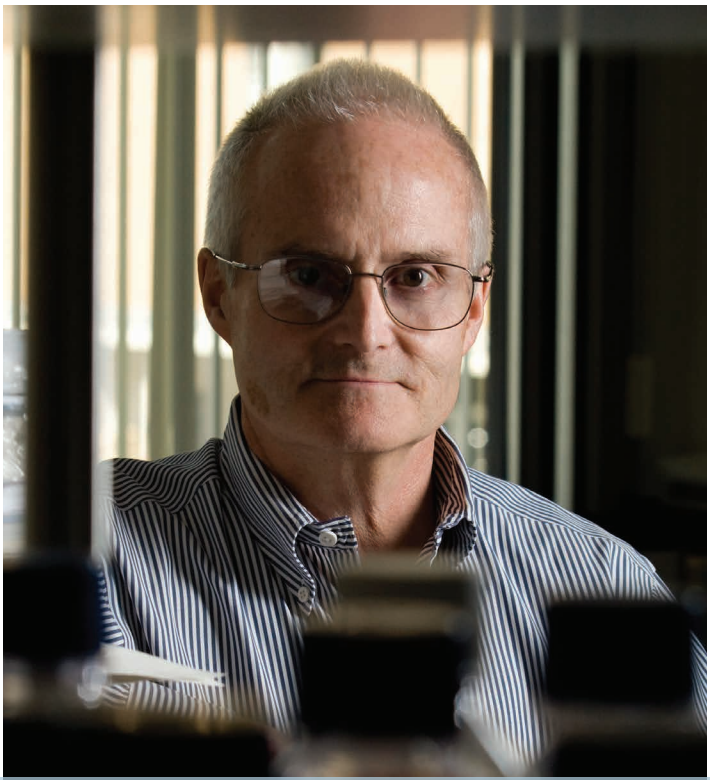
CHEMIGRAM

The newsletter for BYU's Department of Chemistry and Biochemistry



Message from the Chair

GREGORY F. BURTON

This year marked the end of President Cecil Samuelson's tenure at BYU and began the administration of Kevin Worthen as the 13th president of the university. It is exciting to watch the change in administration here at the university and feel the enthusiasm that President Worthen brings to his new assignment. The president has taken a distinct "mission centric" approach to guiding the university. This emphasis has caused us to consider how we might better contribute to the stated mission of BYU. In addition to a new president, we have continuing changes on campus and in the department. During the last academic year, we welcomed four new colleagues: Rebecca Sansom, Kara Stowers, Jeremy Johnson and Ken Christensen. Each brings enthusiasm and a strong background to the department. Rebecca Sansom is our new General Chemistry Laboratory Coordinator responsible for the Chem 107 labs and teaching general chemistry. Kara Stowers is an inorganic chemist working on catalysis and Jeremy Johnson is a physical chemist doing laser spectroscopy. Ken Christensen joins us after an 11-year career at Clemson as a bioanalytical chemist. We also have three current faculty position vacancies and anticipate one or two more before the current year ends. If you know of potential faculty applicants for these positions, please encourage them to apply. The BYU Cancer Research Center was renamed in November of 2014 as the Simmons Center for Cancer Research (SCCR). This year also marked a change in directors of the SCCR with the appointment of Professor Merrill Christensen (Nutrition, Dietetics, and Food Science) as director, and Professor Steven Castle (Chemistry and Biochemistry) as associate director of the SCCR. Daniel Simmons served as the director of the center for nearly two decades. During his tenure, he instituted a seminar to educate students about cancer and cancer research. He also began a fellowship program that provides support for students involved in cancer research in faculty laboratories. Dr. Simmons also played a seminal role in the continued success of the annual Rex Lee Run. Other major changes at the university include the completion of the new Life Sciences Building and its dedication in April by Elder Russell M. Nelson of the Quorum of the Twelve Apostles of the Church of Jesus Christ of Latter-day Saints. This past year, our department faculty taught over 10,000 student enrollments. We had 335 undergraduate students enrolled in our majors and 90 graduate students who were enrolled in our PhD and MS program. We graduated 56 students with BS or BA degrees, and awarded 4 MS and 13 PhD degrees. We also published 86 unique peer-reviewed publications. Thus we continue to stay busy and focused on our mission. In July of this year, Adam Woolley, Steven Wood, and I will begin our last year of service in the department office. It has been wonderful to see colleagues and students achieve success and recognition for their roles in teaching, scholarship and citizenship. Those who went before created a strong and vibrant department and it continues to be our goal to maintain and build upon the tradition of excellence they (and you) created. We appreciate the continuing level of support you, our friends and alumni, provide. I hope that 2015 will be a rewarding year for the department, its students, faculty, staff and alumni.

NEWS

Three Students Win Awards at SciX Conference

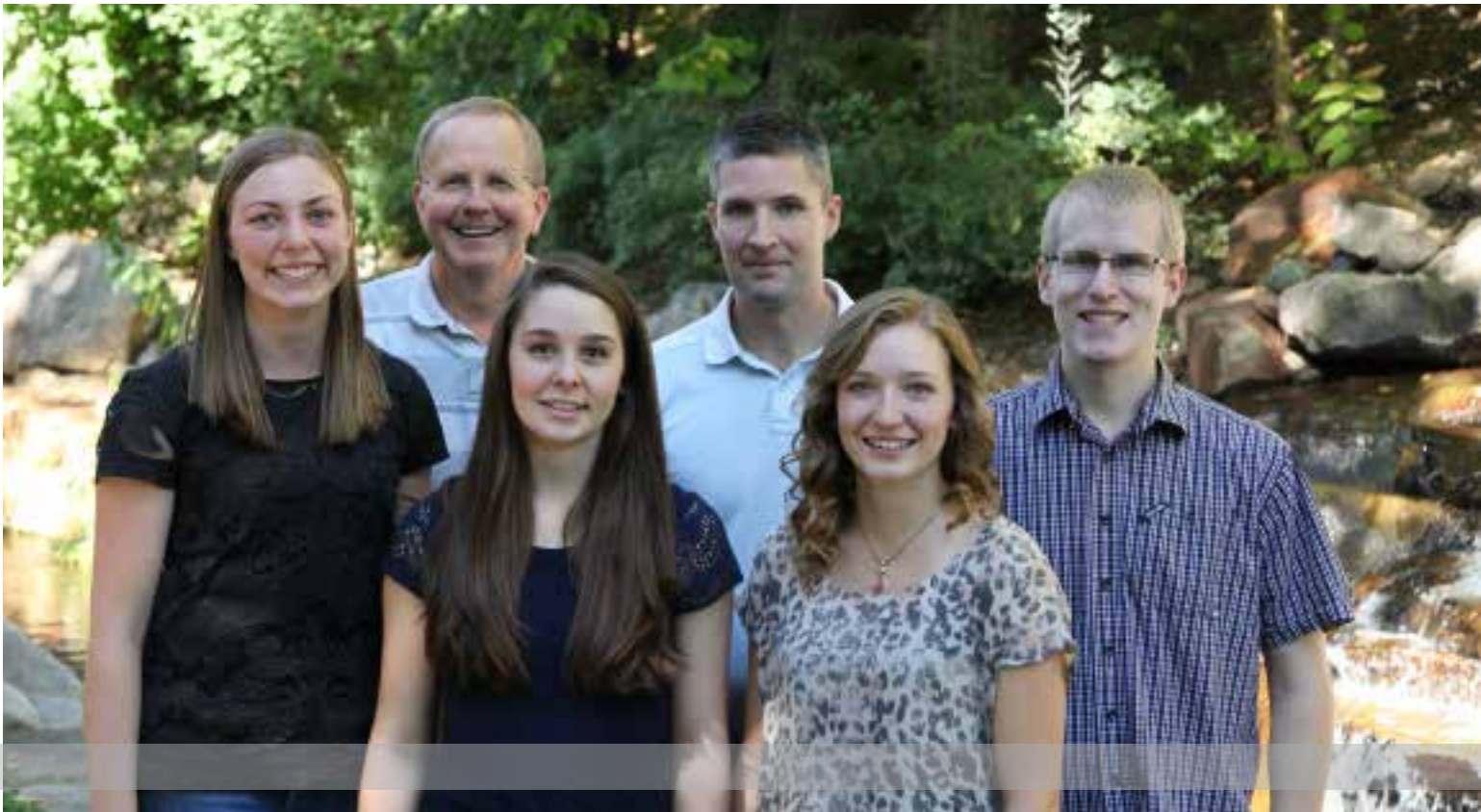
The 2014 SciX Conference held in Reno, Nevada, was a great success for Dr. Paul B. Farnsworth's research group. The conference, which stands for "The Great Scientific Exchange," is held annually at a different North American location and draws scientists from around the world. SciX is sponsored by the Federation of Analytical Chemistry and Spectroscopy Societies (FACSS).

Farnsworth attends nearly every year with one or two students. This year, because the conference was within driving distance, Farnsworth had the special opportunity to bring all five of the students in his research group: Wade Ellis, Lance Moses, Jessica Ramsey, Charlotte Reininger, and Anna Openshaw. Three of Farnsworth's students received awards in the poster competition that accompanied the conference. Ellis received the first-place prize, and Moses and Ramsey were both named runners-up.

"The best moment was learning that my students had done so well in the poster competition" said Farnsworth. "There was a lot of stress in getting everyone ready for the meeting, and there were times that I doubted we would all be ready. It was a relief to see everyone do well, including the students who did not win prizes in the poster session."

BYU was the only school at SciX to have more than one student presented with a FACCS Student Poster Award. "My current group is exceptional," said Dr. Farnsworth of his students. "They are bright, curious, and hard working. I think that this road trip was fun for all of us, and one that we will remember for a long time."

Written by Jordan Wright
Photo courtesy of Paul Farnsworth



Finding New Treatments for Tuberculosis and Malaria in Nature

Life-saving chemical compounds are traditionally created using hundreds of thousands of dollars and multiple years in the lab, but Dr. David J. Michaelis is currently working on a process that could revolutionize the pharmaceutical industry. "We want to be able to design any molecule we can envision as a drug candidate and synthesize it with the same efficiency that nature achieves," Michaelis said. Developing an artificial process as efficient as a natural process has the potential to dramatically reduce the cost of new drugs, making life-saving drugs more available to the world.

Michaelis and his team have focused on the problem of creating cancer-toxic compounds and, with nature as their inspiration, have started developing an assembly-line approach. "Nature has an amazing ability to generate really complex molecules, which in many instances also have important drug properties," Michaelis said. "One way nature is able to assemble these challenging molecules—often in a single cell—is by using an assembly line of enzymes that puts the molecule together piece by piece."

The Michaelis lab is seeking to mimic this natural process using chemical tools rather than enzymes—a process they have coined "assembly-line chemical synthesis."

The Michaelis lab plans to dramatically reduce the cost of developing and synthesizing new drugs. In one instance, they took a previously existing anti-malarial compound with a seventeen-step synthesis and used their new approach to propose a mere six-step synthesis. "So we have made a significant reduction," said Michaelis. "But we want to go much further than that. We want to perform all six steps on our assembly line, in a single reactor, so that we can put in all the starting materials and come back the next day and have our compound."

Written by Mackenzie Brown, CPMS

3MT Program Helps Students Explain Research

2015 marked BYU's second year participating in the Three Minute Thesis program (3MT), which challenges PhD candidates to present their doctoral thesis in under three minutes, using language that a non-specialist audience can understand. Competitions are held first in individual departments, then in colleges, and finally in a university-wide round. In this year's competition, chemistry students Mukul Sonker and Jayson Pagaduan received honorable mention at the college level. "I realized that you can make people pay attention to your research if you make it interesting enough," said Sonker. Another chemistry student, Komal Kedia, who reached the university level of last year's 3MT competition, said that participating in 3MT taught her how to be concise. 3MT is quickly becoming a favorite academic event at BYU because it shows the diversity of research happening on campus. "The Graduate Student Society did such an amazing job of bringing colleges together at the university level," said Kedia. "I am so proud of BYU."

Written by Jordan Wright
Photos courtesy of Austin Gillett

Chromatography Student Published in Top Journal

PhD student Tayyebeh Panahi recently had an article published in the *Journal of Chromatography A*, one of the top journals that publishes work in analytical chemistry. Panahi works in Dr. Roger G. Harrison's lab developing new stationary phases for ion chromatography columns. She then applies these columns to the separation and detection of analytes in biofluids and environmental waters. Her article focuses specifically on separating and detecting low levels of toxins in urine. "People who suffer from kidney failure accumulate toxins in their body," she explained. "This paper is about the detection and quantification of some of these toxins, which could lead to an earlier diagnosis of kidney problems and the start of patient care." Panahi obtained her bachelor's and master's degrees in her home country of Iran. She heard about BYU through one of her friends and, after studying more about the research, decided to move over seven thousand miles away to join the graduate program here. At first, Panahi's parents were a little nervous about sending her to the U.S., but were comforted after learning about BYU's honor code and cultural values. Depending on her research, Panahi plans to graduate in early 2016 and hopes to find work in U.S. industry where she can expand her knowledge and experience in chromatography.

Written by Jordan Wright
Photo courtesy of Tayyebeh Panahi

Decorated Scholar Lectures on Renewable Energy

Dr. Alexis T. Bell visited BYU to present at the eighth annual Reed M. Izatt & James J. Christensen lecture. Bell is a professor of chemical engineering at the University of California, Berkeley, and a faculty senior scientist at the Lawrence Berkeley National Laboratory. He is also a leader of the Joint Center for Artificial Photosynthesis (JCAP), a program developing artificial solar-fuels generation technology. Bell has spent 40 years studying catalysis and has authored or coauthored over 500 publications. Known worldwide for his research in heterogeneous catalysis, he is recognized as a pioneer in developing new ways of promoting important chemical reactions, such as those needed to provide sustainable energy for future generations.

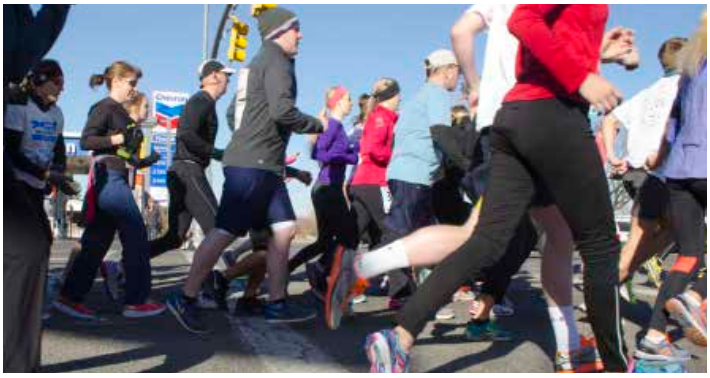
Bell gave two lectures, both open to the public: a general lecture titled "The Case for Developing Renewable Energy Sources and the Challenges Ahead," and a technical lecture titled "Role of Experimental and Theoretical Methods in the Development of a Molecular Perspective of Catalysis."

Cancer Research Center Celebrates New Name, Old Tradition

The College of Physical and Mathematical Sciences and the College of Life Sciences recently announced the re-naming of the BYU Cancer Research Center to the Simmons Center for Cancer Research (SCCR). This name change comes as Dr. Daniel L. Simmons steps down as director of the center after 17 years of service. Replacing Simmons as director is Dr. Merrill J. Christensen of the Department of Nutrition, Dietetics, and Food Science. Dr. Steven L. Castle of the Department of Chemistry and Biochemistry will serve as the center's associate director.

"I hope to see the current programs expand and grow under the inspired new leadership," Simmons said. "I think we've only just begun to scratch the surface of what BYU can contribute to this important field."

One program that is certainly expanding is the annual Rex Lee Run, which celebrated its 20th year this past March.



The run honors Rex E. Lee, former president of BYU, who battled cancer while serving at BYU and eventually lost his life to the disease. This year, the number of racers doubled from approximately 900 in 2014 to almost 1,800. Net revenue from the event, which will help fund the fellowship program in the SCCR, rose from around $12,000 in 2014 to $55,000. The fellowship program, initiated by Simmons in 1997, gives promising students the chance to work with faculty mentors on specific cancer research projects. Since its creation, over 200 students have participated in the program.

"We had a record number of applicants this year," said Jared Cowley, the SCCR Program Coordinator. Cowley estimates that, in light of the 2015 Rex Lee Run's success, at least 16 of the 34 applicants will be funded for full-time cancer research over the spring and summer terms. The fellowship program not only benefits the careers of the students chosen, but also lets them make an active difference in the fight against cancer. "This is extremely exciting," said Cowley. "We'll be able to fund eight different cancer research projects from this year's race alone."

Written by Meg Monk, CPMS, & Jordan Wright

Harvesting Solar Energy

Chemistry graduate student Trevor Smith is the second author of a paper published in the journal *Nanotechnology*. He and first author Stephen Erickson, a physics student, conducted and published research about how nano-sized crystals can improve solar panels. Solar panels provide reliable and clean energy, but they don't do it very efficiently. Most solar cells rely on silicon-based semiconductors, which harvest less than 29 percent of the available energy from sunlight. That's because silicon-based cells only convert a portion of the light spectrum into electricity. The light from wavelengths that are too long or too short is mostly unusable. Dr. Richard K. Watt, who mentored the students on the project, has been using a protein called ferritin as capsule in which he and his students can grow tiny crystals. The idea is to grow crystals that capture the light that silicon misses. "We started off with one particle that could only absorb blue light and all the other light was wasted," said Watt. "The thought was if we could put another particle that could absorb red wavelengths and another that would absorb yellow and another green, we would be able to harvest most, if not all, of the energy from light." That hope became possible when Watt joined forces with physics professor Dr. John Colton. In his lab, they can finely tune these nanocrystals to capture very specific wavelengths of light. This lets them make combinations that work in a coordinated fashion.

The researchers are still looking to fill a gap that silicon normally covers on the light spectrum. If they can grow a nanoparticle similar to silicon, the theoretical conversion rate climbs to 51 percent.

Written by Joe Hadfield, BYU News
Photo by Jaren Wilkey, BYU Photo

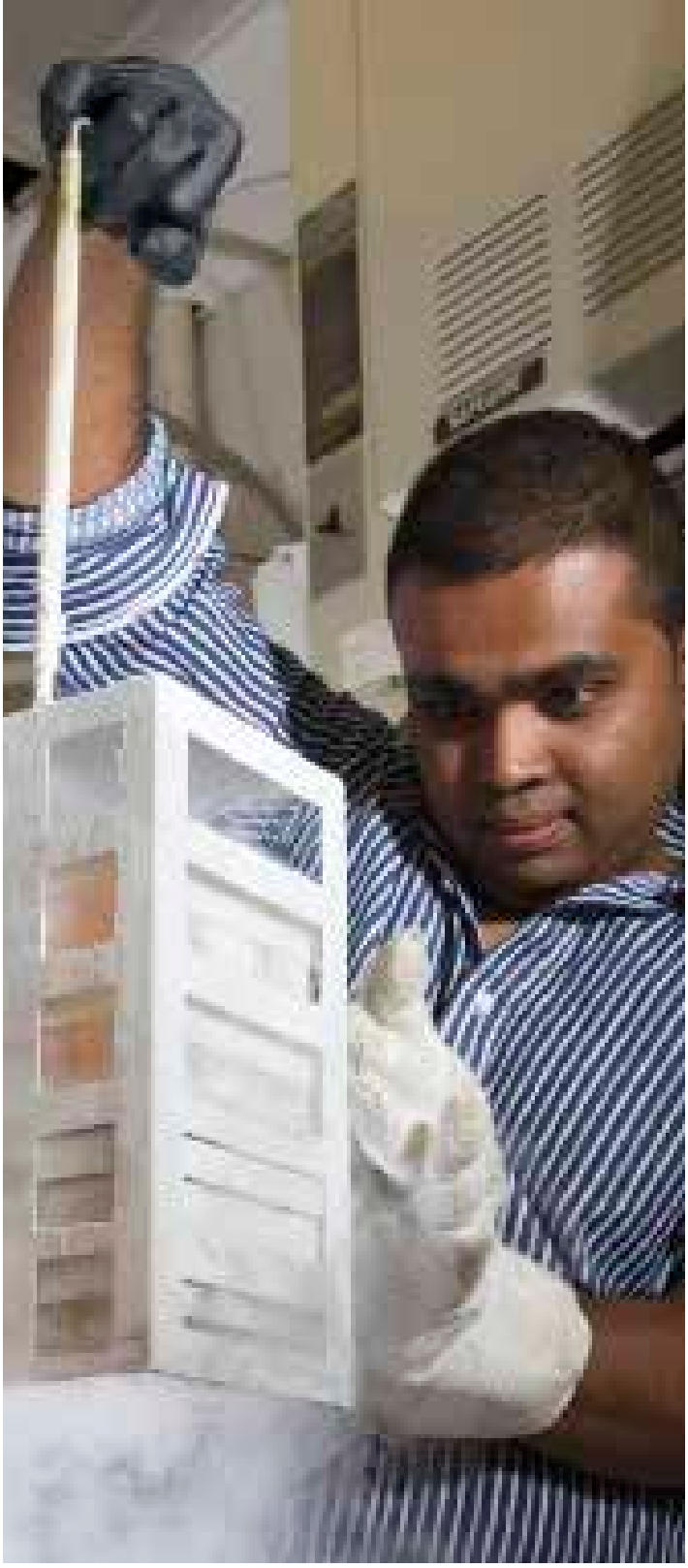
Discovery May Lead to Lower Doses of Chemotherapy

No matter what type of chemotherapy you attack a tumor with, many cancer cells resort to the same survival tactic: they start eating themselves in a process known as autophagy. The prospect of discovering which proteins pair up and, consequently, switch on this process, spurred an international hunt. However, it was Dr. Joshua L. Andersen's lab at BYU that ultimately discovered the two proteins.

Several other labs started with a protein called ATG9 as their prime suspect and then looked for its accomplice among thousands of other proteins. But the BYU team, comprised mainly of undergraduate students, stumbled into the race unexpectedly from a different direction. They wanted to know why cancer cells made a surplus of a protein called 14-3-3 zeta.

"This unique approach we used, partially by luck, gave us an advantage," Andersen said. "I don't think we would have discovered this through more conventional approaches." Using breast cancer tissue in the lab, they forced tumor cells to undergo autophagy by depriving them of oxygen and glucose. A comparison with a control group let them see that the two proteins hook up only when under attack. That's because stress makes Atg9 undergo a modification that enables 14-3-3 zeta to bind with it and switch the cancer cells to survival mode.

"This gives us a therapeutic avenue to target autophagy in tumors," said Andersen. "The idea would be to make tumors more chemo-sensitive. You could target these proteins and the mechanism of this switch to block autophagy, which would allow for lower doses of chemotherapy while hopefully improving patient outcomes."



PhD candidate Vajira Weerasekara directed the experiments and was lead student author in the study. Undergraduate students David Panek and David Broadbent also made significant contributions to the research and appear as coauthors. When they complete their degrees at BYU, Weerasekara will re-join the faculty at the University of Colombo in Sri Lanka, Panek will go to medical school, and Broadbent will pursue a joint MD and PhD program.

Written by Joe Hadfield, BYU News
Photos by Mark Philbrick, BYU Photo

PhD Student Wins Poster Competition in Florida

Sambhav Kumbhani, a PhD student studying with Dr. Jaron C. Hansen, won first place for his poster at the 33rd annual American Association of Aerosol Research (AAAR) Conference in October 2014.

"Studying atmospheric chemistry has been a very rewarding experience for me," said Kumbhani. His main focus of study, aerosols, are tiny particles of solid or liquid suspended in air. Aerosols contribute to the poor visibility during inversions here in Utah, they cause breathing-related diseases like asthma and bronchitis, and they affect global climate change.

Though models have been created to predict aerosol levels in the atmosphere, the actual concentration is far higher than models suggest. To bridge this gap, Kumbhani is working to discover other ways in which aerosols form.

For the poster competition at the AAAR Conference, Kumbhani focused his work on atmospheric radicals and built a system in the lab to mimic Earth's atmosphere. His work showed that radicals can actually form aerosol particles.

"It was an amazing experience," said Kumbhani of the five-day conference. "I got to meet the experts in our field, to know more about the research they are doing, and to present my research to them." After networking with other chemists and receiving important feedback on his research, winning the poster session was "the cherry on the cake."

After graduation in April, Kumbhani is heading to the University of California, Irvine, to do post-doctoral research with Dr. Barbara Finlayson-Pitts, a leader in the field of atmospheric chemistry and a member of the National Academy of Sciences.

Written by Jordan Wright
Photo courtesy of Sambhav Kumbhani

Perseverance

Midway through her pursuit of a PhD in biochemistry, Rebecca Plimpton hit a complete dead end with her research. Rather than quit, she decided to throw out all of her data and start over. Thanks to her perseverance, Plimpton and her faculty mentor, Dr. Barry M. Willardson, have unlocked some mysteries behind "G proteins."

G protein systems control how cells respond to different hormones, growth factors, neurotransmitters, and sensory stimuli such as vision, taste, and smell. Malfunctions in G proteins result in many diseases, including heart disease and cancer. In the study, Plimpton and Willardson collaborated with José Valpuesta's lab in Madrid to couple advanced biochemical techniques with cryo-electron microscopy imaging and view the process of G protein assembly.

"It's very challenging to develop drugs that improve or inhibit G protein folding," said Willardson. "This research will make it easier because it identifies specific places that might be targeted by drugs."

Their work appears in the *Proceedings of the National Academy of Sciences*, one of the top-ranked science journals in the world.

Written by Sierra Naumu Thomas, BYU News
Photo by Mark Philbrick, BYU Photo

SELECTED UNDERGRADUATE RESEARCH AWARDS

DAVID PANEK

mentored by Joshua L. Andersen

"Regulatory Mechanisms of Autophagy through Phosphorylation of Atg9"

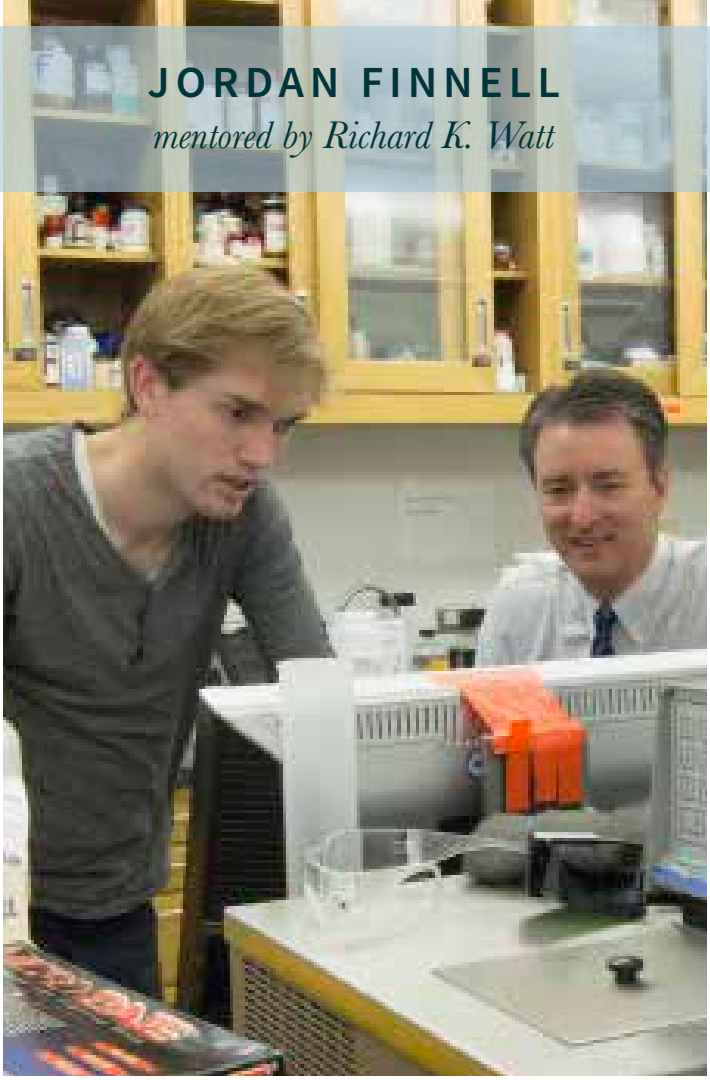
I am currently working in Dr. Joshua L. Andersen's laboratory to understand how tumor cells adapt and survive during hypoxic stress, which occurs frequently within tumors. Although it has been known for years that hypoxia promotes chemoresistance and metastasis, the mechanism by which this occurs is poorly understood. We recently published a study claiming that hypoxia triggers phosphorylation of a protein called Atg9A, which, in turn, activates a pro-survival cellular process called autophagy. Cells utilize autophagy to provide themselves with critical nutrients under stressed conditions. The mechanism we described in our paper gives us critical information for developing strategies to block autophagy and prevent chemoresistance in tumors. One important finding in our previous publication was that Atg9 phosphorylation is mediated by two kinase proteins: AMP kinase (AMPK) and Unc-51-like kinase 1 (ULK1). We hypothesized that ULK1 only serves to bring Atg9A into close proximity with AMPK, which then phosphorylates Atg9A. To test this hypothesis, we developed several DNA constructs through site-directed mutagenesis and inverse PCR, including a mutant of ULK1 that is inactive in its kinase region, leaving it unable to phosphorylate proteins but still capable of bringing AMPK close to Atg9A. We also constructed a mutant of ULK1 that was defective in its AMPK binding region, leaving it unable to associate with AMPK but still with an active kinase domain. Together, these constructs will allow us to test our hypothesis. We are also in the process of developing several large-scale deletion mutants of Atg9 and ULK1 to determine the precise location where each protein interacts with the other.

Written by David Panek
Photo by Zoie Young

"Mechanism of Transferrin Loading to Prevent Non-Transferrin Bound Iron in Chronic Inflammatory Diseases"

JORDAN FINNELL

mentored by Richard K. Watt

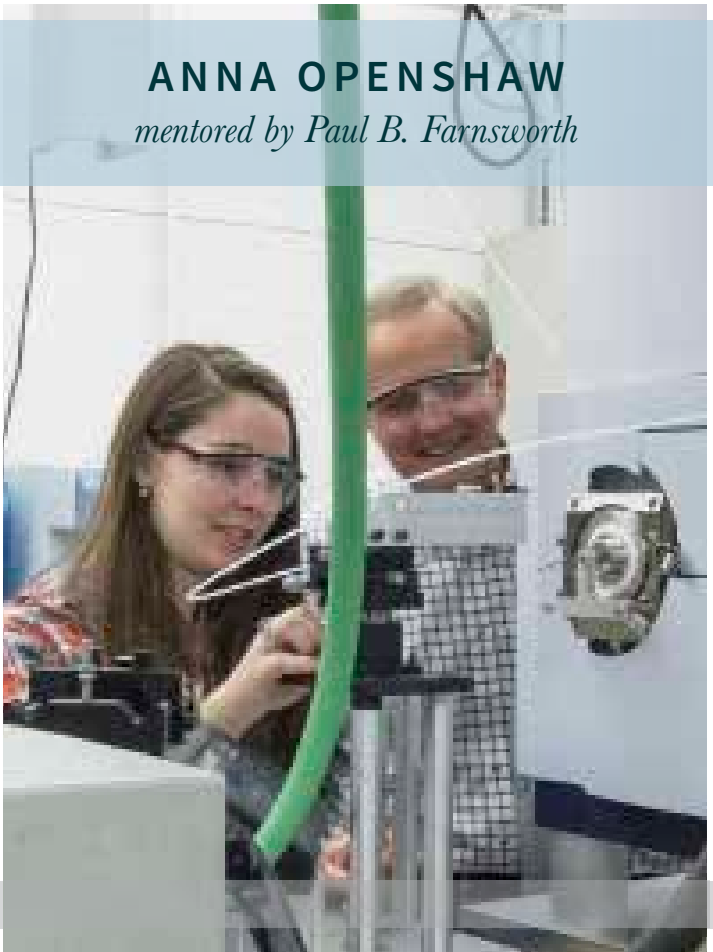


In Dr. Richard K. Watt's lab this semester, we conducted research to further elucidate the mechanism of loading Fe(III) into transferrin. In diseases of inflammation, free iron is found in the bloodstream and causes oxidative stress. Transferrin is an iron transport protein that normally binds iron very tightly and prevents oxidative stress. Our goal is to identify molecules that will assist transferrin in binding iron during inflammation to prevent oxidative stress. Specifically, we have analyzed the effects of deferiprone (an iron-chelating pharmaceutical drug) on transferrin loading to determine if it could be used as a facilitator of iron loading. Transferrin absorbs light at 460 nm when iron is bound. As such, this absorbance can be used to monitor the iron loading into transferrin over time. The literature suggests that under certain physiological conditions, deferiprone can load iron into transferrin. I have tested several in vitro conditions to evaluate if deferiprone can overcome known inhibitors of iron loading into transferrin. Our work on this matter is still inconclusive. Our spectrophotometric assay is complicated in this case, as the deferiprone-iron complex also absorbs strongly at 460 nm. We have adapted our studies to include native gels that allow us to see if iron is loaded into transferrin. Additionally, we have had encouraging results that suggest that the abundant serum protein, albumin, might assist in transferrin loading.

Written by Jordan Finnell
Photo by Zoie Young

ANNA OPENSHAW

mentored by Paul B. Farnsworth



"Mass Spectrometric Imaging of Spatially Regulated In Vivo Metabolic Rates"

During this past fall semester I have been working on a project involving mass spectrometric imaging under the direction of Dr. Paul B. Farnsworth. The ultimate goal of this project is to create spatial maps of isotope-labeled tissue samples in order to gather information on metabolic rates and establish a more clear understanding of muscle atrophy. These images are created by scanning the tissue samples with a desorption electrospray ionization source. So far, I have built an experimental setup that allows for sample scanning on an X-Y stage. I have successfully established optimal parameters for images of standard dye patterns on photo paper. I have also started imaging unlabeled tissue and am working to adjust the parameters for imaging this type of sample surface. I am also testing the effects of several different solvents on the imaging performance. The next step is to monitor metabolic rates by mapping isotope-labeled tissues.

Written by Anna Openshaw
Photo by Zoie Young

HOLLY LARSON

mentored by Roger G. Harrison

"Detection and Separation of Water Contaminants with Ion Chromatography"

This semester I have continued work in Dr. Roger G. Harrison's lab. We are working on characterizing a molecule that contains a resorcinarene cavitand and glutamic acids that I synthesized in past semesters. While NMR is a common method used to characterize these organic compounds, the proton NMR of this molecule showed unexpected broadening of peaks and very weak signals at low concentrations. This semester I conducted binding studies using UV-vis spectroscopy to show that the molecules bind to contaminants. I checked the binding capacity of our cavitand with contaminants on the EPA's list of contaminants of emerging concern. From the UV-vis data I obtained, I calculated binding constants and found that guanidine binds the strongest and cimetidine the weakest (K's, M-1): guanidine (76,000), 1,1-dimethylbiguanidide (36,000), methyl guanidine (24,000), agmatine (5100), and cimetidine (4300).

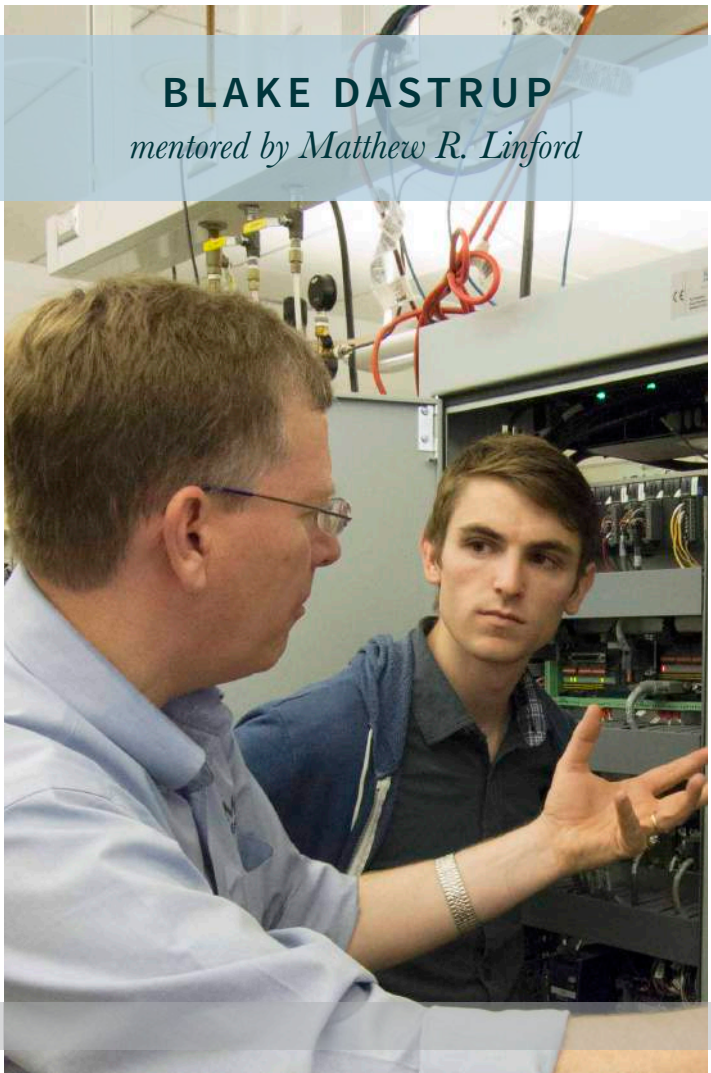
The resorcinarene molecules containing glutamic acids will now be put into columns and used to separate water contaminants. In doing this we will develop a new method for separating and detecting pharmaceutical contaminants in water, which will lead to cleaner drinking water.

Written by Holly Larson
Photo by Zoie Young

BLAKE DASTRUP

mentored by Matthew R. Linford

"Fabricating Nanoscale Semiconductors for Permanent Data Storage"



The project I worked on this semester with Dr. Matthew R. Linford was computer modeling of heat transfer in nanoscale fuses. The project involves fabrication of nanoscale fuses made from thin films (20 nm) of sp2 hybridized carbon. These fuses are meant to be the fundamental components of memory storage devices which have extraordinarily long lifetimes (~1000 years). The goal of the computer modeling project is to create a model which predicts the amount of heat given off by each fuse in the time it takes for the fuse to blow under an applied voltage. The software used is COMSOL Multiphysics with the joule heating module. The utility of such a model will be to predict how the blowing of a large number of fuses at one time will affect the integrity of any kind of passivation layer in contact with the fuses, as well as how the blowing of one fuse may affect adjacent fuses thermodynamically. The outcome to this point is a basic computer model which accurately predicts heat dissipation under steady state conditions.

Written by Blake Dastrup
Photo by Zoie Young

AWARDS AND RECOGNITION

Reed M. Izatt & James J. Christensen Faculty Excellence in Research Award

On November 13, 2014, Dr. David V. Dearden was presented with the Reed M. Izatt & James J. Christensen Faculty Excellence in Research Award. After receiving the award, he presented a lecture titled "Supramolecular Chemistry in the Gas Phase."

The founders of the award, Reed M. Izatt and the late James J. Christensen, worked together at BYU for many years, and Izatt, who was Dearden's mentor during his undergraduate studies at BYU, presented the award. Dearden is the author or co-author of over 60 peer-reviewed publications and more than 170 scientific presentations. He is the 1993 winner of the National Science Foundation Young Investigator Award and has been awarded a BYU Alcuin Fellowship (for teaching in undergraduate general education) twice. Dearden is currently investigating the structure and reactivity of host-guest complexes of cucurbit[n]urils, pumpkin-shaped molecules that can function as some of the smallest imaginable containers for atoms and small molecules. His area of study also involves new methods for obtaining ion-neutral collision cross sections using Fourier transform ion cyclotron resonance mass spectrometry.

Adam Woolley Receives Maeser Award for Research

Dr. Adam T. Woolley, who has taught in the BYU Department of Chemistry and Biochemistry for 14 years, was awarded the Karl G. Maeser Research and Creative Arts Award at the Annual University Conference on August 26, 2014 in the Marriott Center. Woolley received his BS in chemistry from BYU in 1992 and his PhD in chemistry from the University of California in 1997. Woolley was awarded the Young Scholar award in 2008 and was appointed associate chair of the Department of Chemistry and Biochemistry in 2010. While Woolley is committed to his responsibilities in teaching and administration, he always leaves time on his schedule for research. Currently, his research focuses on miniaturization of chemical analysis tools. In that research, he and his team work in three areas.

"One of [the projects] is a really simple low-cost diagnostic that could be used in the field, third-world countries, and resource-limited environments," Woolley said. "Our goal with [the second system] is to be able to take a small blood sample—just a drop—and be able to take certain components of the blood and figure out how much of those components are in the sample. [With the third project] we've done a lot of work using DNA as a scaffold to make small things. In particular, we've been interested in making wires and semi-conductors, and those are kind of the nuts and bolts of integrated circuits."

Written by Mackenzie Brown, CPMS

Steven Graves Honored for Excellent Teaching

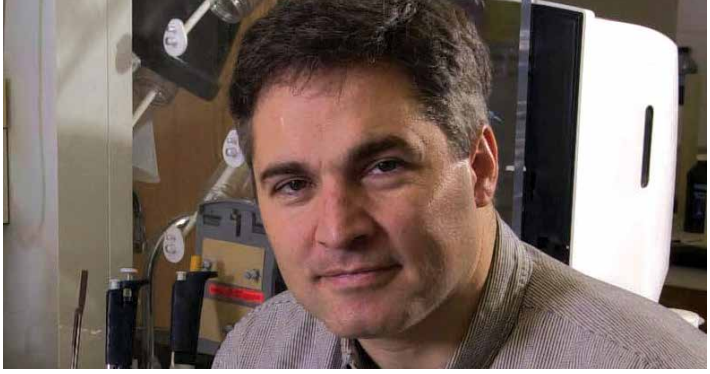
Dr. Steven W. Graves was honored at the BYU Annual University Conference on August 26, 2014, with the Maeser Excellence in Teaching award.

"I was very surprised," Graves said. "I had no idea that I was even under consideration. I am still very surprised!" When Graves first started teaching at BYU, he wasn't sure what to expect. Coming from his position as a researcher in charge of a clinical lab, he didn't have a lot of teaching experience and the learning curve was steep. However, he quickly picked up the necessary skills for teaching and soon taught both chemistry and biochemistry courses.

"Teaching becomes a living and learning experience," he explained. Today, one of his favorite parts of the job is showing students how amazing living processes are.

"We are trying to instill in students a curiosity and a need to understand their environment and the world around them," Graves said. "And as [the teaching process] goes on, the students start to say, 'Wait, I mean, this is crazy! This is so complex and so intricate!' And I say, 'Yes. You are starting to get it.'"

Written by Mackenzie Brown, CPMS



Barry Willardson Receives Award for Graduate Education

Dr. Barry M. Willardson and his team of students focus their research on how cells assemble their proteins into signaling complexes. This research was recently featured in the Journal of Biological Chemistry for the discovery of the Programmed Cell Death Protein 5 (PCDP5) as a potential tumor suppressor. For his effective and dedicated methods to graduate mentoring, Willardson was honored with the Wesley P. Lloyd Award for Distinction in Graduate Education at the BYU Annual University Conference held August 26, 2014.

Willardson has taught and researched at BYU for over 18 years, working with numerous undergraduate and graduate students. When Willardson was a graduate student he had a mentor who greatly helped him along his path, and now he enjoys returning the favor to the students he works with.

"You become good colleagues and good friends," Willardson said. "It's really a very enjoyable interaction, and I hate the student turnover. It's tough to see them leave."

Written by Mackenzie Brown, CPMS

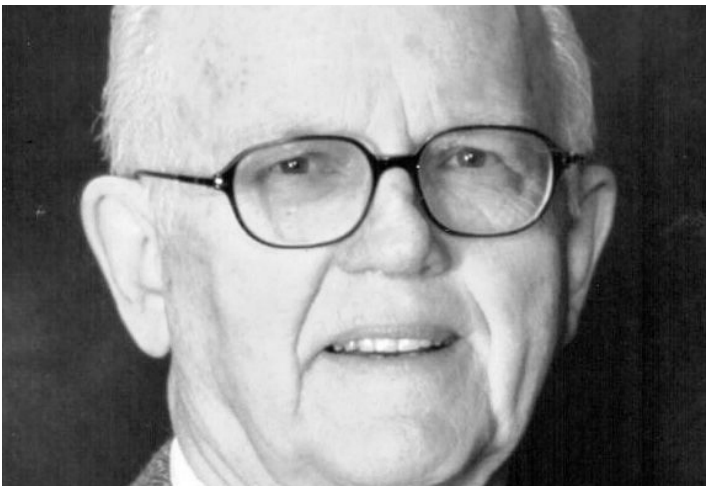
Randy Shirts Retires

Dr. Randall Shirts started his freshman year at BYU as a National Merit Scholar. He was a research assistant for Dr. J. Rex Goates and Dr. J. Bevan Ott, and was named CPMS valedictorian when he graduated in just three years. Shirts' graduate research at Harvard involved theoretical modeling of gas phase reaction dynamics and solar cells. His postdoc at the University of Colorado focused on semiclassical quantization of chaotic vibrations. Before coming to BYU, Shirts worked at Georgetown University, the University of Utah, and the Idaho National Engineering Laboratory. Shirts taught quantum or statistical mechanics to six future faculty members at BYU and taught several others in undergraduate courses. He served as the Y-Chem Society advisor, the ACS Central Utah Section Chair, the Department Honors Advisor, and the Chair of the University Forum Committee. He offered the computer program Boltzmann 3D as a free download, which is now used all over the world to demonstrate principles of kinetic theory.

EDWARD G. PAUL

1931-2014

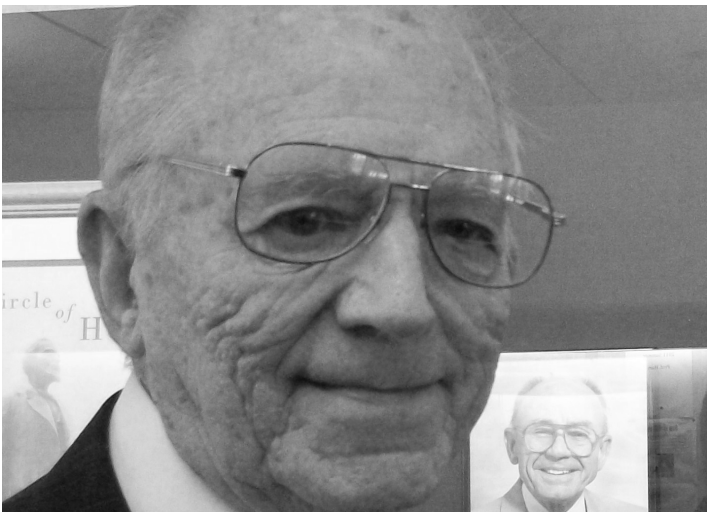
Dr. Edward G. Paul was reunited with his sweetheart, Irene, on August 29, 2014. Paul grew up in Salt Lake City, Utah, and received both his BS in chemistry and his PhD in organic chemistry from the University of Utah. He accepted an appointment as a BYU professor in 1965 and taught the "beauties" of chemistry to nursing and pre-med students, always wearing his signature bow tie. He shared his love of science with the people he served—his family, his students, his community, and the LDS church.



J. BEVAN OTT

1934-2015

Dr. J. Bevan Ott passed away March 27, 2015. Ott received his bachelor's degree from BYU and later returned to teach physical chemistry. He mentored many BYU professors, current and emeritus, including Adam Woolley and Brian Woodfield. Ott spent several years at BYU as chair of the Department of Chemistry and also served as BYU's associate academic vice president over research. Ott married his childhood sweetheart, RaNae, and the couple had six children. After retirement from BYU he served in the Timpanogos LDS Temple for 13 years.



JAMES REX GOATES

1920-2014

Dr. James Rex Goates passed away at the age of 94 on November 28, 2014. Goates returned from infantry service in WWII to earn a PhD in chemistry from the University of Wisconsin. Over the course of his teaching career at BYU, Goates co-authored more than 70 research publications and two books. He served as the chair of the Department of Chemistry and also as dean of the College of Physical and Mathematical Sciences. His wife, Marcia, was also a member of BYU faculty. Their son, Dr. Steven R. Goates, teaches in the Department of Chemistry and Biochemistry today.

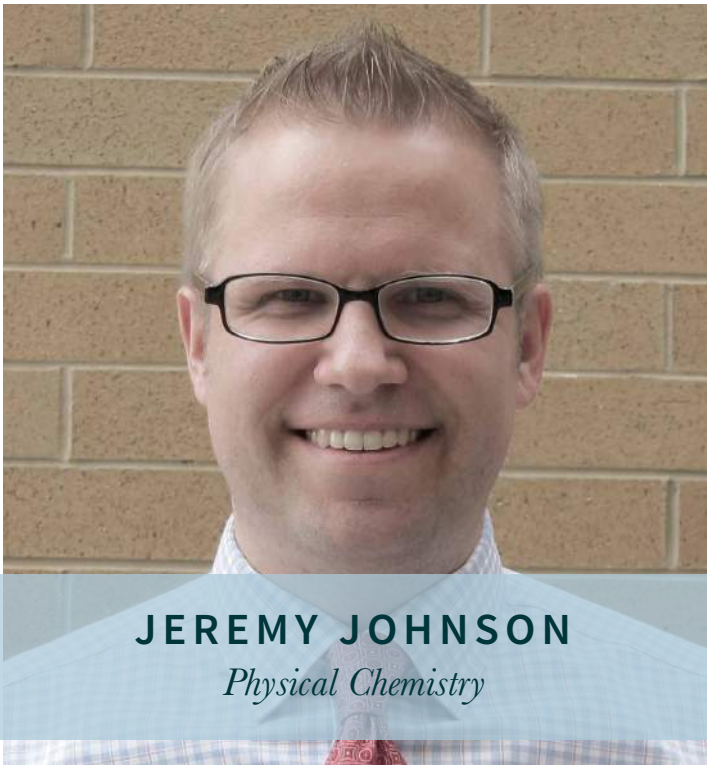
LAWRENCE J. DUNGAN

1959-2015

Lawrence "Larry" Dungan passed away February 1, 2015, after a hard battle with ALS. The BYU alumnus accepted a job managing the Chemistry Central Stockroom in 2011 and was diagnosed in early 2012. Though the disease eventually took his mobility, he became a service missionary for the LDS church, answering emails to questions submitted to LDS.org. He is survived by his wife Lisa and their three children.

RECENTLY DEPARTED

NEW FACULTY



JEREMY JOHNSON

Physical Chemistry

Dr. Jeremy A. Johnson earned his undergraduate degree from BYU, where he researched with Dr. Eric T. Sevy and was first introduced to laser spectroscopy. He graduated in 2006 with a BS in chemistry and then headed to the Massachusetts Institute of Technology (MIT) for his doctoral studies.

After Johnson earned his PhD in 2011, he secured a postdoctoral research position at the Paul Scherrer Institute in Switzerland. Three years and two children later, the family moved back to Provo after exciting scientific research, travels throughout the continent, and a three-month research opportunity at the Yokohama National University in Japan.

"I hadn't thought that I would necessarily come back here," said Johnson, "but things worked together and just worked out, and now I'm super excited to be here and be in the department. We're definitely going to do a lot of cool science here."

Johnson teaches physical chemistry and continues to research spectroscopy. He specializes in terahertz spectroscopy, a relatively new research area that has applications in the study of everything from semiconductors to proteins.

Written by Jennifer Johnson, CPMS

KARA STOWERS

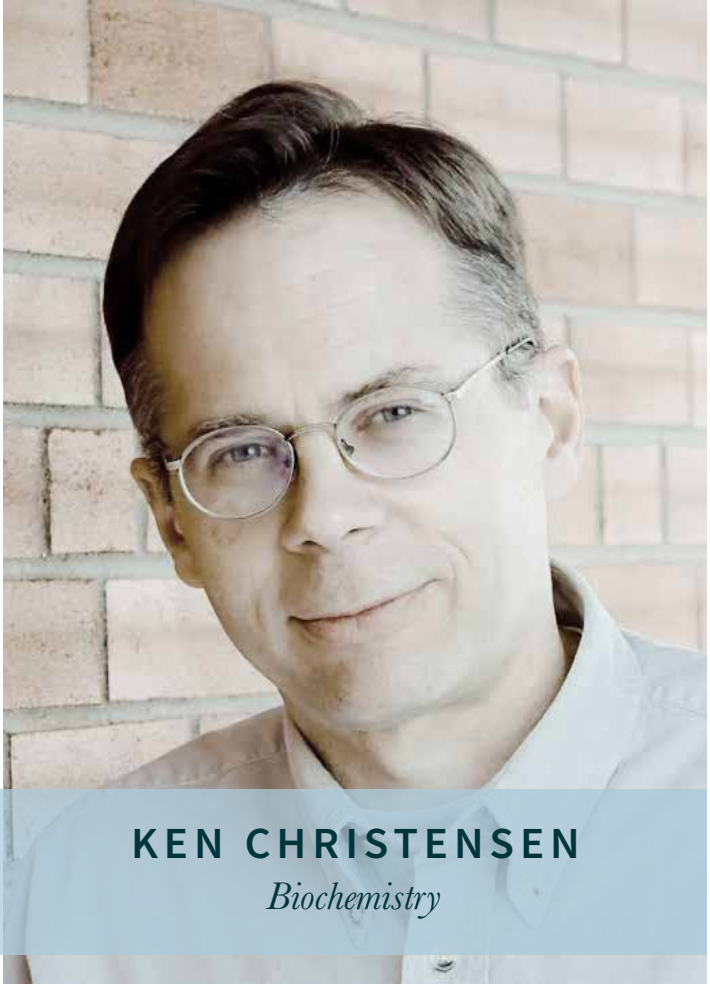
Inorganic Chemistry

"It's a unique opportunity when you can come to a new place and feel so welcome," said Dr. Kara Stowers about her new career at BYU. "The idea of coming into a department that felt so cohesive and felt so collaborative was really very unique and very exciting to me—that I would have not only motivated students but also very supportive colleagues."

Stowers received her double undergrad degree in chemistry and chemical engineering from the University of Utah in May of 2006. She went on to attend the University of Michigan and receive her PhD in chemistry in January of 2012. During her time in school, Stowers researched the different aspects of palladium catalysis for small molecule synthesis. As she continued to work with the catalysts, she grew more and more curious about catalyst design and efficiency. Now she plans to research homogeneous and heterogeneous catalysis during her time at BYU.

"Catalysis researchers are usually very divided into heterogeneous and homogeneous [areas of study]," Stowers said. "I want to be able to understand both the homo- and heterogeneous sides of this field."

Written by Mackenzie Brown, CPMS



KEN CHRISTENSEN

Biochemistry

Dr. Kenneth A. Christensen, who joined the department faculty in May, 2015, has a wide range of interests. He is the father of four children, a certified USA Swimming Meet Referee, an experienced hydroponic vegetable grower, and an avid backpacker. He even built his own cedar strip canoe.

Christensen also has a variety of research interests. Trained first as an analytical chemist in Dr. Steve Goates' lab at BYU, he switched his focus to biochemistry after taking a postdoctoral position in the Department of Anatomy and Cell Biology at the University of Michigan Medical School.

"I realized as a postdoc that I really liked biological problems and could use a range of analytical tools to address and answer these compelling problems," he said.

After time at Harvard and at Clemson University, Christensen is back at BYU. His research, which blurs the line between chemistry and biology, makes him a valuable mentor. He plans to give students "training that will equip them to communicate across traditional disciplinary boundaries."

Christensen will be continuing his experiments with anthrax and with African Trypanosomes—the parasites that cause a sleeping sickness spread by tsetse flies. He also hopes to continue his traditional lab potlucks and his backpacking trips.

"While I will miss backpacking in the Appalachians," he admitted, "I am excited to do some backpacking in the West."

Written by Jordan Wright

REBECCA SANSOM

Inorganic Chemistry

Rebecca Sansom received her BA and MA in chemistry from Boston University in 2001 and Harvard University in 2005, respectively. In 2013 she received her Master of Education (MEd) degree from Southern Utah University. Though she originally planned to receive her PhD from Harvard, as she neared the end of her master's program she decided to pursue her passion for teaching instead.

"I wanted to make a difference in people's lives," Sansom said. "Teaching is an opportunity to help people live up to their potential and follow their dreams, gain confidence, and be successful."

She has been teaching ever since. Sansom taught high school in Belmont, Massachusetts, for several years in addition to teaching part-time at Harvard and later taught concurrent enrollment courses at Bingham High School in Utah. Immediately prior to her arrival at BYU, Sansom was serving as an Albert Einstein Distinguished Educator Fellow in the Division of Undergraduate Education at the National Science Foundation, where she worked with programs related to STEM (Science, Technology, Engineering and Math) teacher preparation. At BYU, Sansom plans to use her classroom as ground zero for her research on effective laboratory instruction in chemistry as she redesigns the freshman laboratory course, Chemistry 107. Sansom also hopes to continue making a difference by increasing recruitment and retention of women in STEM majors and by recruiting talented STEM majors to become teachers.

Written by Mackenzie Brown, CPMS

UNDERGRADUATE STUDENT AWARDS

Chemistry Literature Award

Recognizes an outstanding student in Chemistry 391.

ELISE WILSON

Physical Chemistry Award

Recognizes an outstanding student in the Physical Chemistry 462/463 sequence.

JEFFERSON TYLER

Analytical Chemistry Award

Recognizes an outstanding student in the Analytical Chemistry 521/523 sequence.

CHARLOTTE REININGER

Eliot A. Butler Service Award

Recognizes a student who has provided significant service to the department while maintaining a high performance in course work and professional activities. This award is named in honor of Eliot A. Butler, who was a former professor, chair, dean and associate vice president.

TAMARA CASSINAT

Student Research Conference (SRC) Session Winners

SWATI ANAND, COURTNEY BANKS, DAVID BROADBENT, WADE ELLIS, MARSHALL HUTCHINGS, HOLLY LARSON, ZHIWEI MA, TAYYEBEH PANAHI, CHARLOTTE REININGER, MUKUL SONKER, YING ZHANG

ACS Analytical Chemistry Junior Award

JOSH WOODS

Hypercube Scholar Award

Recognizes an outstanding student in the 105/106/107 sequence.

DAVID PANEK

Biochemistry Award

Recognizes an outstanding student in the Biochemistry 481M/482M sequence.

NICOLE TENSMEYER

Inorganic Chemistry Award

Recognizes an outstanding student in the Inorganic Chemistry 514/518 sequence.

BENJAMIN KAY

Organic Chemistry Award

Recognizes an outstanding student in the Organic Chemistry 351M/352M (majors) sequence and an outstanding student in the 351/352 sequence (non-majors).

KYLE GASHLER
OLIVER MOORE

SRC Outstanding Undergraduate Presenters

DUSTIN BRODERICK, JOHN JENSEN, GIDEON LOGAN, MICHAEL PORTER, ZACHARY PRIBYL, JACOB SHANER, SPENCER WALLENTINE, BRIELLE WOOLSEY

Keith P. Anderson Outstanding Graduating Senior

Recognizes outstanding graduating senior(s) for overall scholarship and professionalism and classroom performance. This award is named in honor of Keith P. Anderson, a physical chemist who taught at BYU for more than 35 years.

CHARLOTTE REININGER

Catalyst Club Award

Recognizes an outstanding junior female student in chemistry or biochemistry. This award is sponsored by the Catalyst Club, an association of women who were current or emeritus members of the department or spouses of current or emeritus members.

ANNA OPENSHAW

Freshman Chemistry Award

Recognizes an outstanding student in the General Chemistry 111/112 (majors) sequence and an outstanding student in the 105/106/107 sequence (non-majors).

JACOB SHANER
ANDREW NELSON
JACOB MABEY (NON-MAJOR)

GRADUATE STUDENT AWARDS

Telford & Frank Woolley Memorial Research Award

Recognizes outstanding students who are conducting significant research in cancer or in other health-related areas. This award is named in honor of Telford Woolley, a physician who passed away prematurely due to cancer. When his father died, his name was added to the award.

JEFF MORTENSEN

Garth L. Lee Award

Recognizes an outstanding continuing graduate student for religious commitment, service and scholarship. This fellowship is named in honor of Professor Garth L. Lee, who was a professor of chemistry at Utah State University for many years.

SARA MATA

Outstanding Graduating MS Student

ANDREW MATHIS

Outstanding Graduating Ph.D. Student

SONIKA SHARMA
ZHIWEI MA
CHAD ROGERS

GRADUATE RESEARCH FELLOWSHIPS

J. Rex and Marcia A. Goates Fellowship

Recognizes an advanced chemistry graduate student for outstanding scholarship and achievement in research. This award is named in honor of J. Rex and Marcia A. Goates. Dr. Rex Goates served as department chair and dean of the college and was a Maeser Distinguished Faculty Lecturer. The award has been renamed to honor him and his wife. Dr. Rex Goates is the father of Dr. Steven Goates.

HUAN KANG
SHAWN AVERETT

Charles E. & Margaret P. Maw Fellowship

Recognizes an advanced chemistry graduate student for outstanding scholarship and achievement in research. This award is named in honor of Charles E. Maw who was the founding chair of what became the BYU Department of Chemistry and his wife, Margaret.

PAUL LAWRENCE

Bradshaw Organic Chemistry Fellowship

Recognizes an advanced organic chemistry graduate student for scholarship and achievement in research. This award is named in honor of Jerald S. Bradshaw, an outstanding emeritus faculty member.

YU CAI

Roland K. Robins Fellowships

Recognizes outstanding graduate students for outstanding scholarship and promise in research. These awards were created to honor Dr. Roland K. Robins, who was world-renowned for his creativity and activity in the syntheses of new medicinal compounds.

TAYYEBEH PANAHI, BHUPINDER SINGH
WHITNEY WALKER, BRADLEY NAYLOR
YUBO LI, TAKUMA AOBA, VAJIRA WEERASEKARA

GIVE BACK

Alumni & Friends Bless Lives by Giving Back!

We need your help and generosity for:

- Scholarships
- Mentorships
- Graduate stipends

Every student at BYU has excellent credentials or they wouldn't be here. The chemistry and biochemistry majors are impressive. They are some of the brightest and best. However, many times a scholarship, a mentorship (paying a student as they work in a lab with a professor), or a stipend makes the difference of whether or not a student will be able to, first of all, be here at all, and secondly, succeed.

Please help by giving back in a way appropriate for your circumstances. You may very well make the difference in someone's life.

You can give by:

1. Sending a check made out to BYU with instructions that it is for the Department of Chemistry and Biochemistry
2. Calling and giving a gift with a credit card
3. Listing the department in your will or trust
4. Wiring a gift from your brokerage (call for instructions)

(Appreciated assets are an excellent giving vehicle for tax purposes.)

Send checks to:
BYU, Attn: Brent Hall, N181 ESC,
Provo, Utah 84604

For additional info or credit card gifts, call:
801-422-4501

Thank you!

How Your Donations Help

Working in the lab of Dr. Farnsworth, I analyze different mass spectrometric ionization sources using atomic absorption spectroscopy and emission spectroscopy. I determined the densities and distributions of helium metastable atoms in four different helium-based ambient desorption and ionization sources using atomic absorption spectroscopy. I am currently taking emission spectra of these same four ionization sources.

In March of 2014, I was selected as a national Barry M. Goldwater scholar, which is an award that recognizes highly qualified scientists, mathematicians, and engineers who intend to pursue research careers. Without the opportunity to work closely with Dr. Farnsworth in his research lab, I would not have been qualified to apply, nor would I have had the enthusiasm and desire to pursue a career in research.

I would like to sincerely express my appreciation for the generous donations you have made to the BYU mentored research program. I am most grateful for the experience I have had to work closely with Dr. Farnsworth to learn the research process and to gain experience in the lab before continuing to graduate school to earn a PhD in analytical chemistry. I have thoroughly enjoyed the opportunity to research as an undergraduate student, and this opportunity with research has been the main influence for me to continue a career in research in graduate school.

Thank you,
Charlotte Reininger

2015

HOMECOMING EVENTS

Please mark your calendars and plan to renew your friendships in the department at our homecoming activities as follows:

DEPARTMENT OF *Chemistry & Biochemistry* ACTIVITIES

October 9th

6:00 *pm*	RECEPTION
6:30 *pm*	DINNER
7:30 *pm*	AWARD PRESENTATION AND SPEAKER

BRIGHAM YOUNG *University* ACTIVITIES

October 10th

8:30 *am*	PANCAKE BREAKFAST
10:30 *am*	PARADE
TBA	FOOTBALL GAME VS. EAST CAROLINA

Below is a reservation form for the Department Homecoming activities. Please mail your reservation form to: Homecoming, Department of Chemistry and Biochemistry C-104 BNSN, Brigham Young University, Provo, Utah 84602, or email marcia@chem.byu.edu.

I PLAN TO ATTEND:

Reception & Dinner
Friday, October 9, 6:00 pm
Reserved Seating

YES ☐ NO ☐

Number Attending _____

Number who are BYU Alumni _____
(Please include yourself in both totals.)

Name: _____

Address: _____

City, State, Zip: _____

e-mail: _____

Contact telephone: _____

PLEASE RSVP NO LATER THAN SEPTEMBER 28

CHEMIGRAM

THE NEWSLETTER FOR BYU'S

Department of Chemistry and Biochemistry

2015