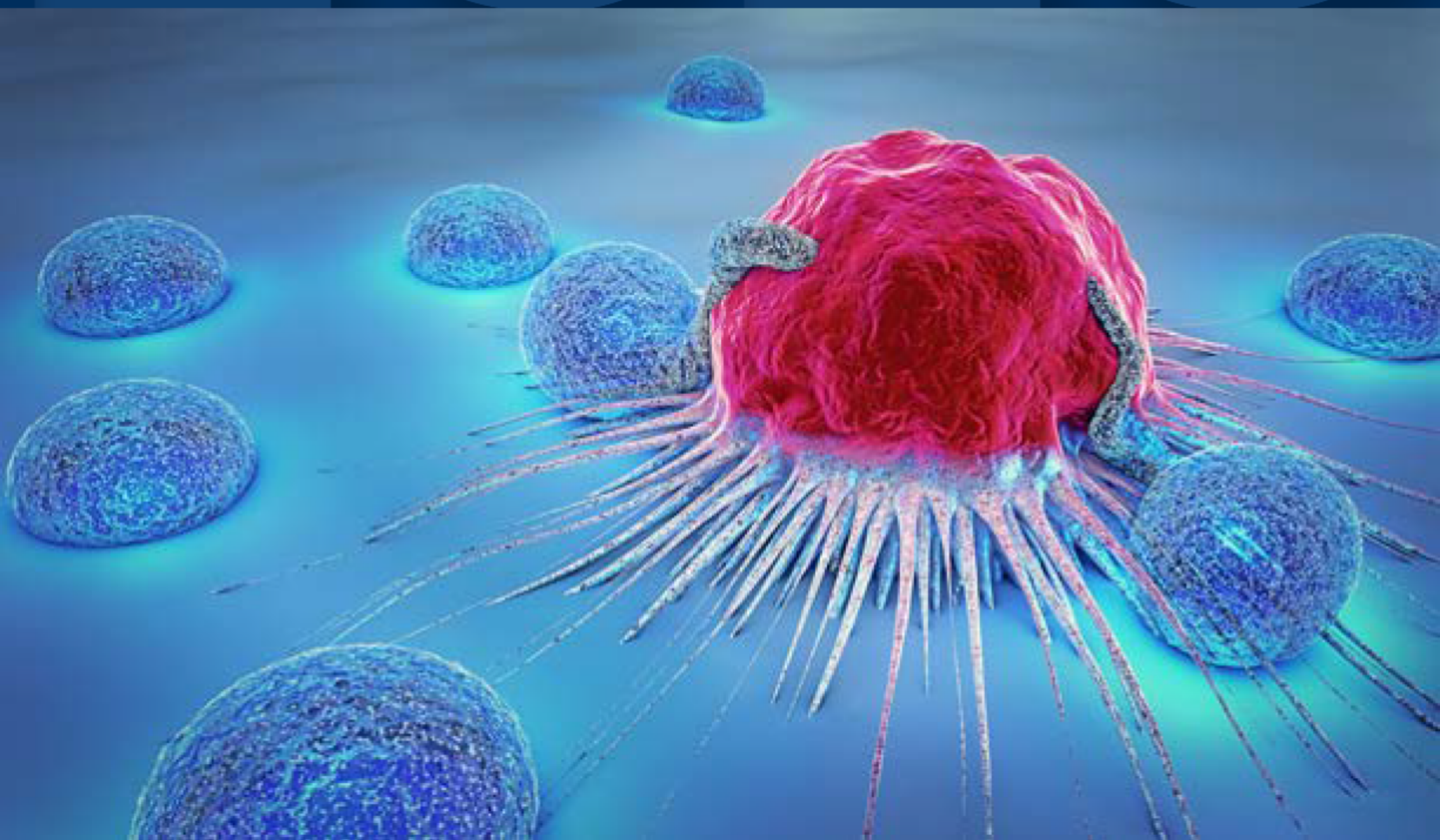
CHEMIGRAM

BYU Chemistry & Biochemistry

2023



THE HEALING POWER OF CHEMISTRY

Letter From the Chair

Sir Roger Gilbert Bannister, an English junior doctor in 1954, had already showcased his potential in athletics two years prior at the 1952 Helsinki Olympics, where he set a British record in the 1500 meters. Inspired by his success in the Olympics, Bannister set an ambitious goal to become the first athlete to complete a mile in under 4 minutes. Accompanied by pace setters Chris Chataway and Chris Brasher, he accomplished this feat on May 6, 1954, at the Iffley Road track in Oxford, with an official time of 3 minutes and 59.4 seconds.

As a young man, I distinctly recall learning about Roger Bannister's remarkable achievement. However, the most captivating aspect of this story was what unfolded just 46 days later. John Landy, an Australian runner, broke Bannister's record by completing the mile in 3 minutes and 58 seconds. Intriguingly, within a year, three runners managed to surpass the four-minute mile barrier in a single race.

Breaking the 4-minute mile record was an extraordinary achievement that seemed unattainable to the world. However, once the record was shattered, it was rapidly surpassed or equaled by others. Similarly, inspired by Bannister's ambitious aspirations, our department, with the support of the Department of Chemistry and Biochemistry's advisory committee, has established a set of ambitious goals. Among these objectives, two stand out:

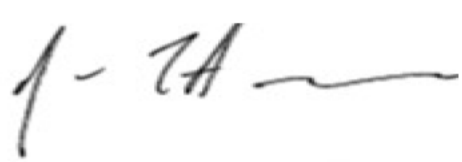
(1) Enhancing job opportunities for both our undergraduate and graduate students, and

(2) Bolstering the department's financial resources to further enrich mentored learning experiences.

Research indicates that offering internship opportunities to students is among the most effective methods of enhancing job prospects. National data reveals that 70% of interns secure employment within the same company where they interned, and former interns are 15% less likely to experience unemployment while earning 6% more than their counterparts without internship experience. To address our first goal, our strategic plan involves collaborating with our college's Career Services representative and leveraging the strengths of our alumni network to provide internship opportunities.

Furthermore, we have initiated a fundraising campaign, supported by LDS Philanthropies and the Dean's office for our college, to strengthen the department's financial resources and enrich mentored learning experiences. This endeavor has already yielded positive outcomes, as we received a generous donation of $1 million from Dr. Phil Low and his wife, Joan.

In this edition of the Chemigram, we are excited to showcase the outstanding skill and dedication of our faculty, staff, and students, who have made impressive progress in fulfilling both the university's and our department's mission and vision. We will explore their remarkable achievements and explore ways in which we can collectively contribute to the attainment of our ambitious goals 1 and 2. Moreover, we are actively working towards the realization of our visionary aspiration to become an exceptional university and department. Roger Bannister demonstrated that achieving the impossible is possible; we are determined to do the same.



CONTENT

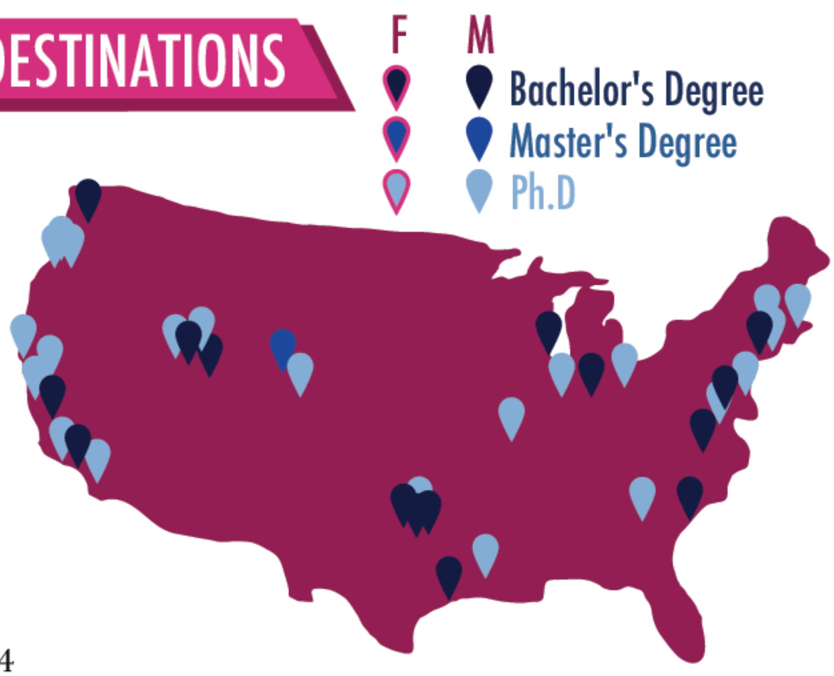
Publisher: Jaron Hansen
Editors: Sue Mortensen & Valerie Rees Maker
Content Writer: Emily Smith
Graphic Designer: Sydney Wride

2022 at a Glance

16,651
students served, for a total of
81,809
student credit hours taught

75 DEGREES AWARDED

DESTINATIONS



$4.7
million+ in research funding

301
students participating in undergraduate research

121,733
total hours of research

113
TOTAL PUBLICATIONS

81 publications with student co-authors

210 total student co-authors

TAKE THE OPPORTUNITY TO

GIVE

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Donor funds this year made it possible for us to award:

$138,000+ in undergraduate scholarship to 68 majors
$267,000+ in graduate research fellowships to 41 grad students
$30,000+ in student travel for research presentations at academic conferences across the nation
$40,000+ in undergraduate research awards

Your expression of confidence in the upcoming generation is represented in the dollars you give... and every dollar makes a difference. You have changed lives, boosted a student struggling financially, and celebrated learning. We extend our heartfelt thanks to each and every one of you.

When you consider giving opportunities, we hope you will keep us in mind. It will make a difference in the lives of the students... and in you. Please contact us with any questions you have regarding your philanthropic gift.

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BYU Philanthropies

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The Healing Power of CHEMISTRY

For students at the BYU Department of Chemistry and Biochemistry, healing is a multidimensional concept. It includes stewardship, cultivation, nurturing, and bringing relief - to people and planet, water and air, body and soul.

Healing People Through Chemical Research

Yujin Kwon, BYU graduate student and recipient of the 2022 Daniel L. Simmons Fellowship, is an accomplished chemist who wants to make the world a better place. A member of the Willardson Research Lab, Kwon specializes in cellular complexes - particularly Gβ proteins - and recently graduated with her PhD.

As part of the Barry M. Willardson Research Lab, Kwon says, "Our lab is mainly focusing on chaperonin-mediated proteins folding. So, just to simply explain it, proteins will be transmitted from DNA and mRNA, and then they have to be able to function in cells properly." The function of these proteins is crucial in maintaining cell health, signaling cellular death, and other functions that are necessary for the function of biological systems. "But," Kwon says, "a lot of proteins need to get folded and structured properly before they actually go work in cells. Most of them need some help from another chaperonin complex, so we are trying to figure out how the chaperone helps the proteins to be folded; how they maintain the protein balance in cells; and how they avoid protein aggregation," which is a major aspect of avoiding cancers and other degenerative diseases. Kwon and her team, under the direction of Dr. Willardson, are working to understand how CCT, a main Gβ protein chaperone, and its mechanisms function in folding and stabilizing substrates.

When asked how her current research relates to her dreams of working in the medical field, Kwon is optimistic about the Willardson Lab's impact on the molecular foundations of medicine. Their most recent research, a study a long time in the making which was published in the spring of 2023, has the potential to help drug manufacturers and scientists discover more effective ways to treat various types of cancer and neurogenetic diseases. The mechanisms of CCT in folding Gβ proteins has always been a bit of a mystery; until now. "I'm very excited about it," Kwon says. "Through this publication, we will be able to understand better. If you are able to see how Gβ protein is folded and how it's inappropriately functioned or folded, we will be able to think of a mechanism to target this specific interaction. If we can just break it down in cancer cells, it will be a pretty big idea for cancer [treatment and prevention]. That'll be a huge publication for the lab; not only just for myself, but the lab and Dr. Willardson. I think that it will be a really great achievement."

Since this interview, Kwon has graduated with a PhD in biochemistry and now works as a BioTech Technial Account Manager CRO with Sino Biological, Inc.

Healing the Earth

Callum Flowerday of the Hansen Research Group, which specializes in atmospheric analysis, is one of these students. An analytical chemist, Flowerday spends his hours constructing instruments to effectively measure atmospheric conditions and track their progression, retrieving data that can be given to local lawmakers as they make decisions regarding air quality and pollution legislation.

"We have a few little calibration projects, but our big project is we're designing a new instrument that can detect molecules in the atmosphere. It's got a broadband cavity and high absorption spectrometer, so a broadband cavity-enhanced absorption spectroscopy. It has two highly reflective mirrors, and we have a light source that permeates through the back of the first mirror and bounces back and forth…that increases our path length, and the longer the path length, the lower your detection limit by Beer's law." Flowerday says this kind of technology is particularly useful in recognizing OH and hydroxyl radicals, also serving as a pollutant–particularly ozone precursor–detector.

According to Flowerday, this kind of instrument is a rarity. "Other instruments often draw in a sample and measure what's in it, but in drawing in a sample, it's longer than the life of the molecule. So, it's usually reacted out by the time [the instrument] gets to it."

In comparison, Flowerday's in situ technique allows the machine to rapidly process atmospheric samples to quickly and accurately measure pollutants before they expire. "No one else in the world has done this yet. There've been two other groups who have been able to measure it, [but] they're not exactly portable. So, they don't really use them, can't really use them for field campaigns. And so, mine is two little tripods. I put them five meters apart and there's a pretty powerful little light source, and my collection optics are just a little bit bigger than [a] microwave. It's pretty portable, you could pack that into a truck. So, that's really exciting, because once we've done that, we can actually do site-specific measurements rather than back calculation."

This kind of research has limitless applications. "We have a pretty bad ozone problem along the Wasatch Front," Flowerday says. "I have several projects right now, and we're going to apply [this technique] to other species, like formaldehyde…and glyoxal. Those are two of the volatile organic compounds that get oxidized [and] end up making ozone." Using his instrument, Flowerday can collect ratios of atmospheric formaldehyde and glyoxal to determine their source. "So, for example, Louisiana and Alabama have pretty high glyoxal standards because they're luscious, green areas, right? Usually in Utah, we tend to have higher formaldehyde levels, which is more of the industrial stuff. Knowing those two ratios, we could give this information to legislature, for example, which we hope to do after this project." Flowerday and his colleagues have used this information to investigate claims of increased arsenic dust in the Great Salt Lake, detect large refinery sources of excess pollution, and predict potential ozone development in the atmosphere.

However, Flowerday knows that issues of atmosphere, environment, and pollution are complicated territory. "It gets a little controversial, that's what I'm learning. If you go tell some oil refinery, 'You're polluting the environment,' well, you're kind of taking away some of their money, right? Obviously refineries and pollution are the one extreme, and scientists are the other extreme." As an analytical chemist, though, Flowerday recognizes the importance of his role in helping find middle ground in polarized issues. "There has to be someone in the middle who makes the decisions. Fortunately, I'm not that guy! I just have to provide the data…but, I think there is a middle ground, and there should be a middle ground." This technology, aside from helping activists, corporations, and the legislature find balance in pollutant regulation, will help scientists and industrialists better cultivate environmental welfare, mending rifts and providing healing relief to compromised ecosystems.

These instruments don't just affect communities and nations; it's also had a personal effect on Flowerday himself. As a member of The Church of Jesus Christ of Latter-day Saints, Flowerday says that the combination of scientific inquiry and religious faith provide unique opportunities for him to make a difference in his family, community, and on an international scale."There's some kind of…behavior, the way we conduct ourselves as religious scientists…science means something. It's not just as much as, 'Oh yeah, respect me. I've done something pretty cool.' There's always an application to humankind. It's not just knowledge for knowledge's sake; sometimes it's nice to think about where the knowledge is coming from, and to take those principles and apply them in our families, and when we talk to non-members or people at conferences, other scientists. It's pretty cool to have the perspective of religion and science together, rather than just having them one by one."

Healing the Water

It's not just air pollution that's being targeted by BYU students. Emmanuel Agbata, B.S., is a current master's student at Brigham Young University studying inorganic chemistry under the direction of Dr. Kara Stowers. With an undergraduate degree from the University of Benin in Nigeria, Agbata is passionate about making the world–and it's water, in particular–cleaner.

Agbata and his associates have been experimenting with the creation of MOFs, or Metal Organic Frameworks. Using a variety of transition metals such as copper or zinc, Agbata explains, "we make a…highly crystalline structure that is made of a metal center… coordinated to ligands. Ligands are organic molecules, like dicarboxylic acid and a host of others." Agbata and his fellows use these ligands, metal precursors such as zinc salts, and create MOF materials at room temperature and pressure.

Why are MOFS important? Agbata understands the complexity of the process. "So, why do we care about them? They are very porous. They have high spaces in between, and it coordinates to form a very ordered structure. They can be used for chemical sensing. They can be used for gas storage, for sequestering, and for cleaning up the atmosphere. You can use MOFs to reduce the amount of $CO2$ in the environment. So, what my project is about right now is more on the catalysis part." He explains that his current research focuses on creating what he calls "DMCAPZ-MOF5," creating pyrazole ligands to form crystals with zinc. "We make a thin film of this MOF on a substrate. Then, we try to apply them in heterogeneous catalysis. Because of their high porosity and very high surface area (both internally and externally), you can use them as catalysts." He explains that their unique properties are a significant improvement to catalysts already available, thus having the potential to interact with more molecules with increased efficiency.

Agbata and his team are already working on ways to implement this unique catalytic structure. Currently, their studies include using an ultra-high vacuum to eradicate pressure in a small chamber, allowing them to better test and collect reactive results on the surface. They have also been discovering new ways in which this process and MOF technology interacts with ultra violet irradiation using photodegradation. This method may be revolutionary in the future of ecological science.

"We're trying to look at how we can use this MOF as a catalyst to help in breaking down some of the contaminants in water, so it can be used, in this situation, for water purification. You have dead water, you bring these catalysts via the photo degradation process, [and] it breaks down all of the toxins in the water and makes it reasonably pure again."

Contaminated water is a global issue. "You have a bunch of sources where you can get dirty water," Agbata explains, specifically mentioning sewage system networks as a major contributor. His group plans on collecting samples of contaminated water and conducting an in-depth analysis to understand the quantity and quality of bacteria and contaminants. Using MOF photo degradation, his team will reexamine the water samples to determine the elimination percentage. Should his method succeed, this kind of technology can be changed and then applied to be used to clean up airspace with high levels of $CO2$.

"We interact directly with our environment," Agbata says, "and the way our environment is, how our environment affects us, has a way of influencing us, whether adversely or beneficially; that is why we talk a lot about green chemistry, sustainable chemistry. The way that I think my work can affect or help heal the world, heal the people, is by just looking at what MOFs can do for the world. You have this MOF helping with photodegradation with basically detoxifying the water, one of the most important parts of our environment. Then, also, $CO2$ sequestering; it's kind of like cleaning up the atmosphere." And, Agbata reasons, having a healthy planet will lead people to experience healthier, happier lives. "If you have good, clean water, and you have a good atmosphere, people can breathe in good air; we have less toxicity in the environment. I think that's a good way of preventing issues that might come up; it's like a proactive way of healing. When all of this is applied, you don't even have to talk about healing because you're going to be healthy if the result of our research is applied to the world."

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THE BYU EXPERIENCE

Medicine, ecosystems, and the psyche of self – these realms are just a fractional glimpse of the healing that takes place at BYU every day. These remarkable students embody the essence of the BYU Chemistry and Biochemistry experience, an experience that focuses on progress, innovation, awe of life and discovery, and the ways in which every individual can "enter to learn" and "go forth to serve" in profound ways.

Written by Emily Smith

Proteomics and Spectrometry

Ryan T. Kelly, Ph.D, could go by many titles; BYU alum, former Pacific Northwest National Laboratory researcher and technologist, husband, father, and BYU professor and laboratory leader are a few, among many. In the past few years, though, Kelly has also distinguished himself as a trailblazer in the field of single cell mass spectrometry research and entrepreneurship, an emphasis that is starting to gain traction and attention around the world.

"My journey as a scientist goes back to taking some community college classes while I was still a highschool student," Kelly says, speaking of his early interest in chemistry. After enrolling in biology and chemistry classes, Kelly felt inspired to pursue a career that combined his passion for both STEM fields - biochemistry. With additional background and experience in analytical chemistry, Kelly graduated with his Ph.D from Brigham Young University in 2005 and spent the next 13 years working at Pacific Northwest National Laboratory. He joined the BYU Department of Chemistry and Biochemistry as a professor in 2018 and founded the Kelly Lab, which specializes in single cell mass spectrometry research.

Kelly and his students have proven to be global leaders in the single cell mass spectrometry field. "The field of proteomics is [somewhat] analogous to genomics, but [focuses on] profiling the proteins that are being expressed instead of DNA. Proteins are a little bit closer to what we call phenotype; 'genotype' is what your DNA is, 'phenotype' is what you are. Proteins are one of the last stops towards phenotype. They are responsible for the structure in your cells; a lot of the function present in a biological system is due to proteins. They serve as enzymes, signaling molecules, nutrient carriers, and a host of other functions," he explains. "The DNA within an organism is [relatively] the same in every cell in your body from birth to death, but the proteins that are present - you need different proteins in your eye than in your finger. The proteins are highly dynamic, and they are also the molecules that are being targeted by drugs to fight a disease. So, proteins are important and monitoring protein expression is very important."

In monitoring these protein expressions, the Kelly Lab focuses on two questions:

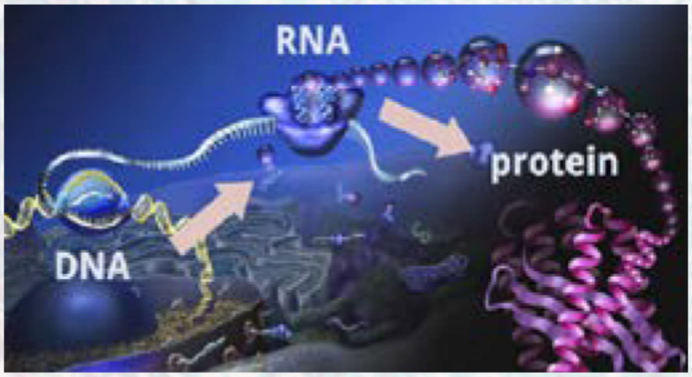
(1) **What proteins are present in a biological system?**

(2) **How much of each of these proteins are present?**

"Identity and quantity, that's kind of everything we do," Kelly states.

While single-cell proteomics is essentially brand new, having taken off in just the last 5 or 6 years, the whole field of proteomics is also relatively young. "This is a field that's been maturing over the last 25 years, but one of the big limitations of it is that you need a large sample. DNA can be amplified, so from a single copy of DNA you can produce millions of identical copies, making it easy to measure. There's no such thing for proteins. Historically, proteomics has required very large samples to get started with - thousands or millions of cells. My research has focused on reducing the sample requirements for proteomics measurements, so [that] now, instead of needing a million cells, we can quantify thousands of proteins from one cell. If you imagine going from a really low-resolution television to a 4k television, you can see the image with a lot greater resolution, and that's kind of what extending proteomics down to the single cell level has done."

The implications of studying single protein cells are immense. "We [don't have to] say, 'Oh what proteins are present in this tumor?' but we can say, 'What proteins are present in each cell of this tumor, and how do they



interact with each other and how do they organize to protect that tumor from the immune system or adapt to chemotherapy?'" The ability to quickly respond to protein idiosyncrasies and have a dynamic view of each cell's proteomic construction has caught the attention of the National Institutes of Health, cancer centers, and researchers with expertise in neurodegenerative health. These institutions collaborate with and financially support the Kelly Lab as they continue to profile protein characteristics that will revolutionize the biomedical community's approach to terminal or fatal diseases. This has already proven true with the nanoPOTS technique, or "Nanodroplet Processing in One pot for Trace Samples, which enables for the first time the in-depth profiling of protein expression from single cells and makes possible high-resolution proteome imaging of tissues."

As if spearheading this research and running the inner workings of a research lab weren't enough, Kelly has also distinguished himself as a chemical entrepreneur. In addition to patenting equipment designed by his lab through BYU, his startup company, MicrOmics Technologies, has garnered attention from the Governor's Office of Economic Opportunity for the State of Utah and received seed funding from the National Cancer Institute. Specializing in single cell mass spectrometry technology, MicrOmics focuses on providing researchers around the world with modern, emphasis-specific equipment that is still new to the market.

About his company, Kelly says, "[We focus on] building robotic systems to feed these prepared single cells into the mass spectrometer. So, it's a robot; it picks things up and separates, analyzes, and we're trying to do it faster and with greater sensitivity than competing systems can do. Some consumables go along with it, like these columns and little special tips, little nozzles that are hard to make."

Kelly's education, research, innovation, and enterprising came to a head this year at the first annual iSCMS seminar, or International Conference on Single Cell Mass Spectrometry. The conference, co-founded by Kelly and his peers from across the globe, held its inaugural proceedings at BYU's Provo campus this October 4th-7th. Future events will circumnavigate the world, with next year's conference slated to be hosted in Denmark and 2025's events likely to take place in Taiwan. "It [originally] was a one-off conference under the umbrella of a national society, and that was one shot deal, [but] it was so successful and built such a nice community that we decided we wanted to continue with the conference on an annual basis," Kelly describes. This conference will provide ongoing opportunities for the brightest minds in single cell mass spectrometry studies to share theories, discuss research, and create connections between a colorful array of backgrounds, cultures, and nationalities.

Despite the constant demands and stressors from such a rich and diverse career, Kelly is optimistic for the future - not only for his conference, business, and research lab, but for the well-being of the students here at BYU. "I just really love interacting with the students; [it] keeps me young. I'm kind of in constant contact with my group all day, and you have these students that really are dedicated and working hard and you're working hard, and you make something great happen together…it's just so rewarding. My students are those hard workers… and towards the end of their time here, you can see how much they've grown." With three of his own children as current students at BYU, Kelly's legacy of learning, research, and innovation is just beginning - and BYU can't wait to see where it takes him.

Written by Emily Smith

Photo Credit: Kyland Ochsenbein

Jason Sorensen, Ph.D.

Jason Sorensen, Ph.D., joined the BYU Faculty during Summer of 2023. From Talent, Oregon, Sorensen received his Bachelor of Science, Chemistry (ACS-Certified) from Southern Oregon University in 2015 and graduated with a PhD in Physical Chemistry from the University of Utah 2021. Upon graduation, Sorenson completed a postdoctoral position at Old Dominion University in Norfolk, Virginia with Peter Bernath, Ph.D. With experience as a wildlife firefighter and river raft guide, Sorenson enjoys hiking, backpacking, camping, and spending time with his wife and four children.

Photo Credit: Kyland Ochsenbein

Kenneth Lee, Ph.D.

Kenneth Lee, PhD., joined the BYU Department of Chemistry and Biochemistry as an assistant professor during the Summer of 2023. He specializes in analytical chemistry and mass spectroscopy instrumentation. From Pleasant Grove, UT, Lee received his undergraduate degree from BYU, where he was recognized on the department's dean's list, received Undergraduate Research Award funding for several years, and met and married his wife after graduating in 2016. Graduating from Purdue University in December 2020 with first and second year graduate fellowship awards, Lee completed a postdoctoral at the University of Wisconsin Madison. Lee is the father of three young children and enjoys playing the piano and violin. He also enjoys playing video and board games with his wife and friends, hiking, camping, and recreational sports.

Photo Credit: BYU Photo

Alison Anderson

Alison Anderson joined the department as a chair's office assistant in September 2022. She attended the University of Utah, BYU Independent Study, and received a medical coding certification at Ensign College. Alison and her husband Eric raised their family of five children in Las Vegas. Her next stop was Los Angeles, where she and Eric worked closely with UCLA Institute students for six years. She was also a paid employee at the Los Angeles Temple, working as lead clerk in the Recorder's Office. After Eric was transferred to UVU Institute, they returned to their roots in Utah. When the opportunity to work at BYU presented itself, Alison jumped at the chance, and is thoroughly enjoying her interaction with the amazing Chemistry and Biochemistry staff, faculty, and students here at BYU. Alison finds joy in the scriptures, temple service, singing, flower gardens, art museums, taking the grandkids on grandma and grandpa dates, working on home improvement projects, and baking artisan sourdough bread.

Dr. Delbert Jay Eatough, emeritus professor of the BYU Department of Chemistry and Biochemistry, passed away on December 16, 2022. A long-time BYU fan, musician, and celebrated chemist, Eatough's contributions to the university and scientific community serve as a lasting legacy that will continue to enrich generations to come.

Born on September 15th, 1940, Eatough spent his early years growing up in Provo, UT. He served as a missionary for The Church of Jesus Christ of Latter-day Saints in the Northern States Mission from 1960 to 1962, during which time he ministered to others and shared his beliefs through music. A member of the Mormon Ten Melody Men and a participant in the "Promised Valley" musical held at the Westhoff Theatre at Illinois State Normal University, Eatough loved his time as a missionary and continued to serve others through music throughout the rest of his life.

Eatough met and married his sweetheart, Judith Mae Pursley, while the two attended Brigham Young University. They had seven children together and currently have ten grandchildren.

Eatough participated in and received several notable awards for his career in analytical chemistry. Earning both his undergraduate and graduate degrees from BYU, Eatough received his education under the direction of revered chemists Dr. Reed M. Izatt and Dr. James J. Christensen. After graduation, he worked for the BYU Thermochemical Institute until it was dissolved, at which time he became an official professor for the Department of Chemistry and Biochemistry. A specialist in calorimetry and air pollution research, Eatough took part in over 400 research publications and held several important positions, including chairman, over both the North American Calorimetry Conference and the Air and Waste Management Association. Additionally, he was a member of the American Chemical Society, Air Pollution Control Association, and American Association for Aerosol Research; he also served as an expertise consultant for the Environmental Protection Agency. With field work taking him across the globe, Eatough spent time gathering data in South America, Africa, Europe, the Middle East, and several national parks throughout the United States of America.

Eatough also received several prestigious awards during his career, including the National Defense Education Act Predoctoral Fellowship, the 2010 A&WMA Frank A. Chambers Excellence in Air Pollution Control Award, and BYU's own Karl G. Maeser award. Notable among his BYU accomplishments is his research with colleague Dr. Lee Hansen on cigarette smoke; their research laid the groundwork for current understanding of the dangers of second-hand smoke inhalation and has been instrumental in saving thousands of lives.

Eatough's life of ministering perfectly encapsulates the mantra of "enter to learn, go forth to serve." The BYU Department of Chemistry and Biochemistry wishes to extend its condolences to the Eatough family for their loss, expressing gratitude for Dr. Eatough and his innumerable contributions to the BYU and scientific communities.

Written by Emily Smith

Fibrotic Disease: Research and Policies

For Dr. Pam Van Ry, studying, teaching, and researching chemistry is both an academic and deeply personal pursuit. After graduating with a Bachelor's degree in general chemistry from the University of Nevada, Reno, Van Ry was motivated to return for her graduate degree after her mother was diagnosed with pulmonary fibrosis. It's a diagnosis that has changed Van Ry's world, bringing unexpected challenges, discoveries, and opportunities for growth. Now, with a PhD in cellular and molecular pharmacology and physiology and more than 6 years of BYU professorship experience, Van Ry is spearheading the field of fibrotic disease research in critical, life-changing ways.

Working in association with generous funding from the Jain Foundation, Van Ry has been able to conduct research on the biochemical components of muscular dystrophy progression and treatment. In addition to working on 2- and 3-dimensional cultures on cancer and fibrotic cells, she also collaborates with the David Baker Lab at the University of Washington in studying lung fibrosis. Van Ry and her students' most recent research involves testing drug dosages and delivery methods, analyzing the fibrotic


Photo by Kyland Ochsenbein

response in test subjects. These experiments are made possible by animal research and human donor tissue contributions.

"We've been really lucky to work with pulmonologists both here at the University of Utah and University of Washington (Dr. Ganesh Raghu), and then with a really fantastic group called Donor Connect," Van Ry explains. When fibrotic or healthy donor lungs become available after an accident or death of a patient, Donor Connect coordinates with researchers to provide them with organs and tissues for research. "They've been so fantastic to work with," Van Ry says, "and once a year we get to meet with donor families and let them know what we're doing with the tissue that they've donated, how it has helped further research, and [how it has helped] further answer questions about how lung fibrosis is progressing. We've been able to get end-stage idiopathic pulmonary fibrosis (IPF) lung[s] from patients who actually received lung transplants; they received healthy lungs and we were able to use their lung that was very fibrotic and we're doing experiments with this tissue. We've also received some 'gross' normal tissue of people who died from some sort of accident or natural cause and [have] been able to use those tissue[s] as a comparative control."

The Van Ry Lab, under the direction of graduate student Aubrey Saxton, cultivates these lung cell lines to produce miniature distal lung organoids, capable of self organization, vascularization, interstitial tissue production, and form alveolar-like gas exchange units. "Our hypothesis," Van Ry says, "is that by giving them interstitial tissue that is either fibrotic or non-fibrotic, they will either become fibrotic or non-fibrotic whole organoids, or mini lungs. The hope is [that], someday, we'll be able to figure out the mechanism–or what components within that interstitial tissue that hold those cells together–that needs to be changed so that we can decrease the fibrotic load, or in the case of cancer, decrease the metastatic potential of many of those cells."

While producing hundreds of these miraculous "mini lungs" at a time has allowed for increasingly accurate research on treatment response, living animals are still required for certain tests, such as walking-distance and lung function analysis. With increasing social activism and animal-rights groups that scrutinize the use of animal test subjects, Van Ry recognizes

the complexities that come with animal research. She, however, remains optimistic as she implements strict animal welfare guidelines in her laboratory. “The animals we test are probably taken care of way better than most pets in anybody’s home. We are very careful and protocols have to be filled out for everything. There are cages, the environment, the water; everything has to have special filters. It has to be a specific temperature in the room, [the mice have] special bedding, there has to be some sort of pain management, and every single day we check our animals for any kind of pain or suffering to make sure they’re taken care of. It’s very important to me that we make sure that we’re very conscientious of those animals and treat them as if they were a patient, because that’s what we want.”

In fact, the miniature lung organoids Van Ry’s lab has produced are a huge milestone in ethical medical research. “It’s one of the reasons why we have developed this human organoid model,” she explains, “because then we don’t have to use animal models. We can use patient cells in a precision medicine, or personalized medicine, approach.”

Van Ry’s role as advocate for thorough and ethical research doesn’t stop there. Collaborating with the Baker Lab and Dr. Ganesh Raghu of the University of Washington Medical Center, Van Ry’s research has recently been published in the Nature Communication journal, with another article soon to be published in the prestigious Lancet Respiratory Medicine journal. This article “talks about the idea that pulmonary fibrosis, and specifically idiopathic pulmonary fibrosis, patients, once they’re diagnosed, have about 3.8 years to live. That’s really a small amount of time. One of the reasons why that hasn’t really gotten any better over the years is because, when we have different therapeutics developed, there’s a lot of biochemical and physiological assays that they do both in cells and animals. Then it goes to clinical trials, many times a different set of measurements are done.” Currently, there are no FDA or pharmaceutical guidelines that require exact procedures to be replicated in animal and human subjects. Van Ry explains that experiments performed on mice with lung fibrosis often do not include the mandated tests required in human clinical drug trials. “What we argue in that article,” she explains, “is that preclinical drug development research in mice needs to more closely mirror the drug trials in humans. For example, lung function and walking distance is one of the quality of life measures used to determine if a patient is improving with a drug. We have the capacity to do very similar measurements in animals. However, because lung function can be a difficult measure to obtain and requires a high level of expertise, these measurements are not required to move to human trials. But if we aren’t testing in the same way with the same drugs, how are we ever going to know [if they work]?” Van Ry and her colleagues propose that this is why so many years of research and drug testing in the fibrotic disease realm have yielded so few results.

“Even the two drugs that are approved for clinical use, pirfenidone and nintedanib, really don’t extend the life [of the patient] all that much,” she says. “Our argument is that researchers need to do the same experimental endpoints they do in humans [as] in the animals. And if the drug doesn’t work in these “animal clinical drug trials”, then it shouldn’t be moved on to human clinical drug trials.”

Knowing that her research is directly related to the ushering in of a generation of new treatment options is a major propellant in Van Ry’s motivation and success. With a career of research and personal experiences so intricately woven with life, the hope found in death’s aftermath, and the prospect of undiscovered knowledge, Van Ry is a remarkable asset to not only Brigham Young University and the STEM community, but to individuals around the world that will benefit from her diligent work.

Written by Emily Smith

Faculty Awards

Dr. Ryan Kelly

Early Career Scholarship Award

Now a full professor with the Department of Chemistry and Biochemistry, Dr. Ryan T. Kelly is an accomplished and internationally recognized pioneer in the field of proteomic chemistry. A former researcher with the Pacific Northwest National Laborator, Kelly has received over $16 million in research grants and funding from various institudes during his time at BYU, including the National Institutes of Health. With over 100 publications to his name, Kelly is a deserving recipient of the Early Career Scholarship Award, which honors the promising accomplishments of BYU's junior faculty members.

Dr. Rebecca Sansom

Richard Roskelly Teaching and Learning Faculty Fellowship

Coordinator for the department's general chemistry courses and a teacher of freshman chemistry classes, Rebecca L. Sansom is this year's recipient for the Richard Roskelly Teaching and Learning Faculty Fellowship. In addition to instructing and coordinating first-year chemistry students, she also instructs courses preparing the high school chemistry teachers of the future and co-founded BYU's STEM Faculty Institute, serving as a mentor for STEM community members as they seek to improve their teaching skills.

Dr. P. Christine Ackroyd

Adjunct Faculty Excellence Award

An adjunct professor since 2016, Dr. P. Christine Ackroyd has been teaching Physical Science 100 and multiple chemistry courses at both BYU Provo, and the BYU Salt Lake Center. Her expertise in grant-proposal writing and mentoring both at BYU and formally at the college level has proven a valuable asset to her own research and the lives of others. Ackroyd recieved the Adjunct Faculty Excellence Award, recognizing her contributions in teaching and professional excellence over the past years as a part-time faculty member with the university.

Dr. James Harper

Recognized by the American Chemical Society

Dr. James Harper, BYU professor and leader of the Harper Lab, was honored by the Utah Central Section of the American Chemical Society at the beginning of 2023 for his exemplary research in the field of NMR characterization.

Broadbent Seminar

On January 26, 2023, Dr. Melanie Sanford - PhD, recipient of the Moses Gomberg and Arthur F Thurnau distinctions and speaker for the 35th Annual Broadbent Lecture Series - addressed a group of students at Brigham Young University. A professor at the University of Michigan and director of The Sanford Group, Dr. Sanford specializes in a myriad of chemical research areas, including biochemistry, inorganic studies, and sustainable methods. Dr. Sanford combined these topics at this year's Broadbent Lecture to discuss ways in which her lab is contributing to the sustainability of renewable energy, particularly in storing renewable energy intake to be used and processed at a later time. Using physical organic chemistry, the Sanford Group's goal is to "create next generation electrolytes [to uncover] fundamental science behind key properties;" Dr. Sanford reports that her lab is hoping, within the next couple of years, to make and apply breakthroughs that will surpass the knowledge currently available to the scientific community.

Izatt-Christensen Seminar

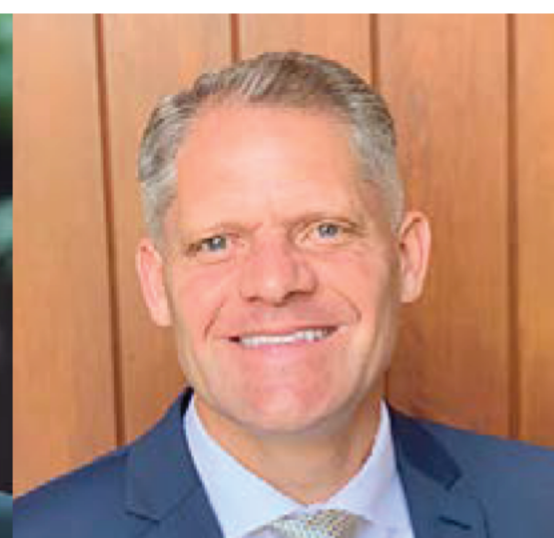
On February 16, 2023, students from various mathematical and scientific disciplines gathered in classrooms on Brigham Young University's campus to learn from Dr. Juan de Pablo, Liew Family professor for the Pritzker School of Molecular Engineering at the University of Chicago and this year's Izatt-Christensen Award recipient and lecturer. De Pablo instructed two seminar sessions, one intended for technical use by students and the second geared toward public interest and explanation. These lectures highlighted two of his most recent projects in studying protein turbulence and plastic production improvements. Dr. De Pablo and his team are currently working in collaboration with Apple and other influential companies to substitute the molecules for plastic production with their new and improved replacements.

Izatt-Christensen Faculty Award

On March 23, 2023, Dr. Grant Jensen, Dean of the BYU Department of Chemistry and Biochemistry, presented his research at the annual Izatt-Christensen Faculty Excellence in Research Seminar. Jensen, leader of the Grant Jensen Lab at BYU, specializes in using Cryo-Electron Tomography to study microbial architecture, specifically in analyzing HIV cellular composition. Dr. Jensen presented his lab's findings on high-definition macromolecular mechanics and creating atomic models of miniscule cell details, including proteins and other systems captured by crystallography and spectroscopy. He presented his research to students and members of the community, providing specific examples of bacterial proteins from his lab's studies to support his claims.

Dr. Melanie Sanford

Dr. Juan De Pablo



Dr. Grant Jensen

Chemical Heat Capacity

If one were to peek in on Dr. Brian F. Woodfield and his students during their lab group meetings, one might be met with a mixture of expectation and surprise. Despite glass walls and windows entirely scribbled over in dry-erase marker notes, equations, and project details, the people in the Woodfield Lab are, perhaps, the most remarkable. Rather than a stale unenthused cohort of scientists, visitors will be met with a small group of confident minds that interact like a close-knit family of innovators, with Dr. Woodfield as the guide.

This familial council of thinkers are doing great science using heat capacity measurements as their primary tool. Their research, focusing on chemical thermodynamics and the fundamental properties of matter are contributing to new insights and are earning their lab a place on the map.

The Woodfield Lab specializes in measuring the heat capacities of novel compounds and cutting-edge

industrial materials. Heat capacity measurements involve cooling samples to near absolute zero (1.8 K in their case) and measuring the heat and temperature as they warm the sample to room temperature. Natalie Parkinson, a student in Dr. Woodfield's lab, explains that "by analyzing the measured heat capacity curves, Woodfield's students can identify the sources behind various contributions to the heat capacity. These findings are a lens through which to understand the physical properties of a material, including the third-law of entropy."

"Fundamentally, we want to understand what we call driving forces; what's stable? We can use our techniques to understand other fundamental physical properties as well. We can measure the heat capacity of any solid material," Dr. Woodfield says, "so the applications of those materials cover the entire spectrum of science." All fields of scientific discovery–biology, biochemistry, physics, chemistry–benefit from the base-level research his lab is conducting and the data they provide.

Conducting their measurements isn't as easy as it sounds, however. "In chemistry, there's a term we call characterization," Dr. Woodfield explains. "If I say, 'Here's a sample,' we know what it is. Let's say I want to measure a piece of metal; we just don't put it in the calorimeter and measure it. We have to know what we have. We have to know its crystal structure, pore size, pore diameter, how much water is on it, [its] chemical structure. So, it's not just chemical purity, but phase purity. We need to know all these things. For most people and for most science, that characterization isn't what's interesting. It's just a validation so that when we do our measurements, we know what we measured. The data we collect gets combined with other data to do something." This combination of data is used by geologists, engineers, pharmacologists and other innovators to create both medical and non-medical products, such as disease-fighting drugs or batteries.

While this process has traditionally taken weeks or even months, Dr. Woodfield and his team are innovating new methods to decrease measurement times to only a matter of days while maintaining measurement accuracy. The Woodfield lab is the only one in the country and one of three laboratories in the world to employ their specific methods for measuring this data. Currently, the Woodfield Laboratory is working on upwards of 10 projects, each focused on a different class of material.

One such project focuses on the mineral greigite, which can be used as a magnetic guide to facilitate drug delivery within the human body. “When is it going to decompose, and what is it going to decompose into?” These are the questions that the heat capacity data from the Woodfield Lab can answer.

Another mineral, coffinite, has been the subject of their recent research. Often found with uranium in a silicate complex, the Woodfield Lab investigated this compound in collaboration with Dr. Xiaofung Guo at Washington State University. Woodfield describes the experience, saying, “When you find coffinite out in a real world someplace, you want to know: how did it get there? How was it synthesized naturally? Is it stable? Is it going to be like that forever, or will it decompose slowly? Did it get created and frozen in there? Our measurements are the only route to calculate the entropy, which when combined with enthalpy, provides the free energy landscape and answers these questions.” Utilizing LDH, or layered double hydroxide, the team is able to purify the coffinite sample and extract heavy, radioactive deposits of uranium near the nuclear reactor, allowing for safe testing.

In another project, the Woodfield Lab is conducting tests on the rare earth oxyhalides REOCl and REOF. The purpose is to develop better separation methodologies to extract rare earth metals from these natural minerals.

While conducting these measurements is time consuming and demanding, Dr. Woodfield is insistent that his students lead the research themselves. “He doesn’t baby you,” they say. When asked why they enjoy his lab, his students enthusiastically give replies such as, “He fosters independent work,” “He wants us to figure it out,” and “Nothing gets thrown away.” Several of his students have expressed that they selected Woodfield’s

laboratory solely for the purpose of interacting with Dr. Woodfield himself, with the subject matter being second in importance. Those attitudes and admiration easily lend to the spirited, familial dynamic that runs through Dr. Woodfield’s lab.

While Dr. Woodfield is beloved by his students, his pride for them is also evident. “These fine people here do the work!” he exclaims, gesturing to his teammates. “These guys are in it for the long haul, and they are smart.” While maintaining professionalism and reverence for his research, Dr. Woodfield infuses it with excitement, fun, and a sense of belonging. With genuine love and devotion to his students, fostering their research abilities and encouraging them to succeed is at the forefront of his teaching approach, especially when it comes to writing about their work.

“It’s a big deal to me. When I got my PhD, I was doing similar measurements on an instrument I designed and made. I was super productive as a grad student, and I think I was an author on 45 papers as a graduate student. But, I never wrote a single one of those papers. My professor, my advisor, never let anyone write the papers. He would write them.” Dr. Woodfield and his peers often found that their written submissions ended up in university trash cans. “I vowed that my students would not have that experience. They collect the data, they analyze the data, and they write the papers. That’s the strength of the group; the students write the papers. I mean, they’re writing great papers!"

Written by Emily Smith

Sabbatical Feature

In 2022, Dr. David Michaelis, leader of the Michaelis Research Group at BYU, visited the Max Planck Institute for Organic Chemistry in Mülheim, Germany for a research sabbatical. Giving seminars and attending conferences across Europe, Michaelis met with world-renowned scientists to discuss the future of transition metal catalysis and bimetallic catalysis. Traveling with his family of 8, Michaelis was able to experience the cultural splendor of Western Europe while acquiring enriching insight that continues to impact his laboratory's studies.

"I went to the Max Planck Institute for Organic Chemistry," Michaelis says, "where there were several researchers that do chemistry that's very related to what I do in my lab. The idea was to find people to discuss our chemistry with, its directions, to get ideas and exposure to new types of chemistry, and to interact with their research groups and see how they run. I was specifically in the lab of Dr. Tobias Ritter, who does bimetallic catalysis, or has in the past, that's related to what we want to do. I attended his group meetings often, I sat down with him several times and we discussed chemistry. I presented my research, we went through ideas, he gave us some ideas that are still shaping how we think about the unique reactivity of our bimetallic catalysts."

Michaelis also interacted with the group of Dr. Alois Fürstner, which focuses on the chemistry of platinum and rhodium. He also had the opportunity to meet with Dr. Benjamin List, the 2022 Nobel Prize winner in chemistry, to discuss the nature of their research and the future of chemistry. Michaelis said that "Dr. List is very interested in the potential to use carbon dioxide as a reagent for performing chemical synthesis.

Based in Essen for 3 months, Michaelis visited several notable universities in Germany, including the University of Freiburg, the University of Münster, the University of Regensburg, and Bielefeld University. Michaelis also shared his research at the University of Vienna in Austria; Cambridge University, and the ICSN near Paris. These seminar visits proved to have a lasting impression on him, both culturally and scientifically.

"[One of the goals]l of my sabbatical was to interact with the European flavor of chemists; they have different emphases in their research, different chemistry that's going on. In Europe, green chemistry is a much bigger thing, for political reasons. And the government supports a lot of green chemistry initiatives for sustainable chemistry. [It] was interesting to see how that happens in different institutes. In the US, we like to do photocatalysis; in Europe they like to do hypervalent-iodine catalysis, so the types of chemistry that they think are important and focus on are slightly different."

"The most significant thing I learned in terms of my research was how to think mechanistically about certain types of catalysts we are trying to develop. Just to gain an outside perspective, you know, as I was interacting with scientists, getting that perspective, it changed the way I think about my research."

In particular, Michaelis notes the unique experience undergraduates have at BYU in comparison to other universities. " I think BYU is very different from all of these institutions, and a lot of that comes from the fact that we do so much undergraduate mentoring. At the Max-Plunck institute, it is a government funded research institute and they are just plush with money. The group that I was in had 30+ graduate students and postdocs. I might have 30 people in my lab, too, but I have 5 or 6 graduate students and 20 undergraduate students, so I do so much more mentoring myself in the lab and am more involved in the lives of the students. It's very different, the way we do research, and yet we can still be really successful doing it."

Written by Emily Smith

Student Awards

Jesus Botello - *American Chemical Society Scholar Merck ASCS 2022 Recipient*

Jesus Botello is an undergraduate student in the Castle Research Group, and is one of only 400 American Chemical Society Scholars in the nation and the only one at BYU. He was also announced as one of the eight Merck ACS Scholars in Fall 2022, and was sponsored on a trip to visit the Merck headquarters this past July.

Sam Mansfield - *Award Recipient from the American Chemical Society*

Sam Mansfield, recently graduated from BYU with a Bachelor degree in Chemistry, received an outstanding performance award from the Utah Central Section of the American Chemical Society this past year for his research, leadership, and academic excellence with the Castle Research Group. During his time at BYU, Mansfield also worked as a research fellow for the BYU Simmons Center for Cancer Research and as a molecular imaging intern for the National Institutes of Health. Now graduated, he works in a position with the Food and Drug Administration.

Joshua Washburn - *Spring 2023 Outstanding Poster Award*

Joshua Washburn, BYU student of Dr. James Patterson, recently recieved the outstanding poster award at the Spring 2023 Amerian Chemical Society Physical Chemistry Poster Session. The competition, held in Indianapolis, Indiana, featured research posters summarizing student work from around the United States. Washburn's poster describes his research, entitled "Characterization of tensile deformation in steel with non-linear optics." He was among the eight students who received an award of achievement for excellent research and explanative display.

Peter Mpaata - *2022 Etter Student Lecturer Award*

Peter Mpaata recently won the Etter Student Lecturer Award fom the Small Molecule Scientific Interest Group (SIG) at the American Crystallographic Association (ACA) Annual Meeting in Portland, OR. Peter spoke about his work developing three novel synthetic routes to bioactive lignans and furopyranones. Peter spoke in the "Cool Structures" session of the conference, chaired and presented by Dr. Stacey Smith.

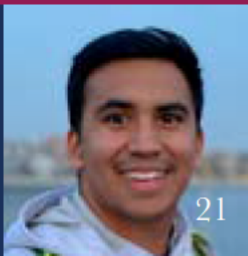
Hsien-Jung Lavender Lin - *Utah's Top 30 Women to Watch Award*

Lavender Lin, postdoctoral researcher and BYU graduate student, was recognized as one of Utah Business's Top 30 Women to Watch of 2023. A member of the BYU Kelly Lab, Lin works in conjunction with Dr. Ryan T. Kelly and his students as they pursue research in the field of proteomic and biochemical analysis chemistry. Lin's goal is to find ways to bridge the gap between holistic and chemical medicine to create a healthier way of life and medical treatment for people around the globe.

Steffano Maggi and Daniel Villanueva Avalos

Izatt-Christensen Faculty Excellence in Research Follw-up Seminar

Stepffano Maggi and Daniel Villanuenva Avalos, students in the BYU Jensen Lab, gave a follow-up seminar discussing Dr. Grant Jensen's research as he presented it in the Izatt-Christensen Faculty Excellence in Research Seminar. Acting as a sequel to his discourse on Cryo-Electron Tomography, the students further explained their laboratory's research and recent publications.



Daniel Villanueva Avalos - *Emmy Recipient at College Television Awards*

Daniel Villaneuva Avalos, member of the Jensen Lab, and his animation team won an Emmy at the College Television Awards for their animated short, "Cenote." Serving as writer and co-director of the project, Avalos also employs his animation expertise toward creating animated models for the Jensen Lab's imaging projects.

Conner Murray

Eric Sevy Physical Chemistry Lab

Updating Instrument Control

The main topic of the research being conducted is understanding the rate of collisional energy transfer to model kinetics of complex chemical environments. Currently, it is not possible to model complex chemical environments due to the inability to measure and calculate the energy transfer probability distribution function for all systems. Our long-term goal is to develop a model to predict P(E,E') for any two molecules, without the need of experimental measurements by determining the molecular characteristics that govern P(E,E'). The objective of the current research efforts is determining how various donor molecules transfer energy to N2O.

The mentored experience has increased my appreciation of hands-on learning. As much as I appreciate learning from textbooks, actually putting into practice the things which I have learned has greatly increased my desire to continue to pursue learning. It has also helped me appreciate that cross-discipline knowledge is important. Much of my time in the lab has revolved around trying to implement a computational approach to the data analysis and collection. The expertise needed is more programming and math-based than it is physical chemistry. I've come to see how pursuing understanding of many more subjects will greatly benefit myself and those I work with as opposed to strictly only learning about my main discipline of chemistry. This Winter Semester has consisted mostly of updating the computer software as well as the hardware which is used to control the instruments utilized in the experiment.

Aimee Schill

David Michaelis Organic Lab

Catalyzed Hydrosilylation

Our research focuses on optimizing platinum-based ligand to perform hydrosilylation reactions on internal alkene substrates. We use an NH-NHC ligand for hydrogen bonding with substrates containing groups that can hydrogen bond. We have optimized catalyst synthesis with the NH-NHC ligand and are continuing to optimize our second phosphine ligand. We have also begun screening reactions for hydrosilylation reactions. Additionally, we are exploring a variety of ways to reduce our platinum catalyst.

This experience has been an incredible and integral part of my experience at BYU. Not only have I grown as a chemist, but I feel that this experience has met all of BYU's aims. I have been given opportunities to think critically and to find solutions. I feel very grateful for the department and all who donate so I can have this experience while at BYU. I feel especially grateful for my PI who seeks to help me develop as a student, as an individual, and disciple of Jesus Christ. I have felt great motivation to work hard and learn, and have also felt incredible support in the learning process.

Ethan Smith

JC Price Biochemistry Lab

Breeding ApoE Mice

The Price lab has been studying samples from the old ApoE transgenic model for years. We are gearing up to study a model developed by more recent genetic engineering technology, and I have been in charge of generating our experimental cohorts. Like our previous models, we hope the data we collect from these mice will be useful for many years to come, for our aims and for the greater fields of Alzheimer's and aging research. Millions suffer from Alzheimer's Disease, and billions suffer from aging, so this kind of work affects most everyone in the developed world.

I have learned deeply about doing hard things. The consequences in a research lab feel real, and that has helped to drive home certain core principles. I've learned that planning is crucial, and that hard work is irreplaceable. The hardest work is the smartest work, when I wrangle my mind into the kind of focus that good planning and execution require.

Makayley Crisp

Roger Harrison Inorganic Lab

DOSY NMR

I am using diffusion ordered spectroscopy nuclear magnetic resonance (DOSY NMR) to calculate the diffusion coefficients of various perfluoroalkyl substances (PFAS) with and without RUA. RUA is arginine undecyl resorcinarene we synthesized prior to this semester. These obtained diffusion coefficients allow us to see the binding trends between the PFAS and RUA. We hypothesize that PFAS and RUA are binding in a host-guest complex, and the NMR data helps confirm this. It is important to see this binding because PFAS have already been produced by many industries and have been linked to adverse health issues in humans and animals. These PFAS are extremely stable and do not break down in the environment. If the synthesized RUA and the PFAS are in fact binding, as should be confirmed using DOSY NMR, we can use RUA to detect these potentially toxic and fatal substances in water samples to prevent them from contaminating our drinking water sources.

My mentor has had a significant effect on my education. It has made a huge difference to work in a chemistry lab with a professor that is always available to answer questions and provide helpful feedback without feeling belittled or undermined. Dr. Harrison has been wonderful in encouraging the use of material learned in classes while also encouraging us to obtain even more supplemental information and research to problem solve in the lab. This URA has helped me feel much more confident in my ability as a chemist and has given me the opportunity to creatively find solutions to my problems without having a procedure already written out for me to follow. It has given me a chance to develop and apply thinking skills that will be needed in the workforce, post-graduation and in furthering my education. Additionally, it has allowed me many opportunities to practice not only collecting data, but analyzing it, and presenting it to others in a way that they can understand. Together we can think of ways to further our research.

Jacob Heninger

Ryan Kelly Analytical Lab

Nanoelectrospray Emitters

Before biological molecules such as proteins, peptides, lipids, and metabolites can be measured by mass spectrometry (MS), they must first be ionized and transferred to the gas phase. Electrospray ionization (ESI) has become a preferred method as it is a "soft" ionization technique in that it can ionize large biomolecules without fragmenting them. The Kelly group has developed an approach for microfabricating these emitters using chemical etching of fused silica capillaries with hydrofluoric acid. The long-term goal of my project is to develop and deploy custom etched picoESI emitters for improved single cell proteome profiling. The central hypothesis is that our new emitters will enable improved low flow stability and improved sensitivity for ESI-MS measurements. This could lead to improvements in the treatment of diseases like cancer and Alzheimer's.

My mentored experience has been an incredible and integral part of my experience at BYU. Through it, I have gained real world experiences in a research laboratory, had the opportunity to collaborate with scientists from all over the world, and had the opportunity to present and defend my own research. When I am in my lab, I get a front row seat to the rigorous process of real science. In my lab, we all come from different backgrounds. This is a strength to our research as we all have different perspectives that strengthen the research process. It also gives us the opportunity to learn of other cultures and their values. Presenting and defending your research is an essential part of the scientific process. At all points I have had this opportunity given to me. More than anything, I want to thank the donors for making all of this possible. Without them, I would not be able to contribute as much to the scientific field and would need to straddle research and a job.

Claire Rader

Jeremy Johnson Physical Chemistry Lab

Modeling Quantum Systems

This semester, I started working on a project that came directly from tools I learned in a class from Fall Semester. Using tools from Linear Algebra, Quantum Mechanics, and existing literature, I have modeled the potential energy surface of crystalline compound $LiNbO_3$ (Lithium Niobate). On this potential energy surface, I have modeled wave packets and been able to study the motion of a single mode of Lithium Niobate. This research is important because often modeling is done with Classical Mechanics instead of Quantum Mechanics. My goal is to compare the two and justify the use of modeling with classical mechanics despite these being quantum processes and systems. To date, I have only modeled the quantum side; however, soon I will begin modeling the classical side of things.

Mentored research is part of the reason I have decided to get a PhD. It's been exhilarating for me to see the concepts I'm taught in classes be explored and proven true and applied time and time again in the lab. This love of research and first-hand observation is really what drives me, and helped me decide to pursue a PhD. Mentored research has also given me an environment where I can work with others and foster new ideas or critical thinking. It can be helpful to step back and realize that all of life is not homework and tests. Failure and difficulty still come with research, and with that, all of the things you can learn from those experiences. But research for me is so much more rewarding and stretching.

Dr. Vajira Weerasekara, PhD., is a BYU alumni and former member of the J. L. Andersen Lab. He recently received a prestigious position as the laboratory head for the Translational Immuno-oncology department under the Oncology Translational Research of Novartis Institutes for Biomedical Research.

Weerasekara recieved his B.Sc. in Biochemistry and Molecular biology from the University of Colobro, Sri Lanka. During his time as an undergraduate, he was mentored by Dr. Chandrasekharan, known fondly by "Dr. Charky" at BYU. Under Dr. Charky's guidance, Weerasekara designed and developed a rapid PCR based multiplexed assay to detect BCR-ABL fusions in Chronic Myeloid Leukemia and Acute Myeloid Leukemia patients. Through Dr. Charky, he learned of BYU's graduate program and, after appying, joined Dr. Joshua Andersen's laboratory.

As Weerasekara participated in research with Dr. Joshua Andersen, he discovered how the energy sensing enzyme of the cell, AMP-kinase (AMPK), activates a self-eating process called autophagy during periods of starvation. They found this process to be a critical signaling pathway for the survival of cancer cells. This research earned him several awards at BYU. Post-graduation, Weerasekara joined the lab of Dr. Nabeel Bardeesy at Harvard Medical School, where his research earned him the prestigious Forbeck Scholar award for Uncovering New Mechanisms of LKB1-Mediated tumor Suppression.

At the end of 2022, Weerasekara became a lab head at the Novartis Biomedical Research center. His lab at Novartis aims to provide thorough and effective healthcare solutions to societies and cultures around the world.

The Translational Immuno-oncology department at the Oncology Translational Research of Novartis is another way through which Novartis, and Weerasekara, are providing much needed relief to suffering individuals and communities. Speaking about his position, Weerasekara says, “My lab comprises of two members – one Senior Scientist (who joined us from the Broad Institute of Harvard and MIT) and a Senior Scientist (who has over 15 years’ experience in [the] biotech industry). My lab works on the interface between cell metabolism and cell signaling. The main focus of our lab is to understand disease biology of cancers and to develop strategies to target them effectively in patients.”

Weerasekara’s mission is to apply scientific discoveries that will help maintain patient comfort, lengthen lifespan, and alleviate patient suffering while giving them their best chance at overcoming various kinds of cancers. Acting as the bridge between discovery and clinical application, Weerasekara and his fellow researchers are on the path to making big strides in the field of cancer research and treatment, providing relief and healing to individuals around the world.

Sources:
Novartis, https://www.novartis.com/, September 2023.
Written by Emily Smith

GRADUATE FELLOWSHIPS

Roland K. Robins Graduate Fellowship

Emmanuel Agbata
Junhan Chan
Shane Drake
Alexander Elliott
Shelby Harris
Samira Jafari
Alvaro Lizarbe
Sanaz Mohammadzadeh
[redacted]
Daniel Odogwu
Tochukwu Okonkwo
Rachel Owens
Hillary Owour
Chao Pang
Andrew Ralph
Mariur Rodriguez Moreno
Ximena Sanchez
Aubrianna Saxton
Timothy Skaggs
Dallin Tyger
Jhon Sia
Alexis Gibson
Latifat Ganiyu
Melissa Lumondang

Charles E. and Margaret P. Maw Fellowship

Jacob Parkman

Bradshaw Organic Chemistry Fellowship

Peter Mpaata
Liahona Angelie

Loren & Maurine F. Bryner Fellowship

Steven Christiansen

Jennie R. Swensen Fellowship

Nicholas Bair

J. Rex and Marcia A. Goates Research Fellowship

Rebekah Stanley

Milton L. Lee Analytical Fellowship

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Research Fellowship, anonymous donor

Aubri Saxton
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Lavender Lin

Roland K. Robins Outstanding Graduating Chemistry PhD

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Garth Lee Outstanding Graduate Student

Kei Webber

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