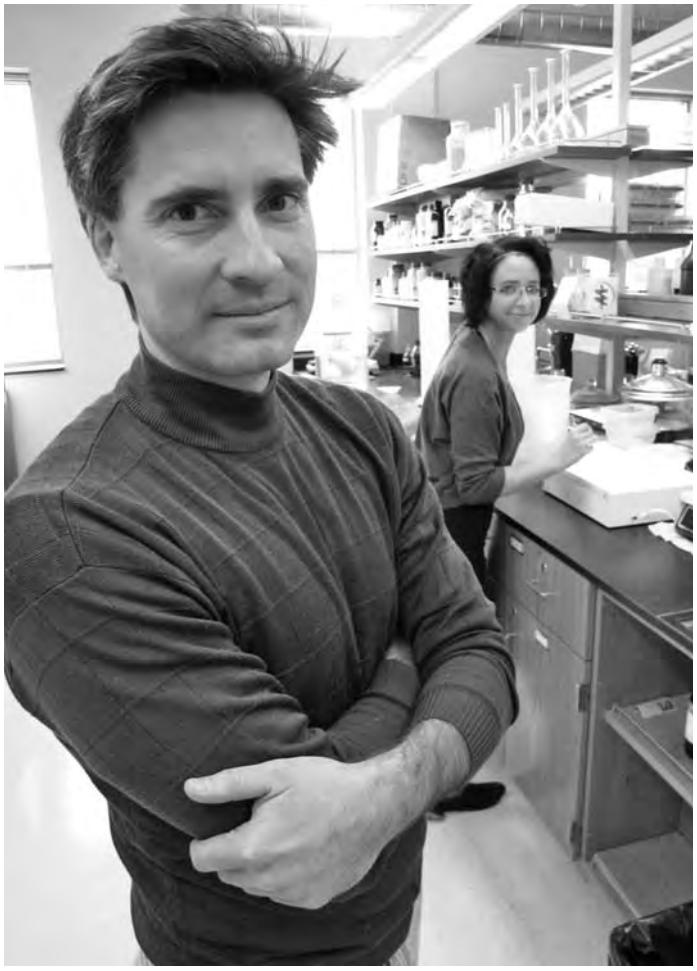
"The myofilament is the fundamental unit that allows the heart to generate force. Your heart has to beat and relax about once every second," Robinson said. "These periods of contraction and relaxation are regulated by the levels of calcium inside cells of the heart. The myofilament is a calcium-sensitive switch that generates force when calcium binds to it."

However, scientists don't fully understand how the myofilament functions or what goes wrong when it doesn't work properly. Robinson said that's because those processes are taking place at the nanoscale, or roughly at a level 100 to 1,000 times smaller than can be seen by using a conventional microscope.

"Switching in the nanoscale is very different from switching in our world. If I turn a light switch on, it stays on," Robinson said. "What we're seeing with protein switches is that just because calcium binds to it, it will not necessarily turn on. It's sort of error-prone. All of the switching is done by heat—random collisions with water is what drives all of this."

Robinson said a revolution in instrumentation is making it possible to unravel such processes, some of which have been studied for decades. Robinson is part of the SDSU-based 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 this case, to analyze biochemical processes.

Robinson's laboratory uses a technique called Fluorescence Resonance Energy Transfer, or FRET, to study proteins at the nanoscale. His FRET measurements are at the "single molecule" level, studying myofilaments one at a time.



South Dakota State University researcher John Robinson, left, shown here in his laboratory with graduate student Maria Moutsoglou, has won a major grant to study mechanisms involved in congestive heart failure. The study will generate new knowledge that could lead to new treatment strategies.

Robinson's five-year NIH project will work to establish what molecular interactions are taking place as the myofilament contracts; and to understand the mechanisms at work when myofilaments' sensitivity to calcium is altered.

Robinson earned his bachelor's degree in biophysics from Johns Hopkins University in Baltimore, Md. His Ph.D. is in biochemistry and molecular genetics from the University of Alabama at Birmingham, Ala., where he also earned his degree as a doctor of medicine. More information about Robinson's research is available online at http://www.myofilament.org/.

Scholarship and Award Winners

University and College Recognition

Schultz-Werth Awards for Undergraduate Creativity and Research: Jennifer Chase

Departmental Awards

CRC Press Chemistry Achievement Award: Alex Bohlmann

Phi Lambda Upsilon Award for Achievement in Organic Chemistry: Kayla Erlandson & Dillon Hanrahan

Analytical Chemistry Award: Bradley Iverson

Merck Index Award: Jennifer Chase

Hypercube Scholar: Dillon Hanrahan

Dobberstein Research Award: Gary Huff

Sioux Valley Outstanding Senior Award: Gary Huff

Sioux Valley Distinguished Senior Award: Jennifer Chase and Alex Bohlmann

Departmental Scholarships

Eugene Burr and Ella Burr Schultz Scholarships: Dillon Hanrahan and Ethan Anderson

Elmer and Roberta Johnson Leaders of Tomorrow: Chelsea Berg (incoming major), Jared Holzhauser (incoming major), Tanya Baldwin (returning student), and Elizabeth Bosworth (returning student)

Olive Burke Crary and Gerald D. Crary Jr. Scholarship: Megan McDougall

Hardin-Palmer Scholarship: Amber Halter

Herbert H. Hodgeson Award: Bradley Anderson

Webster-Klug Award: Kayla Holscher

Arthur W. Dobberstein Achievement Award: Meredith Sauer

Donald E. McRoberts Award: Cory Gunderson

Hach Scientific Foundation Scholarship: Samantha Loutsch and Kayla Erlandson (returning students)

Guss Memorial Award: Lindsey Haselhorst, Michael Krsnak, Gina Morseth and Mitchell Perrizo

Oscar and Elaine Olson Scholarship: Tyler Carlson

Lloyd Baillie/Atlantic Richfield Award: John Potts

E. R. Binnewies Memorial Award: Kaitlyn Baier

Joseph and Coral Bonnemann Scholarships in Medical Technology: Jessie Paris

Louise Guild Scholarship in Biochemistry: Kyle Baumann

Philip and Eleanore Haskett Award: Jeff Fahey, Josh Kofford and Jieqiong Lou (awarded in Fall 2010)

Faculty Award

Leo and Elaine Spinar Award Recognizing Undergraduate Teaching Excellence: Matthew Miller

2010-2011 Chemistry Graduates

Bachelor of Science – Chemistry

Surendra Thapa (B.S. Chem, December '10), Major in Chemistry. *(Going for a B.S. in Chemical Engineering at SDSMT)*

Brian Eckrich (B.S. Chem, December '10), Major in Chemistry. *(Looking for a job)*

Glen San Juan (B.S. Chem, December '10), Major in Chemistry. *(Not sure, doing undergraduate research in Pharmacy)*

Scott Heisel (B.S. Chem, December '10), Major in Chemistry, Minor in Philosophy *(teaching in chemistry)*

Abbi Davelaar (B.S. Chem, December '10), Major in Chemistry, Minor in Mathematics and Biology *(Working for 3M)*

Kevin Deinert (B.S. Chem, December '10), Major in Chemistry, Minor in Biology *(continuing for second major at SDSU)*

Gary Huff (B.S. Chem, May '11), Major in Chemistry. *(uncertain, looking for work in the private sector)*

Alex Bohlmann (B.S. Chem, May '11), Major in Chemistry. *(uncertain, applying for biochemistry graduate program)*

Krista Souter (B.S. Chem, May '11) Major in Biochemistry, Minor in Chemistry *(uncertain)*

Jennifer Chase (B.S. Chem, May '11), Major in Chemistry, Minor in Biology *(Ph.D. in Cancer Biology in Michigan)*

Patrick Kappell (B.S. Chem, May '11), Major in Chemistry, Minor in Mathematics *(Pharmacy school at SDSUC, PharmD)*

Aimee Kambala (B.S. Chem, May '11), Major in Chemistry. *(Year-long internship at Sanford, then medical school)*

Hillary Beldin (B.S. Chem, May '11), Major in Chemistry, Minor in Biology

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.

Student Research Focuses on Soil Health

Measuring the "glue" that helps hold soil together can help solve a sticky research question: How much crop residue can producers safely remove from fields without hurting the health of soils?

Undergraduate researcher Alex Bohlmann helped do the lab studies to begin answering that question while completing his bachelor's degree in biochemistry.

Producers and people in ag processing want to know how much crop residue they can take off the land with engineers rapidly refining science techniques to make biomass materials into biofuels. That means it could pay to harvest some of the plant residue for bioenergy feedstock.

Bohlmann, a student from Brandon, studied soil proteins in the lab of research agronomist Shannon Osborne of the USDA's Brookings-based North Central Agricultural Research Laboratory.

"What we found is that there's a correlation between the amount of residue that you remove and the amount of protein found in the soil," Bohlmann said. "We're trying to figure out what is a healthy level to take off while maintaining soil quality."

Working with Osborne and post-doctoral researcher Sarah Stetson, Bohlmann was especially interested in what happened under different crop management scenarios to a soil protein called glomalin. An Agricultural Research Service scientist first discovered glomalin in 1996. The protein plays an important role in carbon storage and overall soil health.

"Glomalin is a protein found in soil. It's produced by mycorrhizal fungi, one of the most common fungi found in soil in our area," Bohlmann said. "Basically glomalin acts as a glue-like substance to hold the soil together to create micro-aggregates and macro-aggregates — small aggregate sizes and bigger aggregate sizes. That helps with keeping water and air moving through the soil and also with keeping carbon in the soil. In the big picture, more carbon stored in the soil means less carbon for carbon dioxide in the atmosphere. It also helps with the nutrient cycling of the soil."

Using soil samples collected in 2008, Bohlmann used a technique called a Bradford assay to measure the concentration of protein, paying attention to the relations between different soil aggregate class sizes.

Though more research is ongoing, this work is a component of a larger, national Renewable Energy Assessment Project. Researchers are working towards developing recommendations and guidelines for sustainable biomass harvest while protecting the soil resource. The overall goal is to help producers know exactly how removing a known amount of cornstalks or other crop residue will affect levels of glomalin-related soil protein and ultimately, soil quality. That, in turn, will make it easier for producers to keep their soils healthy while growing crops for both food and energy needs.

"When I came to college I thought I'd do some important things, but I never thought I'd get involved in something that could potentially be really important to a huge part of society," Bohlmann said. "It really puts things in perspective to say that I've done some research that can help large numbers of people and our government and maybe even the world to understand this."