A Banner Year for NMRFAM

Special Feature on SARS-CoV-2
Faculty Profile Series
And more
The Biochemistry In Vivo newsletter keeps our community of researchers, students, alumni, supporters, and friends at UW–Madison and around the world up to date on happenings in the department. It is our sincere hope that you will find this newsletter engaging, enlightening, and inspiring. The 2021 edition is a presentation of achievements and continued success as we adapt to challenges and move forward on so many fronts.

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The cover story on p. 3.

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a fascinating educational primer, coming from the research of Assistant Professor Rob Kichdoefer, Professor Katherine Henzl-Weidman, Professor Chad Rienstra, and Professor Ann Palmenberg, on the surface proteins of SARS-CoV-2, the virus that causes COVID-19 (p. 10-13). These are essential determinants of infectivity and immune system protection. At this point, an exceedingly high level of personnel in the department, including high school interns and undergraduate employees, are vaccinated against COVID-19.

In June, when the COVID-19 delta variant was mostly rumor and omicron had yet to evolve, Biochemistry and Biochemical Engineering Professor Chad Rienstra, an expert in the history of ice cream social where masks came off and people saw each other socially for perhaps the first time in over a year. Voices of greeting and elated over the department. Assistant Professor Jacob Rapp graces the back cover. In distinct ways, these examples outline a bright, innovative, productive future for the department.

The department thrives on the diversity, skills and commitment of its members, alumni, supporters, and friends, and as outlined above, we are dedicated to excellence in all facets of our lives. If you can, please join us by becoming a donor to the Department of Biochemistry. Our need for your support in these challenging times is greater than ever, and we request your consideration of generosity in three areas: named fellowships for support of students across all genders, ethnicities and need levels; named professorships to support the innovative work of the faculty; and, named opportunities to support our nationally recognized facilities. A highlight on biochemistry alum Daniel Kleissig, B.S. ’71, on p. 15 provides a great example of how generosity combined with insight can provide impact.

If you are so inclined, please contact us, or the University of Wisconsin Foundation, about your interests in supporting a bright future for the department. Contact details for the department can be found at the front of this newsletter, and details for the Foundation on p. 31.

We encourage all of you to reach out to us, and we look forward to an even more active community, both on campus and online. As we continue to affirm our commitment to excellence. Also let us know if there is something you would like to see featured in future editions of the newsletter.

Mostly, we hope you are able to be safe in the year ahead and look forward to hearing from you.
High-Resolution Mapping of Molecules within Cells

Assistant Professor Amy Weeks Named Packard Fellow

Amy Weeks, a biochemistry assistant professor, was selected as a Packard Fellow for Science and Engineering.

The fellowship is awarded annually to early-career scientists from across the United States and provides $875,000 of funding over five years. Since 1988, the fellowships have supported the scientists and engineers whose research over time has led to new discoveries that improve people’s lives and enhance our understanding of the universe. Amy Weeks is one of 20 members chosen for the 2021 class and is UW–Madison’s 17th Packard Fellowship winner.

“Packard Fellows are at the cutting edge of research into crucial issues and have gone on to receive the highest accolades,” says Brian Fox, associate vice chancellor for research and graduate education. “Amy takes a creative approach to her research and thinks big.”

Packard Fellows are indeed encouraged to think big and look at complex issues with a fresh perspective. For Weeks, this thinking means organizing her research around a grand challenge in biology: assigning functions to the hundreds of thousands of modifications that occur in human cells to the proteins the cells produce from mRNA. Her research group draws from diverse disciplines, including protein engineering, chemical biology, cell biology and proteomics, using a host of different tools and technologies.

“If we can do this, I think it will be really powerful in different areas of both fundamental biology and also medicine,” Weeks says. “When graduate students come into my office and are interested in joining the lab, the main pieces of advice I give them are to be curious and to be willing to learn. You don’t have to come in knowing everything, but you have to be willing to try to figure it out.”

Weeks came to UW–Madison in 2019 and set up her lab just six months before the COVID-19 pandemic forced much of campus to go online. “The Packard Fellowship award is exciting and it is a real relief right now to have some extramural funding for my research that will support my lab going forward,” she says.

Original story by Natasha Kaczala, OFC/RGE
(Office of the Vice Chancellor for Research and Graduate Education)

New and emerging tools such as cryo-electron microscopy (cryo-EM) give scientists a way to define the structures of molecules at high resolution. But identifying exactly how these molecules reside within the cell — and exactly how they interact with their neighbors — remains unknown.

Biochemistry assistant professor and Morgridge Institute for Research investigator Timothy “Tim” Grant is part of a new project supported by the Chan Zuckerberg Initiative that hopes to create a three-dimensional map that aligns these molecules in their proper neighborhoods within a cell. Grant is partnering on the $1.3 million project with scientists Nikolaus Grigorieff, a professor of RNA therapeutics at the University of Massachusetts Medical School, and Bronwyn Ayla Lucas, a postdoctoral fellow in the Grigorieff Lab.

The group is using an innovation called high-resolution template matching, a computational approach that takes existing known structures of molecules and finds their most likely matches within cryo-EM images of a cell.

“What’s really useful is that you can see things that are commonly located next to each other, and so likely interacting,” Grant says. “They could be part of a pathway, for example. This should give us an idea of how systems actually function within living cells.”

The grant is part of the Chan Zuckerberg Initiative’s visual proteomics focus area. Being able to visualize protein molecules within cells opens a new frontier in medicine that can help determine the origins of cellular diseases and what treatments might be most effective.

Original story by Brian Mattmiller, Morgridge Institute for Research

Doubling down on diabetes research and support a new Comprehensive Diabetes Center at UW–Madison

Since they have established and staffed research facilities and funded twelve pilot projects like Simcox’s to bolster innovative research in diabetes, obesity and metabolism. These projects will help advance diabetes research and support a new Comprehensive Diabetes Center at UW–Madison.

Professor Judith Simcox

Original story by Catherine Stoff, Ph.D., Biochemistry

Developing Equitable Biomarkers for Diagnosing Metabolic Syndrome

Diabetes disproportionately impacts underrepresented minorities, who have a higher prevalence of diagnosis and complication rates of diabetes compared to white individuals. Despite this, the prevalence of metabolic syndrome — the proportion of a population that at any given time has a group of five conditions that can lead to health problems like heart disease and diabetes — is similar across races. Why?

“Traditional health markers for metabolic syndrome — high blood glucose, low levels of HDL, which is known as the ‘good’ cholesterol, a high body mass index, high levels of LDL, which is known as the ‘bad’ cholesterol, and elevated blood pressure — were identical for African Americans and Caucasians,” Simcox says. “But what works for them doesn’t work for others.”

For example, a woman’s body mass index (BMI) isn’t indicative of whether she is likely to develop metabolic disease, and correlations between HDL, blood pressure and metabolic syndrome don’t hold for African Americans. Scientists need to identify and develop more equitable biomarkers for metabolic syndrome, Simcox says. Then, new interventions to prevent and treat diabetes that work for more people can be developed.

Simcox’s research will identify and classify previously unstudied lipids to determine whether these could be possible biomarkers for metabolic disease in women and underrepresented minorities. Lipids are a class of biomolecules with a diverse array of functions essential for life, and scientists have yet to characterize thousands of lipids that appear in biological samples obtained from humans.

In a recent study, Simcox and her collaborators may soon be able to explore their questions on an even larger scale and with more collaborators. Last year, Simcox and Dudley Lamming, a professor in the Department of Medicine, received a UW2020 WABER Discovery Initiative Award. Since then, they have established and staffed research facilities and funded twelve pilot projects like Simcox’s to bolster innovative research in diabetes, obesity and metabolism. These projects will help advance diabetes research and support a new Comprehensive Diabetes Center at UW–Madison.

Original story by Catherine Stoff, Ph.D., Biochemistry

Professor Judith Simcox

Original story by Brian Mattmiller, Morgridge Institute for Research

A large fraction of the plasma metabolite pool is lipids. Image courtesy of Judith Simcox
The first grant, a P41, will provide the facility with $6.5 million over five years to pioneer new methods for solid-state nuclear magnetic resonance (NMR) spectroscopy, a tool that can be used to determine the chemical composition, local structure and dynamic properties of solids. With this grant, Henzler-Wildman, Rienstra and NMRFAM scientists will focus on NMR development in three areas: sample preparation, instrumentation, and algorithms and software. Advances in sample preparation will bridge gaps in structural biology research and improve our understanding of how essential membrane proteins function, while fundamental algorithms and software will be automated.

Substantial progress has already been made on advancing solid-state NMR instrumentation. NMRFAM installed a 570 MHz magnet that will contribute to the continuing development of NMR technology at NMRFAM for the next two to three decades. This wide-bore magnet operates at about 350,000 times the strength of Earth’s magnetic field and will help scientists develop new technologies such as probes that can operate at four or five NMR frequencies simultaneously, and pulse sequences and receivers that provide improved resolution and sensitivity.

The magnet and custom probes have already enabled researchers to solve structures implicated in Parkinson’s disease in a collaboration with biochemistry assistant professor Timothy Grant, who is developing computational tools to utilize structural information alongside cryo-electron microscopy (cryo-EM) and cryo-electron tomography (cryo-ET). The new magnet was also used to study the dynamic properties of solids. With NMR frequencies operating at four or five times the strength of Earth’s magnetic field and will help scientists develop new technologies such as probes that can operate at four or five NMR frequencies simultaneously, and pulse sequences and receivers that provide improved resolution and sensitivity.

The second grant is an R24 award that will help NMRFAM maintain and excel in the services it provides to scientists and other users, such as facilitating experiments that scientists may not be able to perform at their home institutions.

"This award will support continued implementation of state-of-the-art methods into our established solution NMR user program so that users have access to the latest technology," says Henzler-Wildman. "It will also enable us to expand our user program to include solid-state NMR methods that will be of interest to scientists studying membrane proteins, fibrils and other complex biological materials."

The diversity of applications and techniques in NMR is both a strength and a challenge. NMR can describe the structure and interaction of complex molecules by using magnetic fields to measure the orientation of the nuclei in the molecules’ atoms. NMR technology can be applied to elucidate interactions between drugs and drug targets, aid in the search for new antibiotics and more.

NSF Award Establishes Network for Advanced NMR

As such, NMR is generally limited to experts who can manipulate the technology and raw and processed data, but NAN intends to make NMR more accessible.

"We have a responsibility to be good stewards of the instruments as well as of the data that’s obtained with the instruments," says Rienstra.

Instruments incorporated into NAN will automatically archive raw data, linking it to information about the sample, experiment and more to make it findable, interoperable and reusable. The project will also help develop a knowledge base to share fundamental information often absent from scientific literature.

"It’s [this type of information] not written down because the experts already know it," says Henzler-Wildman. "Knowledge bases will help users figure out which experiment is most appropriate to get the data they need, how likely it is to work for their particular sample, what kind of information they can get out of an NMR experiment, and how that can help solve their problem. Knowledge bases provide translations so we can bring outside users in and make the whole field more accessible." NAN will also further NMRFAM’s role in pioneering techniques and commissioning state-of-the-art equipment to expand its broad user base.

NAN’s three partner facilities have a combined 50 years of operational experience, space, infrastructure and strong institutional support. UConn will be responsible for managing data stewardship and developing new technologies for consolidating, organizing, annotating, sharing and archiving NMR data. Georgia will house a second 1.1 GHz NMR spectrometer as well as small molecules for metabolomics and drug screening. The NSF funding comes from the agency’s Mid-scale RI-2 Program, part of NSF’s set of “Big Ideas” unveiled in 2016: ten long-term research and process ideas that identify areas of investment at the frontiers of science and engineering.

Once instrument installation and network connection are complete, an open call for membership by shared NMR facilities will be issued, further expanding the reach of NMR projects and technology.
Crop Harvests and Bacterial Blends

Professor Ophelia Venturrelli

Gel exudes from the aerial roots of a special nitrogen-fixing corn variety growing at West Madison Agricultural Research Station. Photo: Michael P. King

When communications scholar Marshall McLuhan coined the famous phrase “the medium is the message” in the 1960s, he was saying that our understanding of an idea will be shaped by how we receive it — whether it’s conveyed through a book, a lecture, a movie or the internet.

Biochemistry assistant professor and Morgridge Institute for Research investigator Jason Cantor has an interesting equivalent for researchers: The medium used to grow cells in a lab has a similarly profound impact on the “message” cells receive on how to grow and respond. This is the concept behind Cantor’s innovation of a new cell culture medium — a biological research tool that since the 1950s has been ubiquitous in labs as microscopes and petri dishes.

Not long into his postdoc, Cantor posed a deceptively basic question: How closely do classic cell culture media reflect biochemical conditions in the human body? The answer: Not too well.

This question ultimately led to the development of Human Plasma-Like Medium (HPLM), a physiologic medium that more closely reflects the metabolic composition of human blood. HPLM contains more than 60 components at concentrations that reflect average physiological values reported in human blood. This innovation in cell culture media design was a long time coming, as the formulations for these reagents haven’t changed much since Johns Hopkins physician Harry Eagle developed “Minimal Essential Medium” in 1955.

Cantor reported the design and initial studies using HPLM in Cell in 2017 while a postdoc at the Whitehead Institute/MIT. Since that initial publication, HPLM has generated a great deal of interest from biologists across the scientific community.

Now Cantor is officially bringing a product to market, “and it should be pretty exciting to see what others discover with HPLM, as well.”

In a paper published earlier this year in Cell Metabolism, the Cantor Lab, together with colleagues at Whitehead Institute, also used HPLM to show that medium composition can have a profound impact on gene essentiality — in other words, the extent to which a human microbe or cell fitness, which is a characteristic critical to many human diseases.

“The really core essential genes,” says Nicholas Rossiter, a former technician in the Cantor Lab and lead author on the paper, “are almost universally important for growth across all human cell lines tested in any medium, no matter how closely it is shaped by human blood. HPLM contains more than 60 components at concentrations that reflect average physiological values reported in human blood. But by performing CRISPR-based screens of cancer cells in different media, the researchers identified conditionally essential genes, and in specific cases highlighted in follow-up work, trace such effects to the availability of components uniquely defined in HPLM (versus traditional media).

“The shows that there are aspects of the environment that we can tinker with to make a gene become more or less critical for cell growth. Certainly, there are also implications here in terms of how to potentially increase the fidelity of what we see in the lab and what might happen in the body,” says Cantor.

Such implications could be far reaching. Use of HPLM may allow researchers to conduct experiments that are more directly relevant to human disease. If, for instance, scientists can alter the importance of a specific gene for cancer cell growth, then its encoded protein could become a more promising target for treatment. And smarter therapeutic approaches can be developed as researchers understand more about the target’s response to various perturbations.

Original story by Catherine Stoffel, Ph.D., Biochemistry and Brian Mattmiller, Morgridge Institute for Research

The (Cell) Medium is the Message: Studying Cell Biology in a Dish

Professor Jason Cantor
Unpacking SARS-CoV-2

Less than a year after he joined the Department of Biochemistry, Robert Kirchdoerfer BS’06 and his nascent coronavirus research program were thrust into the spotlight. The new assistant professor was quickly becoming known around the UW–Madison campus as “the coronavirus guy,” a linchpin of efforts at the university to understand the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes COVID-19.

Kirchdoerfer is an expert in using cryo-electron microscopy and other advanced techniques to characterize viral proteins and complexes. As a graduate student and then as a postdoctoral researcher at The Scripps Research Institute in Southern California, he was a member of one of the first teams to stabilize spike proteins, notoriously tricky proteins that rapidly change configurations to adopt a shape that’s not relevant for recognition by antibodies. By keeping spike proteins in a single configuration, scientists could use cryo-electron microscopy (cryo-EM), an imaging technique used to visualize molecules on sub-nanometer scales, to study the spike protein’s structure, investigate the transitions the protein takes to recognize host protein receptors, and design vaccines with it as an active ingredient.

Today at UW–Madison, Kirchdoerfer and his colleagues are studying the structures and functions of proteins and RNA synthesis complexes from SARS-CoV-2. Their research, which synthesizes expertise and results from several disciplines and state-of-the-art technologies, demonstrates just how much of the “life cycle” of SARS-CoV-2 remains to be discovered — every research study, every experiment, informs another, and lives hang in the balance.

Special Feature

Complementary Data

In spring 2020, scientists at the National Magnetic Resonance Facility at Madison (NMRFAM), a campus-wide and national facility housed in the biochemistry department, were looking for ways to contribute to the fight against COVID-19. Nuclear magnetic resonance (NMR) spectroscopy could complement Kirchdoerfer’s cryo-EM research, said biochemistry professor and NMRFAM co-director Katherine Henzler-Wildman, by providing new insights into parts of the virus that are too small to study individually with cryo-EM.

Henzler-Wildman and her NMRFAM co-director, biochemistry professor Chad Rienstra, decided to study the membrane protein and two nonstructural proteins, nsp7 and nsp8, as part of an international consortium called the COVID19-NMR Project. Improved knowledge of nonstructural proteins, parts of the RNA synthesis machinery responsible for replicating and transcribing the viral genome after a virus infects a host cell, can lead to antiviral drugs that halt a virus replication process.

The scientists’ NMR experiments, performed using protein produced by Kirchdoerfer’s lab, confirmed that SARS-CoV-2 nsp7 is spectroscopically and structurally similar to the nsp7 in the original SARS virus, SARS-CoV. In an ideal world, their studies on nsp8 and the membrane protein would also be straightforward. But that isn’t how research often progresses.

“We can’t say much more right now, but our results for nsp8 aren’t what we expected,” remarks Henzler-Wildman. “We thought that nsp8, which joins with other nonstructural proteins like nsp7 to form the larger complexes necessary for replicating the virus’ genetic material, would be dynamic with multiple conformations in solution. It actually has concentration-dependent oligomerization.” Now, the scientists must consider a different set of potential dynamics, including what nsp8 does in solution and how it ends up in its various conformations.

The NMRFAM team faced a different challenge with the membrane protein: it had never been reliably produced in a laboratory. So, while scientists believe the protein plays an important role in viral “budding,” a process viruses use to exit host cells, the protein remains understudied — and, some experts say, underutilized — in the fight against COVID-19.

By fall 2021, the UW–Madison team was making significant progress at purifying the membrane protein and was pondering their next steps. Data they collect may be especially important: research being conducted nearby suggests that this protein may be an active ingredient in the next SARS-CoV-2 vaccine.

The Next Vaccine Candidate?

In a collaboration with researchers at UW–Madison’s School of Medicine and Public Health, preeminent virologist Ann Palmenberg had been identifying molecular interactions between rhinovirus-C, a virus closely linked to wheezing and asthma, and its cellular receptor when the pandemic hit.

“Basically we’re dissecting components of the immune system down to the biochemical level of, what are the antibodies you want to induce, what are the antibodies you don’t want to induce, and why does one work but not another,” Palmenberg, a biochemistry professor and Institute for Molecular Medicine co-director, explained. “We’re actually studying how the immune system responds to infections.”

Palmenberg’s research complements Kirchdoerfer’s, and the two are working together to find out if the SARS-CoV-2 membrane protein is a good candidate for a vaccine.

Illustration of the SARS-CoV-2 genome and proteins. Biochemistry department scientists have improved our knowledge of the spike protein, membrane protein, nsp7, nsp8, nsp12 and more.

Reprinted with permission from RCSB PDB-101
Special Feature

Molecular Virology affiliate, explains. "We were not going to make the next batch of chips and collect data on rhinoviruses... when COVID-19 came. We said, you know what, instead of designing the rhinovirus sequences on this chip, let's put coronavirus sequences on it."

The peptide array technology Palmenberg used was a brainchild of UW-Madison scientists including biochemistry professor and Biotechnology Center affiliate Michael Sussman (the technology was transferred to Roche, a Swiss multinational healthcare company). Each chip contains the entire genome of a virus in the form of peptides, or fragments of proteins. By identifying where humans mount strong, broad antibody responses to the spike, membrane, and nucleocapsid proteins, because the immunogenicity of spike-based mRNA vaccines is variable, and because not all individuals who get COVID-19 produce detectable antibodies against the spike or nucleocapsid proteins, the scientists suggest that membrane proteins could be a promising target for future SARS-CoV-2 diagnostics, vaccines, and therapeutics.

Signal from Noise

Though his role may not always be obvious, Kirchdoerfer has played a part in many projects that aim to understand SARS-CoV-2. He’s had a hand, for example, in devising new strategies to characterize the activity of enzymes, substances that act as catalysts in biological processes. This project, led by Michael Sussman, is expected to be important for rapid, timely characterization of enzymatic activity in SARS-CoV-2.

Kirchdoerfer’s ongoing research using cryo-EM may also provide insights into the workings of the SARS-CoV-2 RNA synthesis complex and lead Kirchdoerfer, an Institute for Molecular Virology affiliate, helped the scientists match antibody-sequence pairs from the protein chips to structures from cryo-EM.

"Rob works on a number of fronts surrounding how coronaviruses function, from isolated components to intact viruses," says Kirchdoerfer. "To investigate how SARS-CoV-2 replicates, he has started by assembling and examining the structure and function of components of the virus’ replication complex," says biochemistry professor and Morgridge Institute for Research affiliate Elizabeth Wright.

"He does the fundamental molecular biology, protein expression, and functional assays in his lab to determine if samples are of sufficient quality for cryo-EM imaging. We at the Cryo-Electron Microscopy Research Center then support him during the sample preparation, imaging, and initial data processing steps," Wright says. The center, which Wright directs, provides services to UW investigators who are working on SARS-CoV-2 and other projects.

Kirchdoerfer brings techniques from multiple disciplines — virology, structural biology, cell biology, and biochemistry, among them — together to explore the function of enzymatic SARS-CoV-2 proteins. But cryo-EM remains a mainstay of his work.

"A lot of the strengths for looking at SARS-CoV-2 with cryo-EM are the general strengths of the technique," he says. "You don’t need a crystal. It’s great for larger complexes. We also have different moving parts in this machine... With cryo-EM, so much of the data is handled computationally to address that movement, what we can access even those moving regions."

But understanding SARS-CoV-2 isn’t his end goal — it’s just the beginning.

"During an outbreak, there’s intense scientific interest, but as soon as that outbreak ends, interest also ebbs. What I would like to do with my lab is more pandemic preparedness — looking for the next virus that’s going to cause a pandemic."

To that end, Kirchdoerfer is studying other coronaviruses and other virus families, and he’s kicking off a project to look at how viruses recognize cells, enter cells, and how virus evolution tunes the spike protein to undergo fusion with host cells — in collaboration with classical virologists, veterinary biologists, and epidemiologists at UW-Madison.

Beyond Science

Kirchdoerfer and his colleagues are just now getting back to research they were working on before the pandemic started. But their pandemic-related outreach, service and teaching activities continue.

Biochemistry professor Paul Friesen, PhD’83 has taught biochemistry courses for majors and non-majors for nearly two decades. His teaching philosophy is to get students to understand not only the what but also the why of the steps involved, how diseases and disease prevention hasn’t changed during the pandemic.

Though he jokes that he didn’t have a lot of time to devote to science before the pandemic, Friesen has responded to public queries about the virus, sharing knowledge with inquisitive minds or engaging communities throughout Wisconsin, scientists in the Department of Biochemistry manifest one exceptional quality: creativity.

“Often people think of scientists as being incredibly objective and precise and that’s very true," says Kirchdoerfer. “But it really comes down to creativity, I think, in trying to bring together pieces of data that on the surface might not appear to be obvious. It’s a little bit of an art form — but then, an art form you go back to test.”

Original story by Catherine Steffel, Ph.D., Biochemistry

Also in Biochemistry

Jean-Yves Sgro, senior scientist and director of the Biochemistry Computational Research Facility (BCRF), released a bioinformatics tutorial to assist researchers in understanding the SARS-CoV-2 spike glycoprotein sequence while performing multiple sequence alignments with closely-related coronavirus spike sequences. Sgro also released a coloring book of SARS-CoV-2 structures. You can find more information about the tutorial and coloring book on the BCRF website.
Cryo-EM and Cryo-ET Centers to Open

The Cryo-Electron Microscopy Research Center (CEMRC) provides instrumentation, technical assistance, training, and access to cryo-EM for the UW–Madison research community. Scientists throughout UW have been using cryo-electron microscopy (cryo-EM) to make advancements in molecular biology, cell biology, microbiology, virology, and biomedicine, but they’ve had to rely on facilities outside of the university. To meet the growing on-campus need for cryo-EM equipment and expertise, a core of researchers across campus began working to assemble the full power of cryo-EM at UW.

Several years later, scientists now have a place on campus where they can conduct their groundbreaking work. The Cryo-Electron Microscopy Research Center (CEMRC) provides instrumentation, technical assistance, training, and access to cryo-EM for the UW–Madison research community. Groups contributing funding to the CEMRC, UW researchers are already using the center to diverse and innovative ways that will help keep the campus at the bioscience frontier.

The grand opening of the UW–Madison Cryo-EM Research Center will be held as part of the Department of Biochemistry’s 42nd Steenbock Symposium on June 7-8, 2022.

“Knowledge of the structure of biological molecules is profoundly transformative and enabling, leading to better questions and answers to the key challenges of our research endeavor,” Brian Fox, chair and professor of biochemistry and associate vice chancellor for research policy and integrity says. “These efforts have positioned us well to embrace cryo-EM as a newly emerging, transformative technology.”

The symposium will also be the grand opening of the Midwest Center for Cryo-Electron Tomography (MCCET), a national research and training hub at UW–Madison that is part of a cryo-electron tomography (cryo-ET) network supported by the National Institutes of Health. The MCCET, constructed in partnership with the UW Division of Facilities Planning & Management, C.G. Schmidt Construction, and architectural firm Aro Eberle, will support investigators across the United States by providing access to well-trained staff and support state-of-the-art equipment for routine and advanced cryo-ET specimen preparation, data collection, and computation. The MCCET will also provide hands-on, remote, and virtual training in cryo-ET specimen preparation, data collection, and data processing and validation.

The CEMRC and the MCCET represent a continuation of UW’s long history of contributions to structural and cell biology, virology, and medicine, as well as a major return on long-term campus investment for advanced technologies. It will also be pivotal in many ways: for building on the important work of talented researchers of the past and present, for honing UW’s competitive edge in a rapidly evolving field, and for making vital discoveries that have the potential to transform lives.

Both centers are housed in the Hector F. DeLuca Biochemical Sciences Complex and are directed by biochemistry professor Elizabeth Wright.

“Some of our researchers understand how to do the computational aspects of the [cryo-EM] pipeline, and we may just support them with sample optimization and cryo-preservation and data acquisition and then hand off images where they handle the computations on their own,” Wright says about the CEMRC. “For other investigators, we support them through the entire process and provide them with their structure and its interpretation on the back end.”

The CEMRC is also creating jobs and leading to engagements with tech and biotech companies. CEMRC and UW are pursuing non-disclosure and confidential disclosure agreements with companies that are developing new drugs and therapeutics.

“We look forward to long-term partnerships with these companies,” Wright says. “We are also using training grants to provide internships for our students to bring their advanced training to industry. We can be a nucleating point to do a lot of good for the state and bring people together.”

Of the MCCET, Wright says, “Often, in structural biology, we work as separate units, and having this network of centers is special because we are building a community… Each one of the new cryo-ET centers has its own strengths and specialization in how staff consider processing samples and data collection.”

An Alum Gives Back

Financial support for faculty, staff post-docs and graduate students who conduct research in the Cryo-electron Microscopy Research Center (CEMRC) is provided by biochemistry alum Daniel Klessig BS’71. Klessig’s annual gifts are matched by the Department of Biochemistry.

Klessig, professor and former president and CEO of the Boyce Thompson Institute and an adjunct professor of plant pathology and plant-microbe biology at Cornell University, says that he has lived a life that has enabled him to support research and professorships at several institutions, and that he feels strongly about helping improve and further his field.

“One of the reasons I became so excited as an undergraduate at UW–Madison about molecular biology is that it gave me the ability to alter genes and thus figure out what the encoded proteins do. Cryo-EM gives me another level of molecular clarity by being able to actually see where and how those proteins fit in a large biological structure. You can now look at very large molecular complexes and see the working parts,” he says.

Klessig grew up on a dairy farm near Chilton, Wisconsin. The combination of hard farm work and intensive studying to reach the top of his class, despite his dyslexia, meant that 18-hour days were the norm. Those long working days, six-seven days per week, were in part what drove him to get the “hell” off the farm and follow in his brother’s footsteps to study biochemistry at UW-Madison. He did “too well,” though, he says, and the excitement, enjoyment and satisfaction of accomplishments he realized through molecular biology research meant that his dream of having a 9-5 job never materialized. However, he wouldn’t change a thing. He’s still excited about the new discoveries in biology being made almost daily, and the potential of the CEMRC to advance so many different types of research for researchers across the country.

“I’ve had a lot of opportunities in my life. My undergraduate training at the University of Wisconsin and the Department of Biochemistry gave me a leg up, so they are pretty close to my heart,” Klessig says. “It’s time to give back.”

“Dan’s vision of supporting research in impactful ways stems from his insights and experience in research,” biochemistry department chair Brian Fox says. “Through his creation of a generous and flexible endowment to support cryo-EM research, the department is able to support advanced training for students and staff and invest in the operation and enhancement of microscopes needed to keep us at the forefront of this important technology.”
Hoskins Named 2021-2022 Vilas Associate

Professor Aaron Hoskins was selected as a 2021-2022 Vilas Associate. The Vilas Associates Competition, administered by the Office of the Vice Chancellor for Research and Graduate Education, recognizes new and ongoing research of the highest quality and significance. Twenty-three winners were announced for the 2021-2022 award cycle.

Hoskins' research focuses on RNA splicing, a biological process requiring assembly of large RNA-protein complexes called spliceosomes from dozens of individual components. RNA splicing is fundamental and essential to gene expression in all eukaryotes. Hoskins brings to the UW-Madison campus new technologies that allow high-resolution studies of nucleic acid interactions to be carried out simultaneously across tens of thousands of sequence variants.

Outside of research, Hoskins has assumed a major role in the undergraduate biochemistry curriculum, and he’s a new co-author on Lehninger Principles of Biochemistry, a definitive reference text for biochemistry students around the world.

Cox Named ASBMB Fellow

Professor Michael Cox was named a fellow of the American Society for Biochemistry and Molecular Biology (ASBMB). The 2021 fellows, the inaugural class, are a distinguished group of scientists who have contributed to multiple missions of ASBMB over a sustained period of time and enriched the world through their efforts and accomplishments.

Cox’s lab studies the fundamental life processes and cellular mechanisms of DNA metabolism and is best known for contributions to understanding the RecA and FIP recombinases, which have become widely used tools for biotechnology and developing transgenic model organisms. He has a long-standing record of service as a member of the ASBMB Council and an associate editor of the Journal of Biological Chemistry. He was a member of the steering committee that developed concept-driven teaching strategies, and he advises UW-Madison’s ASBMB Student Chapter. He is a co-author of the definitive reference textbook Lehninger Principles of Biochemistry. He also has served for many years as a judge in the undergraduate research poster competition at the ASBMB annual meeting.

Ntambi Re-elected to ASBMB Council

Professor James Ntambi was re-elected to the American Society for Biochemistry and Molecular Biology (ASBMB) Council this year. Ntambi has served as a member of the council since 2018. The ASBMB Council serves as an advisory board to the president and executive director for setting priorities and strategic directions, overseeing resource allocations, and ensuring that all activities align with the society’s mission.

Ntambi’s lab studies the genetic regulation of metabolism in health and disease, including the physiological role of the stearyl-CoA desaturase genes in lipid and carbohydrate metabolism in obesity, diabetes and fatty liver disease. Ntambi is also involved in building the African National Sciences Research Consortium, which brings together academic and research institutions across the East and Central African region with the goal of building a Ph.D. training program in basic laboratory research in biochemistry and nutritional sciences.

Graduate Student Rashan Inducted into Edward A. Bouchet Graduate Honor Society

Edrees “Eddie” Rashan, an Integrated Program in Biochemistry (IPiB) doctoral candidate and research assistant in biochemistry, was selected for the 2021 cohort of the Edward A. Bouchet Graduate Honor Society. The Bouchet Society commemorates Edward Alexander Bouchet, the first self-identified African American to earn a doctoral degree from an American university. Bouchet scholars are chosen for five qualities that exemplify the spirit of Bouchet: scholarship, leadership, character, service and advocacy for historically under-represented students. Rashan’s commitment to empower excellence in students is driven by challenges he witnessed and experienced as a child of immigrant parents. His parents escaped violence, poverty and war in their home countries and met new challenges in the United States as they navigated barriers to education, employment and stability for themselves and their son.

“At a young age I helped my parents navigate the job application process, such as editing resumes and helping them practice for interviews,” Rashan says. “As their only child, I realized the importance of using the privileges and skills I had to empower and manifest opportunities for those from disadvantaged backgrounds.”

As a graduate student in IPiB, Rashan has helped organize departmental talks to better serve underrepresented trainees. He is a Science Graduate Research Scholars Peer Mentor, an IPiB representative at the Society for the Advancement of Chicanos and Native Americans in Science meeting, and an IPiB representative at the Annual Biomedical Research Conference for Minority Students meeting. Rashan also volunteered as a supply chain manager for the New York Biomedical Technician Rapid Response Team, where he coordinated the acquisition of essential personal protective equipment (PPE) and testing supplies during the height of the COVID-19 pandemic.

Rashan’s research focuses on characterizing the enzymatic activities and functions of under-studied mitochondrial proteins, particularly those implicated in lipid metabolism. He and his collaborators are investigating whether these enzymes can protect cells from harmful lipids and determine how their degradation impacts human health.

“Eddie is a remarkable scientist and a model lab citizen,” says David Pagliarini, Rashan’s primary mentor and professor at Washington University School of Medicine in St. Louis. “Through his diligence and passion for science, he is constructing a beautiful thesis on atypical lipid metabolism, through his advocacy, he is helping establish a more diverse and equitable scientific community from which we will all benefit.”

Around the Department

Biochemistry 501 Summer Term Course Provides Popular Class in Online Format

When Hawra Aljawad made her 2020 summer plans, the idea was to take one class and conduct research. Then came coronavirus. With campus essentially shutting down in spring 2020, and undergraduates unable to work in labs, Aljawad, a senior studying chemical and biological engineering and biochemistry, pivoted.

“I had to be flexible with my plans,” says Aljawad. “Activities and socializing became limited, and I couldn’t gain lab experience.

So, I chose to take more classes and focus on finishing some degree requirements.”

One of the classes she decided to take was Biochemistry 501: Introduction to Biochemistry. The online summer course fulfilled the advanced biology elective needed for her degree, and a friend who had taken the class encouraged her to sign up.

Biochemistry 501 is a three-credit course that is offered every semester. The overarching goal of the course is to foster an understanding of how life works at a molecular level. Students explore how proteins, lipids, carbohydrates and nucleic acids are used in various cellular processes. A popular — and required — class for a variety of majors, attendance during the school year, when the class is typically offered in-person, can exceed 600 students many semesters. For the online course in the summer of 2020, more than 250 students enrolled.

Continued on next page
Biochemistry 501 instructor Mario Pennella, helped move the course online.

Original story by: Caroline Schneider, CALS

IPA Degrees 2021

<table>
<thead>
<tr>
<th>Degree</th>
<th>Name</th>
<th>Major Professor</th>
<th>Thesis Title</th>
</tr>
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<tr>
<td>Ph.D.</td>
<td>Zachary Kommerer</td>
<td>(Pagliarini)</td>
<td>Understanding atypical kinases as essential factors for the biosynthesis and cellular distribution of coenzyme Q</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Kyle Robinson</td>
<td>(Pagliarini)</td>
<td>Defining steps in coenzyme Q cellular distribution and precursor biosynthesis</td>
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<tr>
<td>Ph.D.</td>
<td>Justin Mcketney</td>
<td>(Coon)</td>
<td>Advancing mass spectrometry-based proteomic analysis strategies for the investigation of human health and disease</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Lucas O’Neill</td>
<td>(Ntambe)</td>
<td>Investigating the effects of stearyl-CoA desaturase on diet-induced adiposity and regulation of insulin-like growth factor-binding protein-1</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Elizabeth Duchow</td>
<td>(Deluca &amp; Butcher)</td>
<td>Serum vitamin D binding protein plays an essential role in utilizing naturally produced vitamin D</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Megan Leander</td>
<td>(Raman)</td>
<td>Elucidating the molecular basis of allostery in bacterial transcriptional factors</td>
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<tr>
<td>Ph.D.</td>
<td>Yang Lin</td>
<td>(Landick)</td>
<td>Regulatory circuits to program Lysmammaeus mobilis metabolism for cellulosic advanced biofuel production</td>
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<tr>
<td>Ph.D.</td>
<td>Sebastien Ortiz</td>
<td>(Hull)</td>
<td>Exploiting pathogenic fungal spore germination as an untapped source of fungal specific targets</td>
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<tr>
<td>Ph.D.</td>
<td>Harriet Saunders</td>
<td>(Wildong)</td>
<td>Regulation of neuronal microtubule function by acetylation and acetyltransferases</td>
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<tr>
<td>Ph.D.</td>
<td>Nathan Thomas</td>
<td>(Henzler-Wildman)</td>
<td>The proton/drug coupling mechanism of EmrE</td>
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<tr>
<td>Ph.D.</td>
<td>Sophia Sdao</td>
<td>(Merrius)</td>
<td>Cyclin-dependent kinases 1 and 2 control beta-cell metabolism and insulin secretion</td>
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<tr>
<td>Ph.D.</td>
<td>Jessica Cardenas</td>
<td>(Bednarek)</td>
<td>Elucidate the role of PUX1 in GA signaling through its interaction with the GA receptor, GID1 to control cell growth</td>
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<tr>
<td>Ph.D.</td>
<td>Tina Lynch</td>
<td>(Kimble)</td>
<td>From niche signaling to its transcriptional control over C. elegans stem cells: an in vivo view</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Kanika Jain</td>
<td>(Con)</td>
<td>Elucidating the role of the E. coli RanA protein in DNA recombination and repair processes</td>
</tr>
</tbody>
</table>

IPA Graduates

Top to bottom, Megan Pierce, Georgette Paxton, and Sarah Lynn Traver Saunders are pictured in 2020, when the idea for the faculty profile series was conceived and much of the series itself was written.

Original story by Catharine Staffel, Ph.D., Biochemistry

Around the Department

"Enrollment keeps going up. Last summer [summer 2019], the first time we offered it, enrollment was around 100. In 2020 it shot way up to around 260 students," says professor Richard Amasino, who is a Biochem 501 instructor along with professor Samuel Parchez and faculty associate Mario Pennella.

In the online version of the course, students had access to the entire course right away and could watch pre-recorded lectures at any time. Quizzes and exams were provided at intervals throughout the summer. Several resources and discussion platforms, including discussion boards, such as Piazza and PeerWise, where students could ask questions and instructors could respond, were also supported. The instructors also consider conversation and interaction an important part of online courses. They held a discussion section every day during the online summer session. Grad students and undergraduate peer mentors also provided additional discussion sessions, and many former undergraduate students came back to help.

Of her time in the course, Aljawad says, “I’m grateful that all the professors were understanding and flexible. It shows that they’ve tried their best to provide students with the best experience even with classes being online. I really enjoyed this course.”

If I Weren’t a Professor, I Would Be…

W hen we were growing up, many of us wondered what it would be like to encounter our teachers “in the wild.” Outside the confines of school, what did they wear? Who were their friends? What would they be doing if they weren’t a teacher?

Over the past year and a half, administrative staff embraced this inquisitiveness, asking their friends? What would they be doing if they weren’t a teacher? This is how they came up with the idea for the faculty profile series, which ended last summer. To make the series a reality, administrative office manager Megan Pierce, a program assistant who’s also the face of the administrative staff to many faculty members, came up with the idea. “You spend so much of your day at work, and you realize that every person is unique,” she says. “This gives everyone the opportunity to read about the people they work with, but on a different level."

When Pierce pitched her idea to team members Sarah Lynn Traver Saunders and Georgette Paxton, they jumped at the opportunity to make the series a reality. Paxton, a senior financial specialist, emailed faculty and came up with questions to ask, while Saunders, an administrative office manager, organized. The trio see the series, which ended last summer, as a way for faculty to share their lives outside of their careers, the series also strips away the work for the series during the work-from-home portion of the pandemic. By showing students and staff that faculty have full lives outside of their careers, the series also strips away the image of faculty as an administrative office manager, organized. The trio see the series, which ended last summer, as an administrative office manager, organized.

Top to bottom, Megan Pierce, Georgette Paxton, and Sarah Lynn Traver Saunders are pictured in 2020, when the idea for the faculty profile series was conceived and much of the series itself was written.
Diversity, Equity and Inclusion Committee Update

In June 2020, the Department of Biochemistry made a commitment to invest in diversity, equity, and inclusion initiatives. Together we unequivocally stated that diversity adds tremendous richness to our intellectual landscape and that everyone deserves access to the wonder that scientific discovery potentiates.

As a community we came together to deliver on this investment. In 2020-2021 we:

- Established a Department of Biochemistry diversity, equity, and inclusion committee that consists of faculty members and graduate and undergraduate student representatives, and staff members.
- Established a travel scholarship for faculty, staff, and graduate and undergraduate students to attend conferences to promote diversity in STEM including the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS), American Indian Science and Engineering Society (AISES), and Annual Biomedical Research Conference for Minority Students (ABRCMS). We sent nine members of our community to these conferences in 2020, and we sent six to SACNAS and ABRCMS in 2021.
- Increased the training of our community through hosting several national experts in STEM diversity, equity, and inclusion to speak in our Biochemistry Colloquium including Drs. Tracy Johnson, Sean Whelan, and Manu Platt.
- Our support of the AISES Chapter through departmental resources led to a significant increase in student retention in STEM fields. In 2019 only 15% of AISES students had an undergraduate research experience (URE); by 2021, 87% are in URE programs with funding secured for 63%. In 2019 only 37% of AISES students obtained acceptance to their postgraduate applications; by 2021, 100% obtained acceptance, including NIH postbaccalaureate training programs and two admissions into graduate schools.
- We have added a land acknowledgement statement on our departmental website.
- Brian Fox was appointed to the Native Nations UW–Madison Phase 2 Working Group to advance research activities in partnership with 12 Native Nations of Wisconsin.
- We are proud of our community and what we have accomplished as faculty, staff, and students, but we acknowledge that there is a tremendous way to go. In 2021-2022 we will:
  - Continue these initiatives, including support through travel scholarships, hosting outstanding National Researchers for the Biochemistry Colloquium, and support of the AISES Chapter.
  - Expand the mission of diversity, equity, and inclusion on our departmental website by adding resources available to students, staff, and faculty.
  - Continue working to develop relationships with Historically Black Colleges and Universities and with Minority Serving Institutions to open our graduate program to researchers from diverse backgrounds. This will begin through a grant, supported by the Office of the Vice Chancellor for Research and Graduate Education and the Nelson Institute, obtained by Drs. Grace Bulltail, Judith Simcox, Lucas Zser, and Shaan Marcus to build an Indigenous Environmentalism Working Group that includes a collaboration with the College of Menominee Nation. This grant will also support an Indigenous research symposium to be held at UW-Madison.
  - Culturally aware mentorship training for our faculty.
  - Commission an art piece by a Ho Chunk artist to be built from the wood of ‘Elmer’, the elm tree that was the heart of the biochemistry complex and which served as a marker tree used by Native people as a waypoint to guide travelers on their journey.

Meaningful change takes the strength and commitment of the entire community. We are proud of how far we’ve come and excited to continue building a future that better serves the department, STEM fields, and the greater Wisconsin community.

Biochemistry Advisor Degrees 2021

<table>
<thead>
<tr>
<th>Degree</th>
<th>Name (Major Professor)</th>
<th>Program</th>
<th>Thesis Title</th>
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<tbody>
<tr>
<td>Ph.D.</td>
<td>Sonali Gupta</td>
<td>Biophysics</td>
<td>Investigating the dynamics of programmed microbial consortia in spatially structured environments</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Xiangyang Liu</td>
<td>Biophysics</td>
<td>Design of synthetic transcription regulators in bacteria</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Kevin Mayer</td>
<td>Genetics</td>
<td>Investigating molecular mechanisms of flowering time across plant lineages</td>
</tr>
<tr>
<td>M.S.</td>
<td>Jin Wen Tan</td>
<td>Bacteriology</td>
<td><strong>Degrees Dec. 1, 2020 - Nov. 30, 2021</strong></td>
</tr>
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<td>Ph.D.</td>
<td>Edrees Rashan</td>
<td>Ph.D.</td>
<td>Xiangyang Liu</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>Raghav Jain</td>
<td>Ph.D.</td>
<td>Sonali Gupta</td>
</tr>
</tbody>
</table>

Honors & Awards

- **Faculty**
  - Samuel Butcher: Steenbock Professorship of Biomolecular Structure
  - Michael Cox: 2021 ASBMB Fellow - one of the inaugural class of ASBMB fellows
  - Katie Henzler Wildman: Jean V. Thomas Professorship in Biochemistry
  - Aaron Hoskins: Waisman Professorship in Biochemistry of Higher Animals 2021-2022 Vilas Associate
  - Ann Palmenberg: 2020 National Academy of Inventors Fellow
  - John Ralph: 2021 Clarivate Analytics Highly Cited Researcher
  - Amy Weeks: 2021 Packard Foundation Fellow in Science and Engineering

- **Postdoctoral Staff Fellowships**
  - Christopher Emfinger: Artie American Diabetes Association Fellowship
  - Daniel Parrell: Wright NIH Ruth L. Kirschstein Postdoctoral Fellowship
  - David White: Hoskins NIH Ruth L. Kirschstein Postdoctoral Fellowship

- **Postdoctoral Staff Training Grants**
  - Christopher Emfinger: Artie Metabolism and Nutrition Training Program (MANTP)
  - Erin Ostrem Loss: Venturelli Genomic Sciences Training Program (GSTP)
  - Tara Price: Artie Training Program in Translational Cardiovascular Science (TPTCS)

- **Graduate Student Awards**
  - Dana Dahlhan: Bednarik Denton Award for Graduate Student Excellence in Teaching & Mentoring
  - Dylan Plaskon: Record Denton Award for Graduate Student Excellence in Teaching & Mentoring
  - Tina Lynch: Kimble Sigrid Leirmo Memorial Award in Biochemistry
  - Raghav Jain: Simcox 2021 UW–Madison Diabetes Day Nest Graduate Student Speaker Award
  - Edrees Rashan: Pagliarini/Simcox 2021 Edward A. Bouchet Graduate Honor Society Inductee

- **Staff**
  - Ben Minkoff: Susman 2020 Boyer Award
  - Canan Sener: Ralph First place in the Professional Category of the Sustainable Engineering Forum (SEF) poster competition at the 2020 AIChE Annual Meeting

Degrees Dec. 1, 2020 - Nov. 30, 2021

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<td>Dana Dahlhan</td>
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<td>Design of synthetic transcription regulators in bacteria</td>
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<td>Genetics</td>
<td>Investigating molecular mechanisms of flowering time across plant lineages</td>
</tr>
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</table>
Graduate Student Fellowships

Yu Bao
Landick
James Chich-Hsia Mao Wisconsin Distinguished Graduate Fellowship

Matthew Blackburn
Susman
Sam C. Smith Graduate Fellowship in Biochemistry

Joshua Choi
Sines
Denis R. A. and Martha Washburn Whittorn Fellowship in Biochemistry

Kaukol Jain
Cox
William H. Peterson Fellowships in Biochemistry

Josephine Mitchell
Wildonger
Biochemistry Teaching Fellowship

Jacob Rapp
Romero
Stemb硕 Predoctoral Fellowship in Biochemistry

Maxwell Rector
Record
William R.E. Dorothy E. Sullivan WI Distinguished Graduate Fellowship in Biochemistry

Jonathan Tai
Pagharian
NIH Ruth L. Kirschstein Predoctoral Fellowship

Abigail Bartlett
Pagharian
NSF Graduate Research Fellowship Program

Nina Brondel
Con/Keck
NSF Graduate Research Fellowship Program

Christine Huotmyer
Landick
NSF Graduate Research Fellowship Program

Dean Jarois
Gellman
NSF Graduate Research Fellowship Program

Nathan Murray
Pagharian
NSF Graduate Research Fellowship Program

Katherine Senn
Hoskins
NSF Graduate Research Fellowship Program

Roos Soens
Cantor
NSF Graduate Research Fellowship Program

Helaina Van Ban
Simcox
NSF Graduate Research Fellowship Program

Kwame Frimpong
Rotator
Science and Medicine Graduate Research Scholars (SciMed GRS)

Gilbert Liscoue
Sines
Science and Medicine Graduate Research Scholars (SciMed GRS)

Sierra Love
Hoskins
Science and Medicine Graduate Research Scholars (SciMed GRS)

Robert Mejia
Rotator
Science and Medicine Graduate Research Scholars (SciMed GRS)

Anthony Meza
Buller
Science and Medicine Graduate Research Scholars (SciMed GRS)

Johnson Saba
Landick
Science and Medicine Graduate Research Scholars (SciMed GRS)

Undergraduate Awards continued

Tritian Argall
Hoskins
Biochemistry Undergraduate Summer Research Award

Pak Lun Kevin Cheung
Venturelli
Biochemistry Undergraduate Summer Research Award

Sarah Fulbright
Romero
Biochemistry Undergraduate Summer Research Award

William Langholz
Record
Biochemistry Undergraduate Summer Research Award

Evelyn Okal
Romero
Biochemistry Undergraduate Summer Research Award

Qiaowen Qian
Romero
Biochemistry Undergraduate Summer Research Award

Anna Schleger
Kimble
Biochemistry Undergraduate Summer Research Award

Xindi Tang
Biochemistry Undergraduate Summer Research Award

Lucas Voigtis
Hoskins
Biochemistry Undergraduate Summer Research Award

Qiaoyun (Lexi) Luo
Cafe Harker
Barry Goldwater Scholarship

Hoskins
Chemistry Regime Deutsch Undergraduate Summer Research Award

Mac Hurtado-Thiele
Simcox
Hispanic Scholarship Fund Recipient for 2021

Taka Ishikuri
Record
National ACS Undergraduate Award in Chemical Biology for 2021

Jaylin Tang
Record
National ACS Undergraduate Award in Chemical Biology for 2021

Armor Rapanya
Record
National ACS Undergraduate Award in Physical Chemistry for 2021

Qiaoyun (Lexi) Luo
Rhodes Scholarship (Finalist)

Hawa Alajy
Rhodes Scholarship (Finalist)

Mac Hurtado-Thiele
SACNAS Travel Award for 2021 National Conference

Fidelia Beatrice Alvia
Kimble
Singapore’s Agency of Science, Technology and Research (A*STAR) Scholarship

Autumn Chevalier
Simcox
UW-Madison Indigenous Working Group Undergraduate Research Internship Award

Undergraduate Fellowships

Tritian Argall
Hoskins
Hilldale Undergraduate Research Fellowship

Cole Aschenbrener
Hilldale Undergraduate Research Fellowship

Pak Lun Kevin Cheung
Venturelli
Hilldale Undergraduate Research Fellowship

Anna Christenson
Hilldale Undergraduate Research Fellowship

Sarah Fulbright
Romero
Hilldale Undergraduate Research Fellowship

Anika Gupta
Paige Hill
Hilldale Undergraduate Research Fellowship

Audihaa Kasat
Buller
Hilldale Undergraduate Research Fellowship

William Langholz
Record
Hilldale Undergraduate Research Fellowship

Alex (Ximian) Li
Hilldale Undergraduate Research Fellowship

Renni Tang
Hilldale Undergraduate Research Fellowship

Qiaoyun (Lexi) Luo
Hilldale Undergraduate Research Fellowship

Jared Moyer
Butcher
Hilldale Undergraduate Research Fellowship

Evelyn Okal
Romero
Hilldale Undergraduate Research Fellowship

Qiaowen Qian
Romero
Hilldale Undergraduate Research Fellowship

Chloe Stevens
Hilldale Undergraduate Research Fellowship

Anton Tang
Hilldale Undergraduate Research Fellowship

Lucas Voigtis
Hoskins
Hilldale Undergraduate Research Fellowship

Caleb Carlson
Sophomore Research Fellowship

Allison Coorra
Landick
Sophomore Research Fellowship

Jasmine Machchi
Cavagnero
Sophomore Research Fellowship

Gordon Winkler
Cavagnero
Sophomore Research Fellowship

2021 Biochemistry Undergraduate Summer Research Awards sponsored by:

Henry A. Landy Undergraduate Research Fund, Floyd C. McIlvain Undergraduate Research Fund, Dr. Shuang-Chen Pan Fund in Biochemistry, E.W. Hopkins Fund, Jerome J. Stefanakis Biochemistry Scholarship Fund, Eric Bey and Amanda Boley Scholarship Fund, and Carl Krieger Memorial Fellowship Fund.
Below are some updates we received from the faculty and other sources. Have something you’d like to share with us? (You don’t need to wait for someone else to tell us.)

Contact: alumninews@biochem.wisc.edu.

Amsinako Lab
Kevin Mayer now at the Promega Corporation working as a Senior Research Scientist.

Butcher Lab
Allison Didedkouh (Ph.D. 2017, Biophysics) is a Damon Runyon postdoctoral fellow at UC Berkeley and will be joining the faculty at Yale University as an Assistant Professor in Molecular Biophysics and Biochemistry in 2022. Sam Hayes (postbaccalaureate research intern 2020) is a medical student at UW-Madison.

Johanna Virts (postbaccalaureate research intern 2020) is a Ph.D. student at UCSF in the Department of Chemical Biology.

Craig Lab
See-You Ting (IPiB 2017 grad) has joined the faculty of the Institute of Molecular Biology at Academia Sinica in Taipei, Taiwan. Syzmon Ciesielski joined the Dept. of Chemistry at the University of North Florida as an Assistant Professor of Biochemistry this fall.

Frey Lab
Squire Booker (former postdoc) is among the 2021 inaugural class of ASMBF fellows.

Hoskins Lab
Yichen Sun is now working as a video game developer in San Francisco. Clarisse van der Felz is now an Assistant Professor of Biology at Northwest U. in Kirkland Washington.

Matt Ashton graduated from medical school at Tulane and will soon begin his residency in emergency medicine at Mr. Sinai in New York.

Ludden Lab
Paul Ludden recently retired as professor and provost emeritus from Southern Methodist University. Paul and his wife Linda have returned to Wisconsin and live in Middleton. Paul also just completed a term as a member of the CALS Board of Visitors.

Priya Kanguj was recently promoted to Director, Global Market Development - Electron Microscopy, at Thermofisher Scientific.

Ntambi Lab
Sabrina Dumas (Ph.D. 2018) is a Clinical Research Liaison at Imbed Biosciences, Inc, where she identifies, develops, and maintains professional relationships with wound healing clinicians to provide comprehensive medical and scientific support on novel bioreabsorbable antimicrobial wound healing matrices.

Lucas O'Neill (Ph.D. 2021) moved back to Fort Worth to teach science at the I.M. Terrell Academy for STEM and VPA. I.M. Lucas is now working as a video game developer in San Francisco.

Pagliarini Lab
Danielle Lohman (Ph.D. 2017) is now a Foreign Affairs / Science Officer, Biological Policy Staff in the Bureau of International Security and Nonproliferation, U.S. Department of State in Washington, D.C.

Mike Kelliher is in his second year of a Clinical Chemistry Fellowship at Dartmouth-Hitchcock.

Butcher Lab
The Butcher lab has been on a roll and couldn’t be better, thanks to the hard work from staff scientist Dr. Yuichiro Nomura, postdoc Dr. Cristian Escobar, Ph.D. students Saeed Roschdi (IPiB), Riley Petersen (Chemistry) and Rahul Vivek (IPiB), our undergraduate extraordinaire Jarod Moyer, and a revolving cohort of outstanding rotators from IPiB and Biophysics. Mikaela Seeman, Kylie Kawisza, Takuma Kume and Dhaval Ghone. This year we celebrated the 5-year renewal of our NIH R35 grant that supports our biophysical investigations of RNA structure. Jarod received a Hilldale Award, and Sam was named the Steenbock Professor of Biomolecular Structure. Sam supports technology development and the user program for the NMR facility (NMRFAM), which is expanding and doing great under the leadership of Professors Katherine Henser-Wildman and Chad Rienstra. With the help of Dr. Craig Bingeman, we have a couple of amazing new X-ray crystal structures that “fell” out of conversations with Professor Mary Wickens, and these will be submitted soon. Thanks to our outstanding colleagues, the lab is busier than ever and moving in exciting new directions that we never could have imagined!
Greetings from the Weeks lab! We celebrated the two-year anniversary of opening our doors in 2021, and it’s been an exciting adventure! Our lab’s main focus is on engineering enzymatic tools for mapping biological signals across space and time and living cells. Spatial organization and temporal dynamics are essential properties of cellular signaling. However, current technologies are unable to provide a systems-level experimental mapping of the dynamic subcellular localization of proteins involved in these processes. We are initially focusing on two types of signaling processes: proteolysis and phosphorylation, both of which play critical roles in myriad biological signaling pathways relevant to human health and disease.

Our efforts in developing tools for subcellular mapping of proteolysis are led by Clara Frazier and Aspasia (Aspa) Amiridis, who are engineering enzymes for capture of proteolytic neo-C- and neo-N termini, respectively. Clara’s review article on peptide ligase enzymes was recently published in *Biochemical Society Transactions*, and she continues to make amazing progress toward developing a C-terminal bioconjugation enzyme for mapping proteolytic cleavage events. She was also recently awarded a traineeship in the NIH-funded Biotechnology Training Program. Aspa is focused on enzymatic capture of proteolytic neo-N termini, and her methods paper on labeling cell surface N termini was recently accepted for publication in *Methods in Molecular Biology*. Aspa was recently awarded a traineeship in the NIH-funded Chemistry-Biology Interface Training Program.

Spatiotemporal mapping of phosphorylation events is another major focus in the lab. Based on their unique chemistries, we are developing separate enzymatic tools for capture phosphoserine/phosphothreonine (pSer/pThr) and phosphotyrosine (pTyr). Katarzyna (Kasia) Radziwon is leading the charge on pSer/pThr. Her review article on protein engineering for selective proteomics was recently published in *Current Opinion in Chemical Biology*. Haley Penkala is spearheading the pTyr project and making excellent progress. She’s also been moonlighting on another project focused on developing new technologies to map protease specificity and is busy preparing a manuscript.

Lauren Mazurkiewicz is leading a new project that aims to uncover the biological function of the unusual post-translational modification diphenylamide, a histidine modification that is presently only known to occur on one protein, and for which there are no enrichment or identification tools. In support of this work, she was recently awarded a traineeship in the NIH-funded Biotechnology Training Program.

All of our projects have relied on assistance from talented undergraduate students. William (Will) DeAngelis and Alexis (Lexi) Klomhaus were the first undergraduates in the lab. Lexi graduated in 2020 and moved on to an exciting position at Abbott, while Will graduated in 2021 and is currently working at Labcorp Drug Development. In 2021, two new undergraduates, Izzy Eppinger and Brendyn Ramos, joined the lab.

Finally, Amy was awarded a Packard Fellowship in Science and Engineering in 2021. She is incredibly grateful to all past and present members of the Weeks lab for their hard work and creativity (and for taking a chance on a new lab!).

**Left to right, Amy Weeks, Haley Penkala, Katarzyna Radziwon, Clara Frazier, Lauren Mazurkiewicz, Aspasia Amiridis.**

**Weeks Lab**

Letters from the Labs

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**Letters from the Labs**

<table>
<thead>
<tr>
<th>Name</th>
<th>Designation</th>
<th>Year</th>
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<tbody>
<tr>
<td>Kaye Apollo</td>
<td>Generous Supporter</td>
<td>May 2021</td>
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<td>Takis Apollo</td>
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<td>May 2021</td>
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<td>Shirley Aprison</td>
<td>Generous Supporter</td>
<td>January 2021</td>
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<td>Robert Baldwin</td>
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<td>Anastasia &amp; Peter Basdavanos</td>
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<td>Brent Behrens</td>
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<td>Ph.D. 1964 — Prof. Strong</td>
<td>June 2021</td>
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<td>Ph.D. 1979 — Prof. Cleland</td>
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<td>January 2021</td>
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<td>James Chen</td>
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<td>April 2021</td>
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<td>Gregory Duke</td>
<td>Ph.D. 1989 — Prof. Rueckert</td>
<td>April 2021</td>
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<td>David Filmer</td>
<td>Ph.D. 1961 — Prof. Kaesberg</td>
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<td>Irene Ilen</td>
<td>Generous Supporter</td>
<td>January 2021</td>
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<td>Richard Jacobs</td>
<td>Ph.D. 1975 — Prof. Horkstra</td>
<td>December 2020</td>
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<td>Kenneth Johnson</td>
<td>Instrument Technician at the Institute for Enzyme Research</td>
<td>June 2021</td>
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<td>January 2021</td>
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<td>Marjorie &amp; John Losse</td>
<td>Generous Supporters</td>
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<td>John Reed</td>
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<td>Jack Towne</td>
<td>M.S. 1952, Ph.D. 1955 — Prof. Burris September 2021</td>
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<tr>
<td>Robert Weaver</td>
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<td>October 2021</td>
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Our thoughts are with the families of any others in the Biochemistry community who recently passed.
In Memoriam

John Suttie — Nutritional Biochemistry Professor, Vibrant Person

University of Wisconsin—Madison Professor Emeritus of Biochemistry and Nutritional Sciences alumnus John Suttie died on Monday, Dec. 21, 2020 at 86. For four decades, he was a faculty member with expertise in the metabolism and mode of action of vitamin K and fluoride toxicity. He made seminal contributions to both departments, and his advocacy and helping to establish national nutrition policy raised the national visibility of the College of Agricultural and Life Sciences and UW–Madison. He retired from the university as professor emeritus in 2001.

Suttie was born and raised on a dairy farm in Galeville, Wisconsin, where the foundation for his long career in science was laid in a one-room schoolhouse. He obtained his bachelor’s (1957), master’s (1958), and doctoral (1960) degrees in biochemistry under Paul H. Phillips. After completing a year-long postdoc as an NIH Postdoctoral Fellow at the National Institute for Medical Research in England, Suttie returned to UW–Madison in 1961 as a professor.

Throughout his career, Suttie influenced generations of student scientists, training 45 graduate students and 27 postdoctoral scientists, and serving as lead instructor of Biochemistry 501, a key course in the Biochemistry undergraduate curriculum. He authored the highly regarded “Introduction to Biochemistry” textbook for undergraduates and also played a key role in reorganizing Biochemistry’s graduate curriculum.

Among other significant contributions, his lab’s research provided a baseline for assessing hazards, defining emission standards, and enacting regulations of fluoride emissions across the country. He himself served as a world expert on vitamin K and the anticoagulants dicumarol and Warfarin. Suttie’s career was filled with awards and service to the fields of nutrition and biochemistry. He became chair of the Department of Nutritional Sciences, held both national and international positions, published many research articles, and received numerous awards of distinction.

“Because of his great sense of humor, John made life pleasurable for everyone around him,” says Hector DeLuca, a biochemistry professor emeritus. “Yet he was strong and resolute when required. John Suttie is a largely unsung champion of the University of Wisconsin–Madison at all levels...both I and the university will forever miss him.”

Individuals

Ms. Lynn Aisawa
Ms. Jo Akiki
Ms. Pauline Barisla & Mr. Jon Joy
Dr. Roger Bould
Dr. Randy Bonelli
Mr. John Bonmini
Professor James Bradley
Ms. Julie Brady & Mr. James Brady
Dr. Larry Brand
Mr. Steven Braun & Ms. Amy Pollock
Dr. John Brodwater
Dr. Andrew Bougger
Mrs. Kathleen Brugger
Mr. Robert Bullet & Ms. Jennifer Bullet
Professor George Buzen
Mr. Gregory Campbell
Dr. Carolyn Campen
Dr. Hardin Chan
Dr. Marie Chiang
Dr. James Dahlberg & Dr. Elsabet Lund
Dr. Frank Decker
Ms. DePamphilis &
Ms. Margarette DePamphilis
Ms. Ann Dolney
Dr. Alan Easton
Dr. Rodrick Echols
Ms. Andrea Lewis-Echols
Ms. Marcia Elmer & Dr. Larry Mattheakis
Ms. Jeanne B. Eloranta
& Dr. Edwin W. Eloranta
Mr. Stuart Feldman & Ms. Rebecca Feldman
Dr. Charles Frolik & Ms. Barbara Frolik
Dr. Haian Fu & Ms. Guo-Hua Wang
Dr. Carl Gilbert & Dr. Linda Gilbert
Dr. Jonathan Goldstein
Mr. David Gregg
Dr. Joshua Hamilton
Ms. Jennifer Hanson & Mr. Kenneth Hansen
Dr. Ronald Hanson
Ms. Margaret Henzler &
Dr. Thomas Hessler
Dr. Thomas Hoggett
Dr. James Hunter
Dr. Cheryl Janson
Dr. Michael Kaiser
Dr. Dan Klessig &
Ms. Judith Hope-Klessig
Dr. Michael Lemberger &
Ms. Roseann Lemberger
Dr. Leon LeVan & Ms. Elizabeth LeVan
Dr. Chi-Chun Lin & Dr. Renee Lin
Ms. Jennifer Loeb
Dr. Arnold Loo
Dr. Paul Ludden & Ms. Linda Ludden
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Dr. Margaret Manatt & Mr. Stanley Manatt
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Dr. Walter Prosky
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Mr. Christopher Salm & Ms. Susan Salm
Professor James Shall &
Ms. Sara Smith-Shall
Dr. Margaret Shoupuk
Ms. Dace Sprecher
Mr. Daniel Stoffel
Dr. Sidney Stoba
Professor Frederick Stormsland &
Ms. Alice Stormsland
Mr. Jeanne-Tanya Tang
Dr. Gene Tang
Mr. Jeffrey Toretsky
Mr. Raymond Vermette
Ms. Margaret Waller
Dr. Douglas Wiswedel
Mr. Norman Wirzba & Ms. Joy Wirzba
Dr. Ming-Chi Wu
Dr. Andrea Yoder
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Innovation

Designing proteins with tailor-made functions
Philip Romero, Bennett Bremer, Jacob Rapp

Proteins perform complex chemical and biological functions and present tremendous potential for solving challenging problems in medicine, agriculture, environmental protection, and industrial chemistry. Yet, designing proteins with tailored functions is impeded by our limited understanding of these complex molecules. The lab of biochemistry professor Philip Romero is using a robot and machine learning to design enzyme sequences with improved activity, driving our understanding of the relationships between protein sequence, structure, and function. The robot is used to express and test proteins for given properties, while a machine learning model uses this information to tell the robot which proteins of thousands possible to test. The codes above show how the computer decides which sequences to test using the robot. The patent application for this work was filed by the Wisconsin Alumni Research Foundation (WARF).