

THE CARDINAL CHEMIST

The newsletter of the Chemistry Department
at Catholic U

Welcome and Chair's Message

Welcome to the inaugural issue of the Cardinal Chemist, the newsletter of the Chemistry Department at the Catholic University of America. The department of chemistry was one of the first two science departments founded at Catholic U and we've existed quite happily since 1895 without a newsletter. However, the number of times over the past decade when I've thought, "I wish I could share this student's accomplishments with our alumni," and next, inevitably, "I wonder what this alumna/alumnus is doing now?" made me realize we could be communicating better, and we should do something about that. This newsletter is that something.

My hope for this newsletter is that we can regularly share the happenings in the department, including student activities and accomplishments; announce our graduates, their awards and future directions; introduce new faculty, and describe what our current faculty are doing—performing compelling research, receiving grants and awards, and outreach into the larger scientific and non-science worlds. I'd like to bring our former students into this content with a regular "10 Questions with an Alum" column—in this issue we attempt this with a discussion with Johnathan Harrison (BS. Biochemistry, 2021). Regular content will also include reports of our department's participation in University Research Day and our own annual Cardinal Chemistry Day. Faculty are welcome to contribute an article about something of scientific, historical, or professional interest. This issue looks at the history and new-found life of a long-serving poster of the periodic table that has helped decades of chemistry students work their way through General Chemistry and now is helping elementary students in alumna Rachel Figueroa's (BS. Chemistry, 2021) classroom. You can also look forward to pictures of our social events, including our annual Ice Cream Social at the beginning of the academic year, and our newly planned Chemistry of Mocktails Party, to be held this fall semester.

We're writing this newsletter for alumni, current students, and families that are considering Catholic U and our department as a future home for their rising college students. Some of you will receive an email notification of each issue—you're welcome to unsubscribe if your inbox can't sustain another subscription—some will find notification through our social media (Instagram, X/Twitter, Facebook), and others we hope will find it while perusing our website. However you find this newsletter and whatever relationship you have with our department, we welcome your input and contributions to this newsletter and to life in the chemistry department. How can you contribute? You can volunteer to be the subject of a future "10 Questions with an Alum," submit your current contact information and life-updates for our Alumni Directory page, share a fond memory or photo of your time with us to post in a future newsletter, and we'd welcome guest articles describing your past or current experiences related to chemistry and your history with us. Want to know more about Cardinal Chemistry Day? You can request information about our programs or activities. Of course, our department is always looking for new ways to fund student science, travel to conferences, and experiences that expand education and opportunity. You can find a QR code here that can help you contribute to these activities.

We look forward to sharing our chemistry community with you, to reconnecting with past students, and engaging with students interested in joining us.

Excelsior Chemistry!

Gregory J. Miller
Associate Professor and Chair

A Vintage Periodic Table Embarks on a New Adventure

There are few scientific images that are more recognizable than The Periodic Table of Elements. Watson and Crick's double helix of DNA and perhaps the cartoon Bohr model of an atom may be equally as recognizable to scientists and non-scientists as a periodic table. However, the picture of the DNA double helix only implies its function and enormous potential, while the Bohr cartoon requires a creative and more emphatic word for "antiquated" to accurately describe its use in modern chemistry. The Periodic Table, no matter how old, faded, or how many new discoveries have been made since a version's printing, remains one of the most elegant and informative constructs in science. New discoveries don't change the table's fundamental structure and no matter how many elements are created and added, none so far have revealed that its organization contains logical missteps or suggest our foundational concepts of Groups and Periods are wrong. New elements are tacked onto the table in the exact place the table's inherent logic predicts and requires.

For decades, a silent member of the chemistry department sat—or rather hung—in every General Chemistry class at Catholic U. This was a periodic table in the Chemistry department's long-time home in Maloney Hall. Old and faded, we can guess when this periodic table was published in the same way we can predict when a historical US flag was sewn. Forty-three stars? That must be from July 1890-1891 right before Wyoming became the 44th state. This periodic table has Unh as its highest atomic number element. Unh—atomic number 106 and called Unnilhexium from its discovery in 1974 until it was renamed Seaborgium in 1997—suggests publication of this periodic table is within those 23 years. The absence of atomic numbers higher than 106 limits this further yet. Element 107—absent from this table—was discovered in 1981, so this table must have been published before it was updated to add this new element.

Thankfully, there is no planned obsolescence in Periodic Tables—no table is ever past an expiration date—so for the number of times we need to discuss Nihonium, we can forgive a table if it lacks this element or its recently formalized name. Alas, when we moved

from Maloney Hall in 2014, we no longer had an auditorium for our silent colleague, so it took up quiet residence in a meeting room where students gathered to study. Our lack of a permanent auditorium retired it rather than its age. No longer present in our classes—our classroom assignments are now moved around campus each semester in unpredictable and non-repeating ways—we have now had a decade of students who did not benefit from this table in their General Chemistry classes. An age had ended. That was until an alumna, Rachel Figueroa (B.S. Chemistry, 2021) with a newly minted M.Ed from the University of Notre Dame asked if we had a poster of a periodic table we weren't using that she could use in her classroom. Rachel had recently accepted a teaching position at Washington Jesuit Academy (WJA), mere blocks from Catholic U. "Of course we do," we responded, "as long as you don't mind it being...vintage." Rachel seemed to find this a feature rather than a bug. Rachel explained that for her students, "[i]t was particularly helpful to have an older periodic table since I like to emphasize the fact that the periodic table is a living document. Students were able to see that for themselves, which was great!" Our periodic table had found a good home and remains in our neighborhood less than a mile from the chemistry department. "WJA is a tuition-free, Jesuit, all-boys middle school serving underprivileged young men from the District. It's extremely mission-driven and a tight knit community!" Rachel explained. Rachel received the periodic table partway through the 2023-24 school year and put it to good use immediately: "It is like a watchful guardian over the science classroom at WJA. Students as young as 4th-grade love quizzing each other on the names of the elements. It has been wonderful to use, especially as an academic resource in 8th-grade science! It helped to guide our lessons on the history and development of the periodic table."

No one could be happier this Period Table found a new home than Dr. Greg Brewer, Professor Emeritus and former long-time chair of the chemistry department. "The periodic chart is nothing short of a marvel, if read properly" he wrote, "and the one that hung in Maloney Hall brings back many memories of the several thousand students that I instructed in general chemistry there for 27 years (1987-2014). There is no way I could have taught without that chart, I used in almost every class... I have had students say that you really just need the periodic chart, not the text, to understand chemistry. While that is an overstatement it does recognize the central importance of the periodic chart to our understanding of chemistry."

We all have access to the most current Periodic Table of Elements on our laptops, tablets, and phones, but we delight in knowing that our long-serving table—that isn't quite up to date—is in wonderful and skilled hands and will be a useful tool for new generations of chemistry students.

Dr. H Recognized by the University for Teaching Excellence

At this year's University Research Day, Dr. Katherine Havanki—"Dr. H." to her students—received the Provost's Teaching Excellence in Early Career Award. Awarded annually to a faculty who has excelled in teaching while in their first 10 years at Catholic U, we are delighted Dr. Havanki is recognized by the University for her tireless work for her students. Dr. Havanki is a consistent favorite among general and organic chemistry students. Dr. Havanki reimagines these challenging introductory classes to engage and excite students and prepare them for success in all areas of STEM education. This is a Herculean task: these large courses have diverse audiences—there are chemistry majors, biology majors, engineering students, and myriad students in the pre-med concentration. Keeping the attention of this population of students is a challenge. Doing it while teaching at a high level is a commendable accomplishment. To do this in *every* section of *every* course *every* semester is *extraordinary*.

In addition to lecture courses, Dr. Havanki has taught more sections of undergraduate labs than any other current member of our department. To do this

work successfully—as Dr. Havanki does—you need to be an excellent teacher, but also pay meticulous attention to safety concerns. First year students in chemistry labs for the first time in their college careers can be a greater safety concern than any other class on campus. Dr. Havanki manages these challenges professionally and with care for our students' safety. Incidents in our labs are essentially non-existent. This feat is the consequence of the efforts of Dr. Havanki and Ksenia Loginova, our Laboratory Manager. Teaching these courses is clearly more than "just" teaching. It requires the constant vigilance of instructors and staff who care about our students and the integrity of our educational program.

This is not the first time Dr. H has been recognized for her dedication and success teaching our undergraduates. In 2021, she won the Ingrid Merkel Award for Excellence in Teaching given annually by the School of Arts and Sciences.

Congratulations Dr. H!



10 Questions with an Alum:

Jonathan Harrison (BS. Biochemistry, 2021)

Our first victim in this series is Jonathan Harrison. Jonathan graduated with a double major in biochemistry and theology and a minor in math in 2021. Graduating during the pandemic, Jonathan endured the transition to Zoom classes, the first efforts to teach remote labs, and even performed remote research for several semesters and one summer. After graduation, Jonathan remained in the DC area and has worked at the National Institutes of Health. After an application process that took him across the country to some of the most prestigious institutions in the US, Jonathan now prepares to enter a graduate program.

1. What initially sparked your interest in chemistry/biochemistry, and why did you choose to pursue it?

When I first took chemistry in high school, I really enjoyed seeing how chemistry explained so many disciplines and much in our day-to-day life. I had an amazing chemistry teacher, and he encouraged me to explore my interests in chemistry; having that support really helped me pursue chemistry into college.

2. Can you share a memorable moment or experience from your time in the chemistry/biochemistry/environmental chemistry program?

I'll never forget the late night Wednesday and Friday labs with Dr. Knyazev. While it wasn't always fun being hungry and in lab late, it was a great bonding time with my classmates: working together on a common goal and being excited when we saw everything work.

3. Which courses or professors had the most significant impact on your education and career path?

Specifically in the realm of chemistry/biochemistry, doing research with Dr. Miller had the biggest impact on my education and career path. Getting the hands-on experience was instrumental to helping me realize I wanted to pursue research. Outside of chemistry, I was a theology double major, and the most impactful liberal arts class was titled "Charlemagne to Chaucer: Christian Life in the Middle Ages". That class had a huge impact on me for two reasons: becoming a better writer, and learning how to connect topics, how something I learned a month ago connects to the big picture. I was also a math minor, and the most impactful math class was "Euclidian and Non-Euclidian Geometry". The

class challenged me to face problems from every imaginable angle. I try to use that mentality now in the lab when designing experiments, and I think it has been a huge help in my research.

4. How did the university's resources, such as labs and libraries, contribute to your academic development?

The labs built into the classes were a big strength in my academic development. I got the chance to do experiments hands on that people at larger universities only get to read about because they only have so many resources. But at Catholic, I got the chance to learn the ins and outs of these advanced techniques by doing. The labs also gave me a chance to think through problems; rarely would a lab go exactly to plan, but I was given the chance to troubleshoot and think through what caused the problem and how to fix it. That experience was instrumental in my academic development.

5. What was your first job after graduating, and how did you secure it?

My first job (and currently only job) after graduating was with the NIH IRTA Postbac Program in the lab of Dr. Jenny Hinshaw in the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). After my summer internship in a different lab in the NIDDK, I reached out that I would be interested in a postbac, and that I was interested in structural biology/biochemistry. That lab helped direct me to Dr. Hinshaw's lab, matching my interests with her availability to have a postbac.

6. Can you describe a typical day in your current role and how your chemistry/biochemistry background is utilized?

Being in a structural biology lab, I use biochemistry in two different and unique ways. First is expressing and purifying protein. I use a lot of biochemistry to figure out how to express protein and the different techniques for purifying, like the techniques I learned in Biochemistry I and II. The second aspect is the structural element when looking at a protein's structure. I use biochemistry when thinking about specific amino acid interactions – energetics, clashes, and ligand binding rates.

7. Have you pursued any additional education or certifications since graduating? If so, what motivated you to do so?

In August I will be starting at University of North Carolina in their Biological and Biomedical Sciences Program (BBSP) for a PhD. I haven't specified which track, but I will likely do either Biochemistry & Biophysics or Cell Biology & Physiology.

8. Looking back, what do you wish you had known or done differently during your time at Catholic U?

One thing I wish I had done differently was to explore more intellectually, through challenging myself in my classes and finding/attending seminars on campus. Being at the NIH now, we have almost limitless options of seminars, and I have found them super stimulating and great opportunities to learn and build connections. I think there would have been great opportunities to explore had I sought them out.

Don't be afraid to go outside your comfort zones. Try new things and don't be afraid to aim high.

9. Can you share a success story or proud moment in your professional life that you attribute to your biochemistry education?

I've been proud of being able to come in with no experience in clathrin mediated endocytosis and dynamin, to then in three years in my postbac being able to understand the field: understand the developments over the years, the debates in the field, and the biggest unanswered questions. I think one of the key aspects of my biochemistry education was the communication skills I learned, especially presenting and reading papers.

10. What message(s) or advice would you like to share with future students considering a degree in biochemistry?

Work hard – nothing can replace the value of hard work

Be creative – creativity is so important in science, and really any career. Foster creativity, explore ways to be creative, and utilize your creativity.

Explore and find your passion – Don't pigeon-hole yourself to doing one thing, but be willing to try different options, from pure chemistry, to materials, to biochemistry, to environmental options. It's hard to know if you like something unless you try it with an open mind. And find something you're passionate about. As cliché as it sounds, I've found that when I'm passionate about what I'm working on, I find my work fun and time really flies by. Find a niche that excites you.



Congratulations to Our Class of 2024

We congratulate our students who graduated this academic year! We wish them the best in their future endeavors!

Anna Hasker, Bachelor of Science (Chemistry)

Winner of the Chemical Society of Washington
College Achievement Award

**Ben Iannuzzi, Bachelor of Science (Chemistry), minor:
Philosophy**

Winner of the Cynthia and Greg Brewer Award in
Chemistry

Maggie Martin, Bachelor of Science (Chemistry)

**Marc Murphy, Bachelor of Science (Chemistry), minor:
Math**

Avery Pilot, Bachelor of Science (Chemistry), minor: math

**Denisse Tavarra, Bachelor of Science (Biochemistry)
Minor: Hispanic Studies**

Dakota Turnage, Bachelor of Science (Biochemistry)
Winner of the Catholic U Biochemistry Award

Maddy Wahl, Bachelor of Science (Chemistry)



Our graduates (or most of them) celebrate their graduation on a sunny afternoon with faculty.

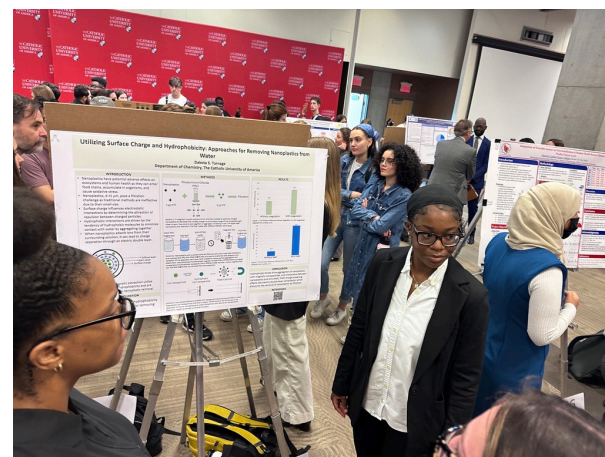
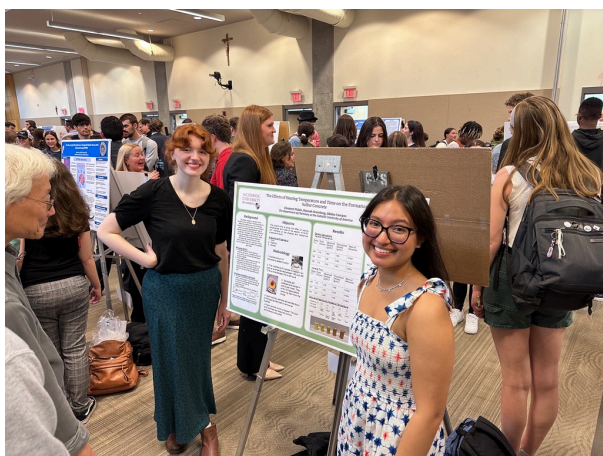
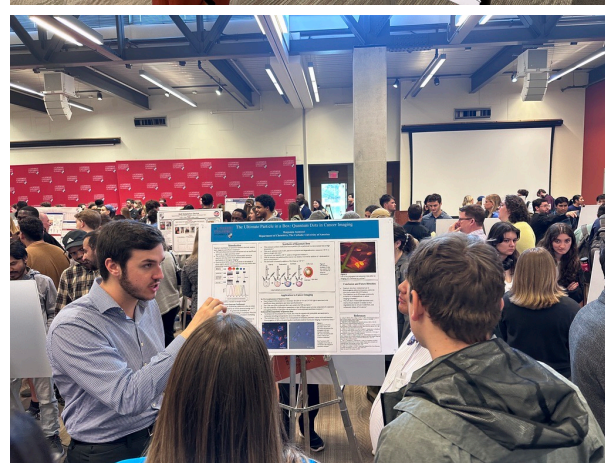
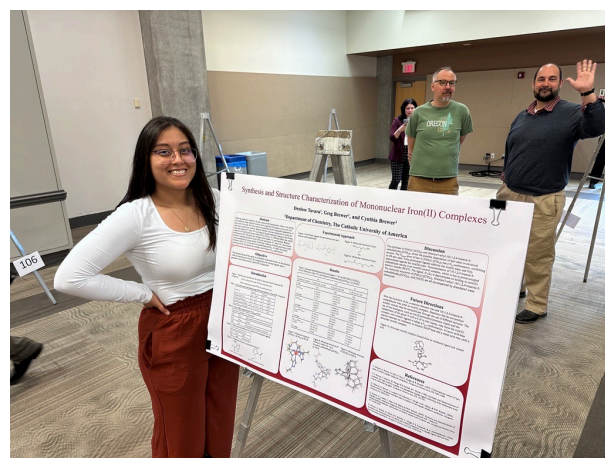


University Research Day 2024

Each spring semester, students, staff and faculty from across campus share their research at University Research Day (URD)! This is an event we anticipate all year as it is an opportunity for our students to showcase their hard work and exciting results.

Avery Pilot (below) was selected as a finalist in the Undergraduate Poster category for her poster: **Is Low Temperature Extrapolation of Stage III Glass Leaching Occurrence Valid?** This was one of the most competitive categories with 58 undergraduate posters!

Congratulations, Avery!

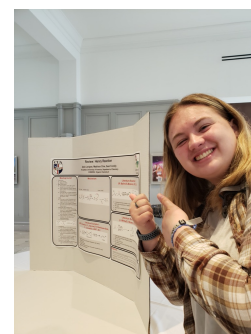
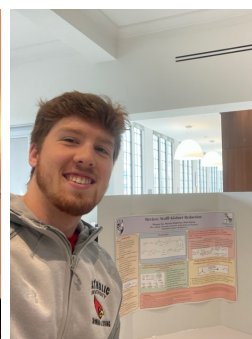
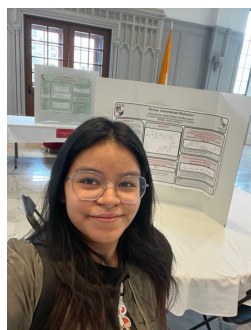
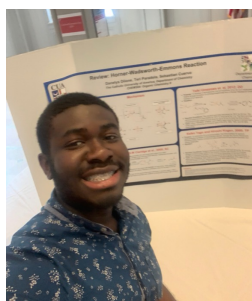


Cardinal Chemistry Day, 2024

Cardinal Chemistry Day is a day-long scientific conference on Catholic U campus. This conference was started in 2023 and highlights student research in chemistry, biochemistry, and environmental chemistry. Our seniors present posters of their research as part of their Comprehensive Exam and we have student and faculty research talks. In addition, we had posters from our second-year students who shared their work from their organic chemistry classes.

Our alumni speaker this year was Timmy Le (B.S. Biochemistry, 2013). He talked about his Ph.D. research on the influence of biological sex and sge on alcohol modulation of neurons.

Congratulations to all our participants!



Chemistry Faculty Activities

Dr. Aaron Barkatt, Professor Emeritus

Dr. Barkatt has been accepted to present two presentations at upcoming conferences:

"Sulfur concrete as in-situ construction material on Mars: Preliminary analysis of the MMS-1 and MMS-2 Martian regolith simulants and concrete specimens made from the simulants" by M. Okutsu, L.P. Cook and A. Barkatt, ASCEND meeting (conducted by AIAA, American Institute of Aeronautics and Astronautics), Las Vegas, NV, June 17-20, 2024.

"Sulfur concrete for immobilization of waste products: Preliminary study using fly ash and blast-furnace slag" by M. Okutsu, P. Kwiatek, W. Wong-Ng, L.P. Cook and A. Barkatt, 12th International Conference on Sustainable Development, Rome, Italy, September 11-12, 2024.

Dr. Greg Brewer, Professor Emeritus

Dr. Brewer has recently published two papers. They contain 19 structures of the ketimine tautomer of amino acids that have been proposed in biochemistry for ~70 years but never isolated or structurally characterized. We present 2 methods of synthesizing the ketimine tautomer of amino acids and demonstrate isomeric control over the product of the reactions.

Formation of Ketimines from Aldimines in Schiff Base Condensation of Amino Acids and Imidazole-2-Carboxaldehydes: Tautomerization of Schiff Bases of Amino Acids resulting in the Loss of a Stereogenic Center. Brewer, G.; Brewer, C. T.; Butcher, R. J.; Zavilij, P. *Inorganics*, **2023**, 11, 381. <https://dx.doi.org/10.3390/inorganics11100381>

Selective Generation of Aldimine and Ketimine Tautomers of the Schiff Base Condensates of Amino Acids with Imidazole Aldehydes or of Imidazole Methanamines with Pyruvates- Isomeric Control with 2- vs 4- Substituted Imidazoles. Brewer, G.; Brewer, C. T.; Butcher, R. J.; Zavilij, P. *Molecules*, **2024**, 29, 1324.

<https://dx.doi.org/10.3390/molecules29061324>

Dr. Greg Miller, Associate Professor

Dr. Miller is a member of the American Society for Biochemistry and Molecular Biology (ASBMB) Science Outreach and Science Communication Committee and this spring co-chaired, with Dr. Crystal Mendoza (Apriori Bio) a 3.5-hour course on *The Art of Science Communication* at DiscoverBMB, the national annual meeting of the ASBMB in San Antonio, TX. Participants included graduate students, postdoctoral fellows, and faculty.



Programs and Goals

Student Research

One of our priorities is to fund research experiences for our undergraduate students. These opportunities are essential for students to gain experience applying what they've learned in their formal coursework to the expansion of knowledge in research laboratory.

Funding for these programs will expand the scientific questions students can ask as they explore their projects. It fund their travel and registration at local, regional, and national conferences where they share their research with the greater scientific community. It can also fund their research as summer employment over the summer. Students can continue their research in a way that does not require them to seek additional employment.

Teaching and Research Instrumentation

We offer rigorous hands-on training using modern instrumentation. This requires us to maintain our current equipment and work to expand and update the equipment for our students' use.

This is essential for students to be well-trained and prepared for the next stages of their educational and research careers.

If you would like to help fund these and other programs, this code can be used to direct you to our donation page. Thanks for your support!



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