MONTANA STATE UNIVERSITY
Mountains & Minds

Montana State University Chemistry & Biochemistry News

Winter 2025

On the cover

Photo credit: Logan Mikesell. This photo was taken on Mt. Garnet in February 2024.

Chemistry & Biochemistry Newsletter Team

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SHARE YOUR NEWS!

Alumni and current department members: what do you want to see in the next issue of the newsletter? What did we miss in this issue? Share your news, somebody else's news, or your ideas with the newsletter team by reaching out to Sharon Neufeldt or Doreen Brown at **MSUChemNews@montana.edu**. Thank you!

JOIN THE NEWSLETTER TEAM!

Current students, faculty, and staff: if you are interested in supporting the newsletter, we are seeking team members and contributers with relevant skills or interests including the following:

writing **interviewing**

Please contact Prof. Sharon Neufeldt or Dr. Doreen Brown with questions or to express interest.

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Welcome from the Department Head

Dear MSU Chemistry and Biochemistry Community—

Hello Friends of the Chemistry and Biochemistry Department,

Happy New Year! As we usher in the new semester, we continue to celebrate the accomplishments and achievements of our faculty, staff, and students in the Winter 2025 edition of our newsletter.

We have faculty highlights from Prof. Jen DuBois' research sabbatical in the Spring of 2024. She shares an impactful story behind her efforts to make science accessible and why she is compelled to start teaching through the lens of neurodivergent students. We celebrate Assistant Prof. Martin Mosquera's 2024 U.S. Department of Energy Early Career Research Program Award for his ideas and contributions to quantum computing research.

Two research highlights include the work of PhD students Matt Kania and Albert Reyes (Neufeldt Lab) whose recent publication in the *Journal of American Chemistry Society* helped to explain selectivity in cross-coupling reactions. Another research highlight focuses on the work of Anthony Kohtz (Ph.D. F'24, Hatzenpichler lab) and Dr. Viola Krukenberg (Hatzenpichler lab) and their groundbreaking discovery of methane-producing archaea in groups that were not previously known to include confirmed methanogens. Their work resulted in two recent publications in *Nature*.

The influence of research in undergraduate education is explored in this issue with two first-hand accounts from undergraduate seniors Liam Shores and Joey Solomon. We also share the exciting news that, after a two-year hiatus, our National Science Foundation supported Research Experience for Undergraduates (REU) summer program will return under the leadership of Professors Nick Stadie and Chris Lemon.

This issue also highlights Kimberly Hilmer and Samantha Walker, essential front office staff, and graduate students Emma Orcutt, Brett Sather and Keegan Walker on how they navigate work-life balance having young children while pursuing graduate degrees.

The current issue covers the dates of June–December, 2024. A lot has already happened in 2025 that is not contained in this issue, but please stay tuned for another newsletter this summer.

We are grateful for your continued generosity and financial support. Thank you to our donors and alumni. Your support makes an impact on our students and to the mission of MSU. Your financial contributions allow us to honor the achievements of our undergraduate and graduate students. If you would like to make a donation, visit our website at www.chemistry.montana.edu for the link. If you have any news or information you would like to share, please send us an email at msuchemnews@montana.edu — we would love to hear from you. If you want to stay connected to us year-round, visit our website at www.chemistry.montana.edu for updated events and news throughout the year.

Joan B. Broderick
Professor and Head
Department of Chemistry & Biochemistry

C&B Department Homepage

electronic version of this and past newsletters

FACULTY NEWS

Sabbatical Activities: Using the Art of Storytelling for More Accessible Science

In Spring 2024, Professor **Jennifer DuBois** embarked on a sabbatical journey through science and storytelling to honor the past that laid the foundation for a brighter future. Her sabbatical work bridges together history, science, and empathy through tracing the roots of protein-based medicines that redefined treatments for diseases such as cancer as well as activities focused on making chemistry accessible for neurodivergent students.

Along with introducing new perspectives and approaches to the lab environment and acknowledging the need to refresh research practices, particularly considering biotechnological advances following COVID, DuBois dedicated much of her time to writing a manuscript she had long envisioned. Her goal was to explain the science behind protein-based drugs in a way that everyone could understand. Through clear storytelling, she aimed to make complex science accessible to all.

Her draft delves into the early breakthroughs in protein-based drugs, with an emphasis on insulin and the diphtheria vaccine. The discovery of insulin was clearly a milestone that breathed new life into the entire field of protein medicine. Diphtheria, in the meantime, was a lethal disease, claiming the lives of thousands of children each winter. In the late 1800s, as germ theory emerged, Emil Adolf von Behring, the first recipient of the Nobel Prize questioned why animals like horses could catch diphtheria without falling critically ill. His hypothesis was that something in horse blood might defend against the disease. To verify the hypothesis, researchers took blood from horses, spun it to separate the serum, and injected the serum into sick children—saving lives almost miraculously, even before they fully understood how. Before long, they found that if they grew bacteria that caused diphtheria, these tiny little creatures would release a toxic substance. When this toxin was injected into horses, the animals could produce protective substances in their blood. By slightly treating the toxin with chemicals like formaldehyde, or by heat-treating, researchers created what we know today as a toxoid, setting the stage for a safe vaccine. With time, antibodies from horses became unnecessary because the vaccine could prevent the disease. These early studies set the stage for "biologic" drugs. Another protein called insulin became a simple yet powerful tool in medicine, leading to the development of protein science. Over the next century, scientists learned how to make antibodies and other protein drugs, revolutionizing modern medicine.

When DuBois shared the inspiration behind her manuscript, she described how her field has changed at lightning speed. "The pace of change in biochemistry over the past century has been astounding," she explained, noting how things that seemed like magic just a century ago have now become intricately woven into our daily lives. The study of proteins, an idea over a hundred years old, has evolved from isolating small natural molecules to today's vast biotechnological innovations.

Now, biotechnology touches everything —human health, environmental stability, agriculture, and food production. And people deserve to understand it. "If you know the science," she said, "you can make smarter choices—whether it's a new treatment at the doctor's office or decisions about the world we share." Her manuscript is her way of making this complex science accessible, empowering people to see biotechnology not as a mystery but as a tool for informed, safe decisions.

Unlike contributing a chapter to a textbook, DuBois' efforts have included a journey into trade publishing—a whole new path where she aims to make science accessible to everyone. She recognizes it as a one-of-a-kind form of teaching, to share what she knew deeply, yet what many people might not understand, like the fundamental concept of a protein. While writing the manuscript, she relied on storytelling, a technique she often used in her seminars and teaching. "Stories are how we communicate," she explained, "whether it's science or anything else, it's always a story first." Shaping these stories into a book gave her a unique opportunity to bring a storyteller's voice to technical and complex ideas, transforming them into something anyone could grasp.

Her draft was not just an intellectual effort but a heartfelt reflection on her journey of survival. "It was uplifting to think back on how we, as biochemists, protein chemists, and cancer survivors, have reached this point," she shared. She recalled the painful treatments she has endured, those "incredibly punishing" drugs taken only because there were no alternatives. But now, there is hope. New treatments, especially antibody treatments for cancer, offer options she once couldn't imagine—less harsh, more targeted therapies that were only recently developed. And these innovations spread through every challenge we face, from bioremediation to producing sustainable food and energy. "Multiply this by every disease and every cutting-edge biotechnology," she explained, "and you see the same kind of phenomenal innovation." For her, it's a testament to the power of biochemistry to renew not just lives but the world.

During this sabbatical, DuBois said she managed to spend more time with her son, who is on the autism spectrum and often struggles in traditional school environments. "We have a way of turning the personal into the pragmatic," she explained. Her experience with her son's challenges inspired her to take action, transforming frustration into a meaningful new project. "School isn't a place that helps him succeed; it's stressful and demoralizing, even though he's intellectually capable." With this in mind, she recently submitted a grant with a team at MSU to create new, inclusive ways of teaching chemistry to neurodivergent college students. This project, driven by insights gained from her son, is a step toward building a supportive learning environment not only at MSU but also within the wider chemistry community.

Her journey through this sabbatical wasn't just about research; it was a chance to turn personal experience into meaningful change. Through her passion to making science accessible—whether through her manuscript on the origins of protein drugs or her innovative efforts in neurodivergent education—she's bridging knowledge and empathy. Her work reminds us that every scientific breakthrough traces back to a different story, a challenge, and a commitment to make the world a better, more inclusive place for everyone. As she returns to her role, her impact will continue to spread, inspiring students and future scientists to see that great science doesn't just change lives—it unites them!

Faculty Award: Creation, Control, and Probing of Atomic Qubits

Assistant Professor **Martín Mosquera** of the Chemistry and Biochemistry department received a multifaceted Early Career Research Program Award from the U.S. Department of Energy. This award will allow Mosquera and his team to explore a new family of theories developed at MSU that can describe the control of coherent and entangled quantum states, especially in atomic qubits. A long term goal of this work is manipulating complex entanglements and superpositions on a plethora of qubits as opposed to on just 1 or 2 qubits. The main research questions behind the work are: How to know if you have an entangled state? How can you probe it? And, of course, how can you improve the fidelity? Mosquera goes on to say "I am not interested in quantum algorithms for quantum computing, that is well covered. I am interested in theories." Another aspect of the award is that Mosquera will be continuing to take steps within our theory curriculum to teach the fundamentals of quantum computing to undergraduate and graduate students.

TEACHING AND COMMUNITY ENGAGEMENT

Improvements to the Instructional Labs and Organic Chemistry Courses

The instructional labs have received another modernization update this semester. After revamping procedures in the lab manual and introducing a brand new instrument (the 60 MHz NMR) last year, in Fall 2024 the teaching labs were equipped with electronic card readers. This eliminates problems new graduate teaching assistants would encounter such as not being issued keys on time or covering another TA's morning lab and realizing you don't have a way to unlock the labs for the day. Additionally, to make organic chemistry course assistance more abundant and accessible for all students, the department has founded an Organic Chemistry Help Center equipped with brand new white boards, model kits, and several of the most popular organic chemistry textbooks. These additions to our undergraduate lab curriculum will hopefully elevate the experience of the students taking and teaching chemistry lab courses here at MSU.

Research Featured in Podcasts

Associate Professor Sharon Neufeldt recently appeared on an episode of the increasingly popular *Synthesis Workshop* podcast which features synthetic chemists from around the world to discuss their research in a more casual but further reaching format than a seminar. In the episode, Neufeldt discusses her lab's work in the cross-coupling of aryl halides.

link to Synthesis Workshop

Associate Professor Roland Hatzenpichler's work was discussed in two podcasts, *This Week in Microbiology* and Microbe TV's *Matters Microbial*. The podcasts discussed two of his group's papers on novel methane-producing microbes. His work is discussed in detail at the beginning of *This Week in Microbiology*'s episode 317 as well as in episode 43 of *Matters Microbial*. Members of the Hatzenpichler lab also appeared on episode 59 of that covered the work of Montana State's Thermal Biologiy Institute, entitled "Some (microbes) like it hot".

TWiM episode 317

MM episode 43

MM episode 59

RESEARCH NEWS

Department Statistics at a Glance

numbers represent the time frame of June 2024 – December 2024

39
Publications
authored by members of the department

~50+
Student Coauthors
from our department, including post-doctoral scholars

8
New Grants
awarded to faculty members in the department

51
Active Grants
with departmental faculty as PI or Co-PI

$32.5M
Current Funding
research dollars associated with active grants

RECENT PUBLICATIONS

The department continues its tradition of excellence in scientific publication, with 39 peer-reviewed manuscripts published from June –December 2024 in scientific journals. Here, we highlight two of these recent publications.

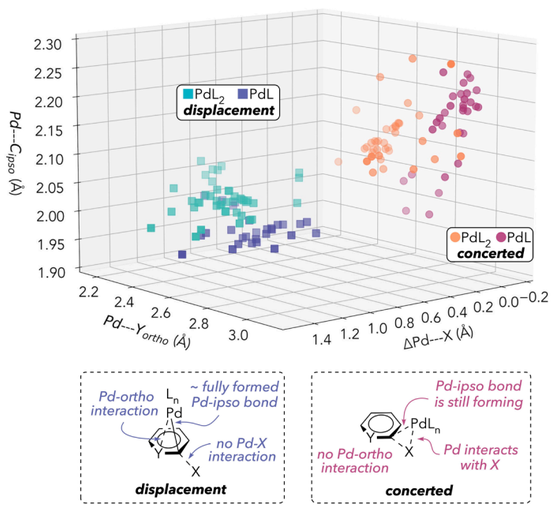
Mechanisms of Oxidative Addition at Palladium(0)

Associate Professor Sharon Neufeldt's lab is known for mechanistic research in cross-coupling reactions. Cross-couplings are a type of reaction in which a transition metal catalyst induces formation of a new bond between two organic molecules. Synthetic chemists rely heavily on this technique for making carbon-carbon, carbon-nitrogen, and other bonds to carbon during the synthesis of pharmaceutical drugs, agricultural chemicals, and materials. In cross-coupling reactions, the new bond typically replaces an old bond between a carbon and a halogen. Neufeldt's lab especially focuses on the selectivity of cross-coupling reactions when multiple halogens are present. Being able to control which halogen is discarded and replaced with a new bond is critical to obtaining the exact chemical structure that is needed by synthetic chemists. For their mechanistic research, Neufeldt's team uses both experimental and computational tools.

The Neufeldt lab recently undertook a detailed systematic investigation into how the transition metal palladium breaks carbon–halogen and related bonds in a mechanistic step called oxidative addition. The work was done under the premise that a better understanding of the nuances of this step could facilitate controlling selectivity in cross-coupling reactions. Graduate students Matt Kania and Albert Reyes used computational molecular modeling to evaluate two limiting mechanisms for oxidative addition. In the "concerted" mechanism, palladium breaks a carbon-halogen bond by grabbing onto each atom and pushing its way in between them. On the other hand, in a "nucleophilic displacement" mechanism, palladium interacts with only the carbon atom, and that interaction causes the halogen (or a closely related "pseudohalogen") to dissociate away on its own.

The calculations by Kania and Reyes revealed trends in the mechanistic preferences of different substrates and palladium catalysts. Certain organohalide substrates prefer to react with palladium through a concerted mechanism, while others (especially aryl triflates and some heteroaryl halides) would prefer to react through a nucleophilic displacement mechanism. At the same time, palladium displays different mechanistic biases depending on how many other small supporting molecules ("ligands") are attached to the metal. In particular, if palladium has only one ligand, it strongly prefers a concerted mechanism for oxidative addition. However, when palladium has two ligands, the preferred mechanism is more nuanced and depends on the identity of those ligands.

To gain confidence in the experimental relevance of the calculations, Kania completed a series of experimental natural abundance ^{13}C kinetic isotope effect (KIE) studies using NMR spectroscopy. This technique was pioneered in the 1990s but is only used by a small number of labs worldwide because the technique is very finicky. It involves taking quantitative ^{13}C NMR spectra and measuring the tiny changes in isotope distribution in recovered starting material after a reaction is nearly complete. This is challenging because ^{13}C has a natural abundance of only about 1%, and the magnitude of heavy atom KIEs is very small, necessitating extremely accurate measurements of relatively weak signals. Kania spent around a year learning the technique and, with the help of NMR director Dr. Brian Tripet, fine-tuning the protocol for obtaining accurate measurements using the 500 MHz NMR spectrometer in our department. In the end, Kania's experiments corroborated the calculations and provided the first KIE-based evidence for these divergent mechanisms for oxidative addition at palladium(0).



Finally, Kania and Reyes demonstrated the practicality of these studies by "match-making" different reaction sites of bromochloroheteroarenes with ligands for palladium. Guided by the mechanistic insight, the team was able to demonstrate divergent selectivity in the cross-couplings of several substrates bearing two halogens.

This work was published in the *Journal of the American Chemical Society* in July 2024. The research was primarily funded by the NSF. Kania is currently writing his thesis and has scheduled his defense for Spring 2025. Reyes is a 4th year student who is continuing to study selectivity of carbon-halogen bond substitution in cross-coupling and related reactions.

link to publication

New Methane-Making Microbes Discovered in Hot Springs

Associate Professor Roland Hatzenpichler has a fascination with studying extremophiles, organisms that thrive in environments considered extreme by human standards. Our proximity to Yellowstone National Park offers convenient access to some of these extremophiles, heat-loving microorganisms living in the park's geothermal hot springs.

One such group of microbes of interest is methanogens. Methanogens are organisms that convert small molecules like carbon dioxide or methanol into methane for energy conservation. By contrast, humans eat complex foods and breathe oxygen to conserve energy. Although they have been known for over a century, all known methanogens belong to one group of archaea, the Euryarchaeota.

In the past decade, several DNA-sequencing studies have shown that other groups within the archaea might also be capable of producing methane. However, until the work of the Hatzenpichler group, no one had put these genomic hypotheses to an experimental test; it was mere speculation from their DNA-sequences. This is problematic because organisms might not make use of their genetic potential. For example, human DNA encodes the potential to anaerobically ferment (i.e., to grow without oxygen), but only a few cells under very specific conditions – muscle cells during heavy exercise – ever make use of it. (You cannot put a plastic bag over a person's head and expect them to live.) Thus, we cannot rely on mere speculation from genomic sequences when trying to understand how organisms actually live in nature.

Therefore, graduate student Anthony Kohtz and postdoctoral researcher Viola Krukenberg set out to determine whether these other archaea with the genetic potential for producing methane are indeed methanogens. Targeting Yellowstone hot springs, Kohtz and Krukenberg embarked on a long, "painstaking" process that culminated in cultivating the first methanogens outside the Euryarchaeota, breaking with the long-held paradigm that methanogenic archaea are confined to a small group of microbes.

Identifying not one, but two new branches of methanogens suggests that other methane-producing organisms are yet to be discovered. The two newly cultured organisms use methanol and hydrogen for methane production, which sets them apart from most other methanogens that prefer carbon dioxide or acetate for methane generation. Additionally, in collaboration with Professor Martin Pilhofer and graduate student Nickolai Petrosian at

Hot springs are used as model systems in Hatzenpichler's research.

ETH Zurich, the Hatzenpichler group explored the cell structure of Methanomethylicia and discovered a novel cellular feature: cell-to-cell tubes that connect two or three cells, the function of which is yet unknown.

The studies that these new archaea, member of the groups *Methanomethylicia* and *Methanodesulfokora*, are indeed methanogens were published in two articles in the journal *Nature* in Summer 2024. The research was funded through the NASA Exobiology Program, the Simons Foundation, and the Gordon and Betty Moore Foundation.

Krukenberg completed her postdoctoral work in the Hatzenpichler lab in 2022. Kohtz graduated from the Chemistry and Biochemistry department with his PhD in 2024 and will start his postdoctoral position at Monash University (Australia) and UC Berkeley in February 2025.

Hatzenpichler recently designed an infographic on the importance of methane for global climate and the role microbes play in its production and consumption.

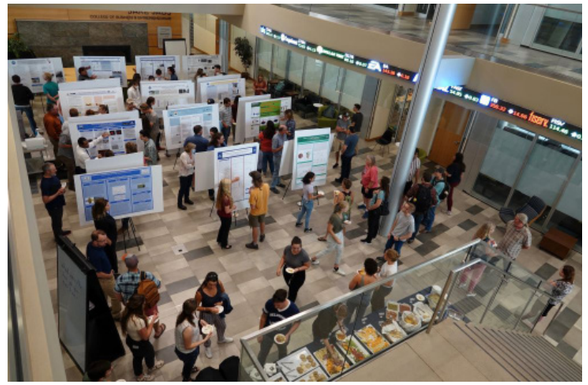
links to publications *link to infographic*

Return of the REU Program

After a two-year hiatus, our department proudly welcomes back the Research Experience for Undergraduates (REU) program with a grant from the National Science Foundation! This milestone marks the revival of a 20+ year tradition of fostering undergraduate research excellence. We look forward to inspiring the next generation of scientists and fostering innovation once again!

Led by two dedicated co-PIs, Associate Professor Nick Stadie and Assistant Professor Chris Lemon, this program offers life-changing opportunities for underrepresented students in STEM fields, particularly Indigenous students from tribal colleges.

The REU program extends opportunities to students beyond MSU, often from institutions without robust research programs, a chance to explore research through 10 weeks of active, hands-on learning over the summer. This dedicated time empowers participants to explore their passions in science, develop valuable skills, and experience life at a leading research institution like MSU. According to Lemon, who participated in an REU program as an undergraduate himself, the program aims to "spark excitement in students, empowering them to see the connection between scientific research and real-life applications."



End-of-summer poster session for the 2021 REU program.

A signature of the REU program is its focus on increasing diversity in the scientific workforce. The REU program in our department prioritizes recruiting Indigenous students from Montana and neighboring states, such as North and South Dakota. Activities rooted in Indigenous ways of knowing, coupled with mentorship from Indigenous scientists, provide an enriching and culturally responsive learning experience. This initiative seeks to address the issue of underrepresentation of Native Americans and other underserved groups in advanced STEM fields, such as chemistry.

"MSU is a land-grant university—a place for everyone," emphasized Stadie. "We don't want anyone to lack access to the tools to do science. This program is our way of breaking down barriers and ensuring students from all backgrounds have the opportunity to thrive in STEM."

MSU's Department of Chemistry and Biochemistry has a reputation for successfully running the REU program over the past two decades, establishing it as a pioneer in undergraduate research training. This legacy, coupled with the department's ongoing collaborations with tribal colleges, establishes MSU as a center for scientific advancement and diversity. Each summer, our REU program recruits 10 students, matching them with faculty mentors based on their preparedness, research interests, and program fit. Faculty across the department's diverse research areas—including materials science, biochemistry, and catalysis—are encouraged to participate. PIs and graduate students receive mentorship training to guide undergraduates, creating a collaborative and supportive environment. Stadie reflected on the impact of the program: "As an undergraduate, I was inspired by the people around me in the lab. Watching our REU students experience that same inspiration is incredibly rewarding."

The REU program strengthens MSU's role as a land-grant university dedicated to fostering opportunities for all by engaging students in research, showcasing their contributions through publications and presentations, and encouraging them to consider graduate school. As the department looks forward to warmly welcoming this year's REU cohort for Summer 2025, Stadie expressed his excitement: "I work hard to bring together undergraduate researchers from all across the country, especially different parts of Montana. Meeting these smart, enthusiastic young students who have their whole lives ahead of them and helping them find their path in science is one of the most rewarding aspects of this program."

The REU program's return reflects MSU's commitment to empowering the scientists of tomorrow—one summer, ten students, and ten breakthroughs at a time.

STAFF NEWS

Meet the C&B Front Office Staff. *There are a lot of moving parts that keep the department running at full efficiency. Occasionally, it can be easy to get lost in one's own work, taking these moving parts for granted. In this issue we sat down with two of our front office staff to highlight some of the work conducted behind the scenes and remind students of some of the resources at their disposal here at MSU.*

Kimberly Hilmer, Business Operations Manager

Kim could be described as the glue that holds the department together. Whether it is safety concerns, appointments, or making sure you receive your paycheck, she is likely the one overseeing the process. Kim also is the point contact for the building. She makes sure the Chemistry and Biochemistry Building (CBB) is running effectively and efficiently, daily. If there is a problem with a leak, the fume hoods, the elevator, the HVAC system, or the autoclaves, Kim is usually the first person receiving the call—day or night—to assess the situation and act. She communicates with engineers, plumbers, carpenters and IT people with apparently infinite knowledge and understanding, and she has saved the department a considerable amount of money because of her decision making. Kim is a Montana native, originally hailing from Helena, MT, just down the road about 100 miles northwest

Kimberly Hilmer

of Bozeman. She is an MSU alumna, graduating with a degree in biochemistry in 2002. Some of you may not know that Kim was a scientist before moving into the business operations position. She worked for several years as a research associate and lab manager in Prof. Joan Broderick's lab, and before that in Prof. David Dooley's lab. She even has a first author paper in the journal *Biochemistry*. Because of her time spent here at MSU and her familiarity with the department and the people in it, Kim is an invaluable resource to current students, offering help with the many questions you may have during your time here in Bozeman. She encourages you to come stop by the front office and make a point to introduce yourself. Outside of the department, Kim says that she enjoys hiking and a casual ride around the local trails.

Samantha Walker, Academic Services Coordinator

Sam has been in the department for almost a year. Sam is from Northern California, originally traveling to Bozeman for MSU's business program, ultimately graduating with her degree in business accounting. Sam is point person for Chrome River and Smart Buy, two software programs utilized by 90% of C&B personnel.

Samantha Walker

Her expertise in both programs has not only calmed the nerves of faculty, staff and graduate students using the programs, but she quickly resolves issues and can facilitate an expedient plan of action, especially when essential supplies and equipment purchases are needed. She is detailed-oriented and an aficionado with Excel. She frequently interprets qualitative and quantitative departmental data into spreadsheets for ease of understanding information. Sam's efforts of support are not only felt in CBB. She also spends three days a week in Gaines Hall helping with general administrative duties, technical support, and providing valuable assistance to faculty and students. As her title implies, Sam is also responsible for undergraduate resources, including class scheduling and any issues regarding class credits. She makes sure every undergraduate student in the department has the means to graduate on time or has a path forward to graduate. Sam encourages you to say come say hello. She offers a few words of advice: "I always like to tell students, make MSU your home. Find your people and find the things that you like to do that connect you to campus and your fellow students." Outside of the department, Sam says that she enjoys playing board games.

WORK-LIFE BALANCE

Living in Bozeman offers extraordinary opportunities for activities outside of the lab. In the multi-issue "Work-Life Balance" series, we will be highlighting extracurriculars of some of our students and faculty. In this issue, we focus on raising a family from the perspective of three graduate students in our department.

Balancing Academics with Family: Insights from Chemistry and Biochemistry Graduate Students

Graduate school is a demanding endeavor where finding balance between work and extracurriculars can be tricky. For students looking to start their own family, this balance can appear nearly impossible to achieve, pushing many to wait until they've completed their studies and moved into their careers. However, some students here at MSU have found ways to achieve this balance while maintaining momentum in their advanced education. In this issue, we sat down with three students to get their perspectives on how they navigate the boundaries between work and life, while juggling a growing family.

Brett Sather is a fourth-year graduate student studying food omics and metabolomics as a member of the Bothner research group here at MSU. Sather is a Bozeman native, obtaining his undergraduate degree from Montana State in 2012. During his undergraduate work, he developed an unwavering love for the university and the people who inhabit it. After a few years pursuing endeavors such as starting his own business and a family of his own, he enthusiastically jumped at the opportunity to pursue a lifelong goal of obtaining his PhD.

Orcutt and her two older children.

Emma Orcutt is a fifth-year graduate student studying material properties and their interactions with light through spectroscopic methods as a member of the Grumstrup research group. Orcutt is originally from Spokane, Washington, and graduated with her undergraduate degree from Brigham Young University (BYU) where she worked in inorganic synthesis. Following the birth of her first child and graduation from BYU, Orcutt made the decision to move away from wet-lab work and further her education down a new path, ultimately joining MSU's PhD program in 2020.

Keegan Walker is third-year graduate student investigating high-temperature energy conversion mechanisms as a member of the Walker research group (no relation). Keegan Walker moved around a lot growing up as a military child, eventually settling down with his family in Bozeman about eight years ago while he was still in high school. After moving to Bozeman, Walker witnessed both his father and his older sister complete degrees from MSU, motivating him to also attend MSU

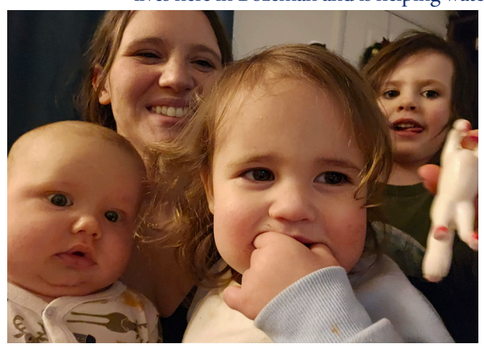
for his undergraduate studies. Following completion of his undergraduate degree, Keegan joined the PhD program, hoping to follow in his father's footsteps and continue his education.

Walker and his son.

R.B.: ***Could you describe a typical day/week for yourself, work and family lives included?***

B.S.: A typical week revolves heavily around the family unit and the kids. Typically, my partner and I wake up around 6am and make lunches for the day for our two kids. The morning routine is a bit of a tag-team; I watch the kids while my partner gets ready, switching back and forth until it's time to leave around 7:30am. Our oldest is great about helping the process along as he is very independent, even if he needs a little push here or there. We then leave the house around 7:30, with my partner taking one kid to school and I take the other, then working until it's time to pick the kids up at the end of the day. At home we do some kind of dinner before putting the kids to bed by 9pm.

E.O.: With an 8-week-old, a typical week can feel like a lot. I normally wake up anywhere from 5-7am, a little earlier on Tuesdays and Thursdays because I teach a morning exercise class at the YMCA, and a little later on MWF when I do not have my morning class to teach, allowing my partner a little extra rest. The morning consists of breakfast and a few chores before beginning with some morning math with our oldest. Typically, I then spend the rest of my 9-4 in the lab conducting research, fully planning my day ahead of time. Back at home my husband and I switch off with dinner responsibilities before family time where we spend time together every night at 7pm, with the kids in bed by 8pm.



Orcutt and all three of her children.

K.W.: I normally wake up around 6:30 so I can get some stuff done around the house before my son wakes up around 7-7:30. I try to treat my schedule like a normal job as much as possible, aiming to keep a consistent 9-5. Managing my time between family and school can be difficult, however, the flexibility of grad school allows me to move my schedule around if I need.

R.B.: ***How do you attempt to navigate the boundaries between work and life?***

B.S.: It is really challenging. Finding the balance would largely be impossible without such a great support system in my partner; in fact I wouldn't be here without her. My partner has been paramount to even attempting this degree and I honestly don't know how anybody could make it work by themselves.

E.O.: There are two primary things that allow for the balance we have: lots of planning ahead and a good support system. I am very lucky to have a partner who can be a full-time stay-at-home dad, both teaching our kids through homeschooling and taking care of them throughout the day, not having to rely on outside childcare. I also plan my days out well in advance so I can be as efficient as possible from the moment I get to campus to the time I leave.

K.W.: I am very lucky because my mother lives here in Bozeman and is helping watch my son a lot. She actually lives only about twenty minutes away so having her here to help has really been awesome. I don't think we'd be able to do it without her.

Most of the Walker/Orcutt clan.

R.B.: ***Are there any challenges you face that feel unique to your situation?***

B.S.: I would say that financially it can be pretty tight. We are very lucky that our oldest is in public school this year and we only have to pay for one kid to go through daycare now. Last year was a very rough year financially for us (regarding childcare). Also, time management can be a bit of a challenge. Time is our most precious resource and making it work can be very challenging without a strong plan of attack.

Time is our most precious resource...

E.O.: I would say getting a system down that works for you can be difficult. The more kids we have had, the more we've found that we have had to really buckle down to make things work. We have tried a lot of things that didn't work or would only work for a transient phase.

K.W.: I don't feel like there are unique challenges per-se, just that some of my challenges are a little more intense at times. For example: everybody has deadlines in graduate school but sometimes trying to juggle family and research can make these deadlines feel more pressing. I would also say that making it work financially can be a little rough.

R.B.: ***Does MSU do a good job of making you feel supported? Do you have any suggestions that might make you feel more supported?***

B.S.: I can't tell you how many different jobs I have had, and Brian (Bothner) is easily the best boss I've been able to work with - without a doubt. He cares that I get my work done, but never at the expense of important family time or personal health. I would say that your choice of PI is one of the greatest factors that influences how supported you feel day to day, it's really important to pick someone who can help you during your time here.

E.O.: Some of the individuals that I interact with regularly, such as my PI, the college dean, and the departmental staff do a phenomenal job of making me feel welcome and heard and are the ones who have made the transition into a graduate degree that much smoother. I do feel MSU could work to ensure more secure housing for families as that can add a layer of unnecessary stress.

K.W.: I'd like to think so - I feel very lucky to be in the position that I am in here at MSU. I've also heard good things about some of the offerings on campus, such as their childcare, however, the waitlist can feel never-ending. It would be nice to have a few more options for childcare around campus.

R.B.: ***Do you have any final words of advice for other students who might find themselves in a similar position?***

B.S.: If you're already a parent, you know that you are getting yourself into a large endeavor with graduate school. I would say if you don't have a good plan or a strong support system, you might have a bit of a harder time than your average student; plan accordingly.

Walker making time for large and small family events.

E.O.: I would say to listen to advice that is given to you but try to discern what actually works for you. Good advice for one may be bad advice for another. I would also say to hold on, the tough days can feel rough but the light at the end of the tunnel is worth it - sure it's more work but I've never regretted my decision [to start a family] even once.

K.W.: It can be easy to get caught up in the fast-paced nature of graduate school, so I would say to take a step back when you are getting bogged down and make time for those large family events.

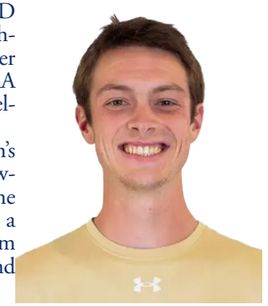
C&B Halloween Costume Contest

In the departmental Halloween costume contest held on October 31st, creativity took center stage! The individual category winner was Magalee Frometa who hilariously embodied Professor Mary Cloninger, complete with her signature style. The lab category award went to the Neufeldt lab, whose students dressed in red shirts and white gloves, representing water molecules, combining science and spookiness in the best way!

Cloninger and Cloninger

Water molecules in the solid state

Meet PhD Student-Athlete Will Kelly



Will Kelly is our department's first PhD graduate student athlete! Kelly had a highly decorated career at St. Olaf and after graduating had one year left of NCAA eligibility due to COVID and the cancellation of the 2020-2021 season.

Will was a member of MSU's Men's cross-country team in Fall 2024, narrowly missing out on top-10 honors in the Big Sky Conference. Will is currently a member of the Men's track and field team where he competes in 5K steeplechase and other distance events.

As a first-year graduate student in the PhD Biochemistry program, Will continues to set an example that a student athlete can excel in a rigorous graduate program. Will adapted with ease and continues to meet all of the PhD requirements and expectations on time. He even holds a 19-hr per week graduate teaching assistantship.

His PhD advisor, Prof. Brian Bothner has this to share about Will "As his advisor and mentor, I have been impressed by his academic and athletic performances. It was fun to cheer him on through an excellent season on the cross-country team in which he contributed significantly to the team's outstanding performances. While he won't readily admit it, having excellent time management skills is essential for pulling off this double duty and in fact, you have to probe him a bit to find out about just how well this year is going."

We applaud Will for his accomplishments to date.

STUDENT NEWS

Student Statistics at a Glance

numbers represent the time frame of August – December 2024

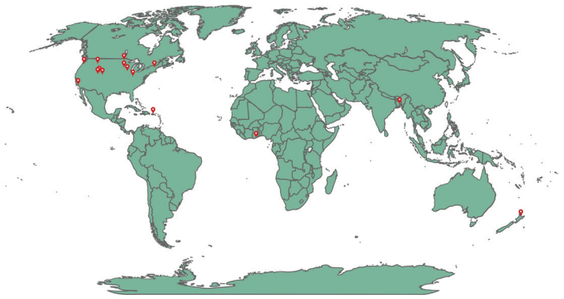
8
PhD Degrees
conferred in Chemistry and Biochemistry

3
MS Degrees
conferred in Chemistry and Biochemistry

15
BS Degrees
conferred in Chemistry and Biochemistry

22
New Graduate Students
joined the department

MEET THE 2024 COHORT OF PHD STUDENTS



Robin Das Sourab
Feni, Chittagong, BGD

I completed my undergraduate studies at Shahjalal University of Science and Technology (SUST) in Sylhet, Bangladesh. In my free time, I love watching movies and series, but I also enjoy staying active by playing cricket and cycling. I'm a huge fan of Bengali cuisine, especially the classic 'Kacchi Biriyani'—it's the kind of meal that can instantly brighten my day!

Lillian Bonsuh
Kumasi, Ashanti Region, GHA

I obtained my Bsc. in Biochemistry at Kwame Nkrumah University of Science and Technology, Ghana. I love watching movies and listening to music (both African and Western).

Magalee Frometa (she/they)
Downey, CA, USA

I did my undergrad at Whittier College. I really enjoy crafting projects, decorating interior spaces, and planning parties. If I ever have any free time, I enjoy playing video games like BG3 and Sims 4. My favorite foods are cookies and s'mores.

Charles Brenzel (he/him)
Saint Paul, MN, USA

I obtained my BS in biochemistry from Montana State University last Fall (2023) after enrolling in the summer of 2022. I also spent three years at the University of Tennessee, Knoxville but dropped out during COVID. I spend most of my free time 3D printing various things. I also play a bit of disc golf and enjoy taking my cat on walks.

Gabe Gracza
Roseau, MN, USA

I did my undergrad in Duluth, MN, which is also where I met and married my wife Kierra. We like to hike and ski, as well as go camping. We both love to read, with Agatha Christie, C.S. Lewis and Tolkien being our favorites.

Blake Chennai
Portland, OR, USA

I did my undergraduate degree in Biochemistry and Molecular Biology at Carroll College. In my free time, I like to read, workout, hike, and build things. I love horror movies.

Vittal Kamath (he/him)
Auckland, NZL

I went to undergrad at Iowa State University, Ames, IA. My favorite hobbies are hiking, camping, road trips. I love spending time outside when it's cold. My favorite sport is Cricket. I absolutely love Thai food. A fun fact about me is that I was born in Indonesia.

Neina Kashyap (she/her)
Jorhat, Assam, IND

I did my undergrad from a college affiliated with Dibrugarh University of Assam, India. Some of my hobbies include painting, sketching, singing, listening to music, writing, reading, and taking small solo walks in nature. My favorite dish is Paneer butter masala. (The attached picture is me and my dad after a successful road trip on our motorbikes.)

Parker Keller (he/him)
Helena, MT, USA

I went to undergrad at Providence College (Rhode Island). I really enjoy film photography, I process and develop all of my own photos. If I have free time I am usually skiing, fishing, or mountain biking. I enjoy swimming (open water, and laps) as well as lifting weights.

Will Kelly (he/him)
Golf, IL, USA

I am from the suburbs of Chicago in Illinois. I went to undergrad at St. Olaf College. It is a small liberal arts college an hour south of the twin cities in Minnesota. When I am not focusing on academics, I enjoy distance running. I am on the cross country and track & field team at MSU!

Kenneth Kwansa-Aidoo
Cape Coast, Central Region, GHA

I did my undergraduate at University of Cape Coast (UCC), Cape Coast, Ghana. I really enjoy visiting friends, chatting with friends and spending time with friends. At my free time also, I enjoy riding bicycle. My favorite foods are fufu and light soup and jollof rice.

Robert (Bobby) Lerch
Downers Grove, IL, USA

I did my undergrad at Beloit College in Beloit, WI, where I double majored in biochemistry and French, and minored in physics. As such one of my hobbies is making my life as hard as possible, in addition to playing video games (Nintendo in particular), cooking, filling my brain with chemistry and physics info, being a comedic genius, and general dawdling.

Nigel Li
Charlottetown, Prince Edward Island, CAN

I went to University of Montana & University of Prince Edward Island for undergrad. I will turn anywhere I live in to a mini zoo.

Clayton (Clay) Lince
Tumwater, WA, USA

I did my undergrad at Washington State University. For fun I like to listen to music, play board/video games, and most any outdoor activity.

Sal Martoglio
Greencastle, IN, USA

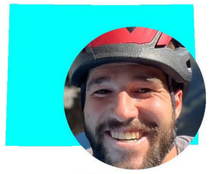
I just completed my undergrad at DePauw University. Currently, I'm interested in biochemistry and protein design. In my free time, I like to play chess, fly fish, hike, and weightlift. My favorite sport is soccer, though I follow the NFL more closely. My all-time favorite TV show is Fleabag!

Nicole (Nel) Matos-Vega (she/ella)
San Juan, PR

I went to undergrad at University of Puerto Rico Mayagüez. I like ice skating and since it's not something common in PR. I've skated in the Dubai Mall before. I love pasta and would love some pernil. A fun fact is that I almost lost a finger a day before a flight.

Lea Molecek (she/her)
Paonia, CO, USA

I did my undergrad at Whitman College in Walla Walla Washington. I took some years off after undergrad and have been working a variety of passion jobs from raft guiding in Alaska and Idaho, ski and rock climbing instructing and being a baker at Wild Crumb. I do a lot of beading in my freetime.



Tagert Mueller (he/him)
Carbondale, CO, USA

I attended undergrad at Bates College in Maine. I love spending time outdoors in the mountains with my friends and family. I think every season should have its own recreational focus. In my free time I enjoy growing crystals and brewing mead.

Balyn Muffley (she/her)
Noblesviller, IN, USA

I did my undergrad at the Massachusetts Institute of Technology (MIT) in Cambridge, MA. I spend my free time playing volleyball and pickleball, running, hiking, and playing video games. I have two mini-Australian shepherds and absolutely adore all dogs.

Krista (Krissy) Osteraas (she/her)
Rochester, MN, USA

I did my undergrad in Chemistry at Winona State University. Some of my hobbies include reading, piano, and ultimate frisbee.

Matthew (Matt) Sandin (he/him)
Monument, CO, USA

I went to undergrad at Western Colorado University. I love outdoor adventures such as snowboarding, biking, and backpacking. I also love to cook, play board games, and spend time with my loved ones.

Kian Hutt Vater (he/him)
Shrewsbeury, VT, USA

I went to undergrad at Connecticut College. After finishing my undergrad, I spent a couple years working in a clinical infectious disease research laboratory in Boston, MA. You can find me doing my favorite things in the mountains from snowboarding, biking and kayaking to hiking, climbing and backpacking.

Graduate Student Osuagwu Completes NREL Internship

Emmanuel Osuagwu is a fourth-year Materials Science doctoral student in the department with a striking research resume. He is originally from Nigeria, where he completed his undergraduate studies in chemical engineering focusing on the storage and interaction of fluids (gases/liquids) within solid frameworks. Wanting to continue his studies of such an intricate process, Osuagwu was motivated to join the Stadie group in the fall of 2021, where he has since led a productive graduate career.

Recently, Osuagwu was awarded a prestigious 3-month long internship with the National Renewable Energy Lab (NREL) in Golden, CO, where he was able to travel to work with top researchers in his field. At NREL, Emmanuel's work was focused on determining the thermal conductivity of various materials with a special interest in zeolite-templated carbon, especially in the presence of different types of adsorbates, a hot topic of current renewable energy research. Through these measurements, he was hoping to corroborate experimental results that he had obtained previously here at MSU, an opportunity to utilize one-of-a-kind technology he says was too exciting to pass up. Since his return, Osuagwu has continued to collaborate with NREL on his work over the summer with hopes of integrating it into his doctoral thesis. He reflects positively on his time at NREL, stating that the tools, skills, and routine that he developed here at MSU were crucial to finding success in a different research environment.

UNDERGRADUATE FEATURE

The Chemistry and Biochemistry Department includes over 175 undergraduate students, many of whom participate in research. We asked two such students to share their perspective. Both students are in their senior year majoring in Chemistry.

Liam Shores. Shores came to Bozeman in 2021 from his home in Portland, Oregon, where he, like many others, took a bit of a circuitous route before landing in our department. Shores originally came to MSU for our exercise science program, but he says his change of heart (and a change of major) came after taking organic chemistry during his sophomore year. While classes provided the intellectual spark, Shores found that undergraduate research gave him tools he could use to make a career out of his newfound passion. Shores has led a productive research career over the past three semesters, participating in chemical research across multiple disciplines, such as computational chemistry and synthetic chemistry. Shores feels that he has found a home within the Fialho and Mosquera research groups, splitting his time between synthesizing asymmetry-inducing hydrogen atom transfer catalysts and studying hyperfine couplings of iron atoms within metalloprotein frameworks. In Fall 2024, Shores decided that he could also help other students through their journey by becoming an undergraduate lab TA. Outside of the lab, Shores is an avid skier and rock climber, saying that the balance between school and extracurriculars can be hard to find at times, but there aren't many places that allow for high impact work in such a beautiful environment.

Joey Solomon. Solomon is originally from Bend, Oregon where he fostered his strong love for the outdoors. Wanting to combine the outdoors with a knack for chemistry that he had developed in high school, Solomon traveled to MSU in 2021 under the prestigious WUE scholarship to continue his studies in the chemical sciences. While the nature around Bozeman drew him here, Solomon says that the chemistry program ultimately kept him around. He has been able to learn many new things from the amazing professors we have in the department and while classes have been interesting, Solomon says that he has especially appreciated his experience with undergraduate research. Solomon is entering his third semester working for the Mock research group, primarily focusing on the synthesis and characterization of organometallic complexes for green ammonia synthesis, hoping his work can be used to help reduce the environmental impact of the Haber Bosch process in the future. Research has played a pivotal role in his professional development, and the tools and opportunities research has given him have shaped his career outlook, further motivating him to pursue a graduate degree here at MSU after completing his BS degree. Solomon hopes others can find success in the way he has here in Bozeman. Solomon's advice for others is to make a point to find something that keeps you grounded outside of the lab. For him, skiing our humble Bridger range is his primary outlet.

PhD GRADUATES (Summer-Fall 2024)

Balci, Batuhan (Broderick)
[FeFe]-Hydrogenase Maturation: Bridging Dithiomethylamine Ligand Assembly During The Biosynthesis Of The H-Cluster

Gauvin, Colin (Lawrence)
Versatility of Cryo-Electron Microscopy as a Structural Technique Informs Iron Mineral Nucleation and Growth in a Mini-Ferritin

King, Alexander (Grumstrup)
Unveiling the Photophysics in Solid-State Organic Materials: A Study on PBI Based Materials

Kohtz, Anthony (Hatzenpichler)
Investigating Novel Methylotrophic Archaea in Yellowstone Hot Springs Through Meta-Omics and Targeted Cultivation

O'Shea-Stone, Galen (Copié)
Investigating the Effects of Capture and Nutritional Variance on the Metabolism of Wild Bighorn Sheep using Quantitative ^{1}H NMR

Sindic, Caleb (Callis)
A Multifaceted Computational Investigation of a Prospective Universal Chemical Role of Water in Enzyme Catalysis

Thiebes, Joseph (Grumstrup)
Developments in Time-Resolved Microscopic Characterization of Excited State Dynamics in Semiconducting Materials

Welty, Connor (Stadie)
Topology-Dependent Energy Storage Mechanisms

MS GRADUATES (Summer-Fall 2024)

Chowdhury, Mashrur Ahmed (Grumstrup)

Evans, Ryan (Livinghouse)
Synthesis of Ciprofloxacin-Coupled AoM Esters as Pre-Cursors for Antibacterial Applications Utilizing Click Chemistry

Wattegedara, Isurika (Livinghouse)
Design, Synthesis, and Biological Evaluation of Novel Antimicrobials for Biofilm Eradication

BS GRADUATES (Fall 2024)

Ahlgren, Dylan (Biochemistry)
Dunham, Brian (Biochemistry)
Gilmore, Crosby (Biochemistry)
Hasenoehrl, Ethan (Biochemistry)
Hisey, Steven (Chemistry)
Holman, Delaney (Chemistry)
Manley, Robert (Biochemistry)
Pierson, Micah (Biochemistry)
Selong, Eli (Biochemistry)
Smith, Corbin (Chemistry)
Walsh, Camron (Chemistry)
Wambolt, Devon (Biochemistry)
Westrum, Jade (Biochemistry)
Wilcox, Kelly (Biochemistry)
Wollenzien, Kylee (Biochemistry)

GRADUATE STUDENT AWARDS (Summer-Fall 2024)

Balci, Batuhan
PhD Completion Award (Fall 2024)

Compton, Dalton
PhD Completion Award (Fall 2024)

Hutt Vater, Kian
NSF Extreme Biofilms Graduate Student Traineeship (2024)

Lerch, Bobby
Mildred Livingston Presidential Fellowship (2024-2026)

Marlott, Alex
Best Poster in Biochemistry Award, NORM (Summer 2024)

Matos-Vega, Nicole
NSF Extreme Biofilms Graduate Student Traineeship (2024)

Molacek, Lea
NSF Extreme Biofilms Graduate Student Traineeship (2024)

Muffley, Balyn
University Fellowship (2024-2029)

Osteraas, Krissy
Mildred Livingston Presidential Fellowship (2024-2026)

Theisen, Jonah
PhD Completion Award (Fall 2024)

Walls, Will
Kopriva Graduate Student Fellowship (2024)

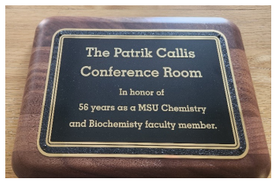
GRADUATE STUDENT MILESTONES (Summer-Fall 2024)

Completed 4th Year Seminar
Beasley, Carlos
Demeritte, Amethyst
Sather, Brett
Sobolewski, Tess
Stein, Collin

Passed Comprehensive Exam
Pollock, Charlie

CBB BUILDING NEWS

In the last newsletter we announced the retirement of Emeritus Professor Pat Callis after 56 years of service to the department. In September 2024, colleagues, friends and family celebrated Pat's incredible career. As a gift recognizing his service to the department and university, we officially named our main floor conference room "The Patrik Callis Conference Room". Congratulations Pat! We hope you are enjoying retirement.



IN MEMORIUM

The department was saddened by the news of the passing of Emeritus Professor **Reed Howald** on November 30, 2024. Reed was a chemistry professor for many years until his retirement in 1998 but continued to have a strong presence in the department by attending weekly seminars and research group meetings. Reed will be remembered as a generous person who helped financially support many of our undergraduate students in their summer research experiences. His financial pledge allowed the department to create the Harlan Byker Graduate Student Research Award, offered to a graduate student that showed promise early in their career for research. We also remember Reed as a person who had a passion for fishing. Who remembers his office in Gaines Hall? It was nothing short of a personal gallery of graph paper tracings of actual fish he caught and hung on the walls of his office. We will miss Reed strolling in the building quietly, wearing a suit coat and tie regardless of the event, and eventually asking us "where are the cookies?"

link to obituary

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Department of Chemisry and Biochemistry
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Bozeman, MT 59717