

CATALYST

Summer 2019



Oregon State
University

CATALYST

Summer 2019

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Contents

2 | **Best & Brightest**
Our talented faculty

6 | **On the move**
Students going above and beyond



8 | **FEATURE**
Research
Deep learning-derived insights: Hendrix Lab

12 | **News**
Fond farewells

14 | **Making us proud**
Alumni & Friends

On the cover — A microscopic view of the compound eye of a fly. David Hendrix uses sequenced fruit fly RNA data to explore the impact circadian clocks and aging have on neuronal health (see p. 8).

2

6

12

14



FROM THE HEAD

Andy Karplus
Department Head

Welcome to our annual newsletter!

Our mission to investigate life at the molecular level and empower students and the public with a molecular understanding of how life works remains steadfast, thanks to our talented faculty and students and all of you who, through your programmatic participation and generous gifts, support our success.

Particularly exciting this year has been our undergraduate program's rapid growth. With our new Biochemistry and Molecular Biology major, our student population has more than doubled, to about 360 students. A happy challenge to have is maintaining our hallmark family-like atmosphere, including close faculty-student connections and a

high level of advising and support for research experiences. As our uniquely supportive environment has been integral to nurturing students who exceed expectations, we are committed to succeed.

Our faculty also continue to excel in teaching, advising and research. A special congratulations this year to Ryan Mehl and Fritz Gombart for promotion to full professor, and Michael Freitag for election as a Fellow of the American Association for the Advancement of Science. Seven faculty participated in summer institutes on scientific teaching and are enhancing their classrooms with active learning. External research funding has nearly doubled since 2017. New projects include National Institutes of Health-

funded work on circadian rhythms in aging, mechanisms of gene silencing, redox signaling in neuronal cancer, and better tools for genetic code expansion. Also, a promising treatment for Lou Gehrig's disease is entering phase II clinical trials.

The past year brought big transitions with the retirements of Gary Merrill, Indira Rajagopal and Kevin Ahern (who will continue to teach online classes). A superb new instructor, Lauren Dalton, will continue Indira's tradition of excellence in teaching and advising. Generous donors have established a "Kevin and Indira Champions of Undergrads" fund now available for alumni who would like to honor their legacy and support our undergraduates. As a department, we mourn the loss of Wil Gamble, who enriched our department for decades with his characteristic warmth and wit.

Going forward, our strategic plan calls us to search for a new department head to lead us into the next decade, while I shift back to teaching more — my favorite part of being a professor. As I look ahead, I join President Ed Ray in believing that, for the department and for OSU, the best is yet to come.

As always, please keep in touch! If you are ever in the area, we'd love to see you and show you around.

WANTED: BB ALUMNI AND FRIENDS UPDATES

What's new for you? Where have you landed and what are you up to on the home or work fronts? Any memories of your time here you'd like to share? We'd LOVE to hear from you!



Take a few minutes and let us know how you're doing. Your fellow BB Beavers are eager to hear!

Fill out a quick form online at BB.oregonstate.edu/alumni-friends.

Stay in touch!

Keep up with the latest biochemistry and biophysics news and join our online community!

Facebook: @OSUBB

Twitter: @OregonStateBB

NEW: LinkedIn group, "Oregon State University Biochemistry & Biophysics"



L to R: Clara Horne, Indira Rajagopal, Kevin Ahern, Virginia Weis (Head of Integrative Biology), Fred Horne (former Dean of the College of Science).



Gary Merrill (front left) rafting the Big Eddy rapid on the Deschutes River with colleagues.

BEST & BRIGHTEST

Retirements

Professor **Kevin Ahern** and Senior Instructor **Indira Rajagopal**, a beloved married duo, are retiring after 30 years of inspired teaching and innovation. Their combined leadership and passion for biochemistry teaching has had a monumental impact on students at Oregon State and around the world.

Together, Ahern and Rajagopal have shown a selfless determination to make education more accessible. They co-wrote three open educational resource biochemistry textbooks; the first, *Biochemistry Free and Easy*, has about 200,000 downloads since its release in 2012. Ahern was one of the first to put his lecture recordings online, forming a popular YouTube channel which now has over 30,000 subscribers and over four million views. Ahern is well known for his *Metabolic Melodies*, many co-written by Rajagopal, which use music and rhythm to help students remember biochemistry facts. The melodies have

received international attention on Nature Podcast and BBC Radio. Ahern also led the STEM Leaders Program, which has increased retention rates of underrepresented minority students in STEM by more than 10 percent.

The duo's teaching awards are too numerous to list but highlights include Ahern's 2017 Elizabeth P. Ritchie Distinguished Professor Award and Best Mentor/Advisor Award by the OSU chapter of the Phi Beta Kappa Society. Rajagopal was the 2016 recipient of the Fred Horne Award for Sustained Excellence in Teaching Science in the College of Science and the 2019 Olaf Boedtker Award for Excellence in Academic Advising.

After a 49-state road trip followed by a joint Fulbright Fellowship in Malta, Ahern and Rajagopal will return to Corvallis for an active retirement. Rajagopal and Ahern will both teach select Honors College

courses, and Ahern will teach online biochemistry and biophysics courses for OSU's Ecampus.

Gary Merrill retired in June 2018 after an impactful 34-year career. Hired in 1984 to join the then new Center for Gene Research and Biotechnology, Merrill's research focused on using yeast as a model system for studying the regulation of eukaryotic gene expression, especially with regard to aging and cancer. After discovering that the enzyme thioredoxin reductase regulated the P53 tumor suppressor, he and his students (graduate and undergraduate) focused their research on the redox control of cell signaling and cancer, including developing a thioredoxin reductase knock-out mouse to test hypotheses. He also taught cancer biology and general biochemistry courses to generations of students. As chair of the department from 2011-15, Merrill hired six new faculty and formed the School of Life Sciences alliance with the departments of Integrative Biology and Microbiology. The latter was a key step towards the 2016 approval of the new and very successful Biochemistry and Molecular Biology major.

Promotions & Awards

Both **Adrian “Fritz” Gombart** and **Ryan Mehl** were promoted to Professor of Biochemistry and Biophysics in September 2018.

Indira Rajagopal won the Olaf Boedtker Award for Excellence in Academic Advising for 2019.

Michael Frietag was elected as an Fellow of the American Association for the Advancement of Science.

New major, multiyear grants

Ryan Mehl, Rick Cooley and **John Perona** of Portland State University received a four-year, \$1.8 million grant from the National Institutes of Health (NIH) for the project “Development of an improved core technology for efficient genetic code expansion in biomedical research.”

Maria C. Franco received a five-year \$1.8 million R01 grant from the NIH entitled “Redox Signaling in Neurofibromatosis.”

Michael Freitag received a four-year \$840,000 grant from the National Science Foundation for the project “Control and function of chromatin-mediated gene silencing in fungi.” He also received a \$500,000 grant from the Joint Genome Institute Community Sequencing Proposal and a five-year \$500,000 sub-contract from the NIH with his collaborator Zachary Lewis at the University of Georgia for the project “Mechanisms of gene silencing by the Polycomb group chromatin network.”

David Hendrix received a five-year \$1.9 million R01 grant from the National Institute of Aging at the NIH for his proposal “Understanding the Gene Regulatory Mechanisms

That Underlie Age-Induced Changes in the Circadian System and Neurodegeneration.” He is also a co-investigator on a five-year \$2.5 million NIH R01 grant entitled: “Defining the developmental and toxicological roles of the AHR-regulated Sox9 lncRNA in zebrafish.” This is with Robert Tanguay (Department of Environmental and Molecular Toxicology).

Fritz Gombart and co-principal investigators **Claudia Maier** (Department of Chemistry) and **Fred Stevens** (College of Pharmacy) received a one-year administrative supplement (\$388,000) to their existing R01 grant entitled “Impact of xanthohumol-gut microbiota interactions on mitigating risk factors for Alzheimer’s disease.”

Welcoming new faces



LAUREN DALTON

Lauren Dalton joined the department as an instructor and advisor in August 2018. After graduating from Pacific Lutheran University in Tacoma, Washington, Dalton earned her Ph.D. in biochemistry and molecular biology at the University of British Columbia, where she taught cell biology and biochemistry. At OSU, she enjoys teaching major and non-major classes, advising students, and boosting her students’ success with evidence-based pedagogy. She is happy to be a part of the biochemistry and biophysics family and eager to explore Oregon’s wonderful countryside.



KENTON HOKANSEN

Kenton Hokansen joined the department last winter as an instructor and research associate. The Utah native earned a bachelor’s degree in psychology at Pomona College and a Ph.D. in neuroscience at the University of California, San Francisco, where he studied synaptic development in the visual system. Kenton, who brings experience in recording neural systems from fruit flies to mice, is establishing and directing an electrophysiology core facility to help OSU faculty probe the electrical functioning of living neurons. He also teaches in the microbiology department and is married to microbiologist Maude David.





ON THE MOVE

Students going above and beyond



Finding a home, exceeding expectations

Honors College senior and biochemistry and biophysics major **Mai Le** ('18) hoped to attend a small college but came to Oregon State instead, “heavily influenced by my parents,” who argued that it was a solid choice financially and academically.

So maybe it wasn't her first choice, but from her first day on campus, Le fell in love with OSU and eventually found the small college experience she was yearning for in biochemistry and biophysics, a department “small enough where I don't feel like I am just floating through.” She discovered many opportunities to enrich her academic studies with real-world research and volunteering.

Le worked in Arup Indra's skin disease lab in the College of Pharmacy all four of her years here, researching how skin responds to ultraviolet radiation, melanoma and wound healing. Her research laid the foundation for her senior thesis on how wound care could

advance based on an understanding of underlying biochemical reactions and new technologies such as nanofiber bandages. She also volunteered for Beaver Hangouts, a program that connects college student coaches with underserved K-12 populations in Oregon, and the Multiple Sclerosis Exercise Program.

Looking back on her major, Le singles out her “awesome” immunology class with Professor Malcolm Lowry and the “safe open space for discussion” fostered by Michael Frietag in his advanced molecular genetics class. She also sings the praises of her advisor, Kari van Zee, for always going above and beyond and encouraging her to follow her passion.

Le is grateful for the generous support she received, including the OSU Finley Academic Excellence Scholarship, the Janet Richens Wiesner University Honors College Scholarship for Undergraduate Women in Science, and two College of Science scholarships, the George and Marthel Porter Pre-Medical Scholarship and the Merrill Family Foundation Scholarship. After a meaningful gap year, Le plans to enroll in medical school.



National recognition

Delaney Smith, an Honors College senior pursuing a double major in biochemistry/biophysics and education as well as a minor in chemistry, was the only scholar in the state of Oregon to win a 2018 Goldwater Scholarship, the most prestigious national undergraduate STEM award recognizing outstanding levels of academic accomplishment and a high ability to pursue a research career.



Smith, a member of the Phi Kappa Phi honor society and president of the OSU Biochemistry Club, has been active in research since high school, when she apprenticed at a behavioral neuroscience lab at Oregon Health and Sciences University to study alcohol use disorders using a binge-drinking mouse model. At OSU, Smith has worked in Jeff Chang's lab in the Department of Botany and Plant Pathology to characterize the ecological role of a toxic protein delivery system encoded by the plant pathogen *Agrobacterium tumefaciens*. In 2017, she received a Goldwater Honorable Mention.

Kendra Jackson, an Honors College sophomore in biochemistry and molecular biology, received a 2018 Goldwater Honorable Mention. Jackson is an undergraduate researcher in **Michael Freitag's** lab, where her academic accomplishments garnered her a Cripps Undergraduate Research Experience (CURE) fellowship, awarded to biochemistry and biophysics undergraduates, last year.

Far and wide

Thanks to donor generosity, many of our students hit the road to attend professional conferences in 2018–19!

Joel Peterson Undergraduate Student Travel Fund Winners

Marissa Gallegos – 2018 SACNAS Conference, San Antonio, Texas

Mark Geisler – Neurospora 2018 Meeting, Pacific Grove, California

Oliver Valdivia Camacho and **Jeanine Pestoni** – Society for Redox Biology and Medicine 25th Annual Conference, 2018, Chicago, Illinois

Mason McDowell – 2018 Regional Medical Education Conference at UCLA, Los Angeles, California

Grace Ross – American Aging Association Annual Meeting 2019; San Francisco, California

Kendra Jackson – 30th Fungal Genetics Conference 2019, Pacific Grove, California

Departmental Graduate Travel Award Winners (donor enabled)

Isabelle Logan – AACR Intestinal Stem Cells and Colon Cancer: Biology to Therapy, 2018, Washington D.C.

Simply outstanding

Jeanine Pestoni and Oliver Valdivia Camacho

presented their research at the 25th Annual Conference of the Society for Redox Biology and Medicine in Chicago, Illinois. They won Outstanding Young Investigator Award and runner-up, respectively.

Joe Kim won the 2018 American Chemical Society Undergraduate Award in Physical Chemistry.

Nadjalisse Reynolds received the 2017-18 Janet Richens Wiesner Honors College Scholarship for Undergraduate Women in Science.

Lisa Lin received the 2017-18 Joe Hendricks Scholarship for Academic Excellence.

Ally Erendson - Neurospora 2018 Meeting, Pacific Grove, California

Lillian Padgitt-Cobb - 2019 Plant and Animal Genome XXVII Conference, San Diego, California

Riley Bednar - American Vacuum Society International Symposium and Exhibition 2018, Long Beach, California

Ally Erendson - 30th Fungal Genetics Conference 2019, Pacific Grove, California

Summer Research

We are grateful to donors for supporting undergraduate summer research, which accelerates students' progress towards future science careers.

Thirteen of the 38 SURE (Summer Undergraduate Research Experience) 2018 winners were biochemistry and biophysics students! Congratulations to **Andrew Baker, Rebekah Cleary, Brooke Frey, Lylan Ho, Bahiya Zahl, Jenna Beyer, Sonia Grutzius, Kaito Hioki, Oliver Valdivia Camacho, Daniel Whittle, Lam Duc, Blake Migaki** and **Sophia Bethel**.

The Cripps Undergraduate Research Experience (CURE) fellowships give undergraduates unique, paid research opportunities with biochemistry and biophysics researchers. Congratulations to 2018 CURE fellows **Grace Bollard, Sonya Boyd, Diego Rodrigues, Mark Geisler, Kendra Jackson, Rose Kim, Tanrushi Kumar, Scout Osborn, Sanjana Saravanan** and **Pete Scruggs**.

Graduate student awards

Nathan Jespersen (Barbar Lab) was the first biochemistry and biophysics student to receive the prestigious MacVicar Animal Health Scholar Award, which honors interdisciplinary contributions to animal health and welfare. Jespersen presented his research on the rabies virus at a reception in October 2018.

Lillian Padgitt-Cobb won the poster competition at the Center for Genome Research and Biocomputing's 2018 Spring Conference.

Isabelle Logan, Ph.D. candidate in the Gombart Lab, received the Mark Sponenburgh Graduate Fellowship for



Nathan Jespersen hiking the Isle of Skye, Scotland.

the 2019-20 academic year from the Linus Pauling Institute.

Amber Vogel won the 2018-19 Christopher and Catherine Mathews Graduate Fellowship, awarded to second-year Ph.D. candidates based on academic merit, teaching acumen and research potential. The endowed fellowship was created in 2015 thanks to the generosity of emeritus professor Chris Mathews and his wife Kate to help recruit and retain top-notch doctoral students in biochemistry and biophysics.



After transferring from Rogue Community College in Grants Pass, Oregon with an Associate of Arts Oregon Transfer Degree, Vogel switched to science at Portland State University and worked in David Stuart's

lab synthesizing iodonium salts for use in the development of novel synthetic routes to benzene substitution patterns mimicking natural products. Ranking in the 98th percentile on the organic chemistry American Chemical Society (ACS) national test, Amber won the Most Outstanding Senior Award by the ACS Division of Organic Chemistry and graduated summa cum laude as a chemistry major with a focus in biochemistry.

At OSU, Vogel works in the Nyarko Lab, where she seeks inroads to new cancer drugs by targeting intrinsically disordered proteins. She plans to dedicate her career to drug development, including a cure to her own disease, type 1 diabetes.

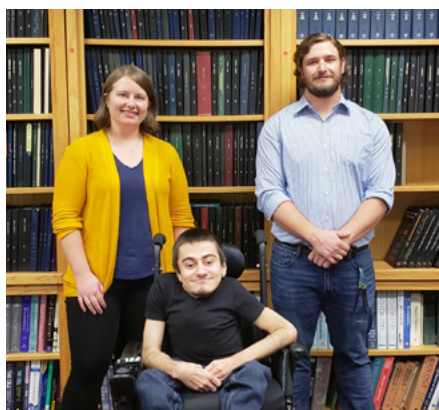
Meet our new graduate students!

Miranda Leek is completing lab rotations and delving into understanding protein structures and interactions. Previously, she represented the United States on the Olympic Archery Team (London 2012) and earned an undergraduate degree in

environmental science at Iowa State University in 2016. She then worked for the Oregon Department of Fish and Wildlife as their first-ever Archery Education Coordinator, fostering multiple youth archery programs and introducing thousands of kids to the sport of archery.

Jesse Howe graduated from California State University, San Marcos with a degree in biochemistry. His undergraduate research focused on the production of dual-labeled proteins for smFRET (a biophysical technique for measuring distances at the 1-10 nanometer scale) using in-vitro translation, artificial amino acid incorporation, and copper-catalyzed azide-alkyne click chemistry. He hopes to expand his knowledge of single molecule biophysics and learn new structural and biophysical techniques. When not working, he enjoys playing guitar and board games.

Patrick Morar graduated last year with a B.S. in biochemistry from George Fox University. As an undergraduate researcher at Oregon Health & Science University, Patrick investigated collagen proteins collected from patients with the genetic disorder osteogenesis imperfecta. Currently completing lab rotations, Patrick is hoping to expand his knowledge of the ever-expanding field of protein biochemistry.



OUTREACH

Summer is for science

The Computational Biology Camp led by **David Hendrix** and graduate students introduced middle school students to basic Python and GNU/Linux programming and concepts in the study of protein and RNA sequences. Through games and hands-on projects, campers learned about RNA folding, RNA transcription, protein translation, evolutionary trees and protein structures. They transformed into “molecular architects” who built proteins by using their genetic codes.

The week-long 2018 Biochemistry and Biophysics Summer Camp led by **Nathan Waugh** and graduate students drew 15 middle-schoolers from across Oregon. Campers picked up DNA on a stick from a fresh strawberry, made crystals out of proteins, grew bacteria that glowed bright green, and used natural enzymes to erupt miniature volcanos. They went home with great memories, new friends and new and empowering ways to think about the world.

Summer is also a time for faculty to welcome select undergraduates from out of state. This summer **Alvaro Estevez** worked with Research Experience for Undergraduate (REU) awardee **Alondra Zaragoza-Mendoza** from Heritage University in Toppenish, Washington, and, thanks to

the Louis Stokes Alliances for Minority Participation program, **Fritz Gombart** worked with **Yonas Kidanemariam** from Seattle Central College.

You go, STEM girls!

“Discovering the Scientist Within,” a long-running annual event to nurture the interest of girls in STEM fields, brought 135 middle school girls and youth to campus for hands-on activities last February. Event organizers **Kari van Zee, Emily Nicholson** (Precollege Programs), **Cathy Law** (STEM Academy @OSU), and **Diana Rohlman** (Environmental Health Sciences Center) recruited over 50 scientists and undergraduate STEM mentors from the colleges of Science, Agriculture, Pharmacy, Veterinary Medicine and Engineering to lead activities and expose the students to positive female STEM role models. Organizers reached out specially to underserved communities and hosted groups from Woodburn, Gresham and Portland among others.

A global lectern

Kevin Ahern in partnership with **Indira Rajagopal** was selected to record 24 biochemistry lectures for The Great Courses video series, which includes lectures by the top 1% of the 500,000+ college professors in the world, including Neil deGrasse Tyson and Robert Sapolsky.



RESEARCH

Driving innovation





Deep learning-derived insights: Hendrix Lab

David Hendrix has never used a micropipette in his life. Instead of lab benches, his bioinformatics lab is made up of powerful computing servers named after the five nucleotides.

Bioinformatics uses data science, machine learning and even artificial intelligence to probe the large datasets available in molecular biology today such as macromolecular structures and genome sequences. Bioinformatics has deepened scientific understanding across many biological fields and enabled the Hendrix Lab to pursue data-driven research that extends beyond the confines of anything that has been studied before.

“What drives me to be a scientist is a passion for discovery — to find some new pattern in the data and be the first person to see that,” Hendrix explains. “I like exciting, interesting questions, and how we can use computers to answer these questions to find new biology.”

Since he first started at OSU in 2013, Hendrix has been most heavily invested in a collaborative project with OSU

biologist **Jaga Giebultowicz** that uses a fruit fly model to study circadian rhythms and how they are affected by aging. Using sequenced fruit fly RNA data collected by the Giebultowicz Lab, Hendrix and his team can model and analyze the diurnal transcriptome and regulatory molecules to find patterns or changes that may occur with age.

Their research has generated new insights into the impact circadian clocks have on neuronal health. For instance, by studying the circadian rhythms in fruit flies, they found evidence that genes appearing rhythmic in young flies often lose rhythmicity with age, and some genes that are arrhythmic in the young gain rhythmicity with age. Their discovery suggests this pattern is strongly correlated with changes in neuronal health throughout a lifetime.

As the anti-aging project continues to develop, Hendrix is also becoming increasingly involved in the heart of a technological revolution — moving away from traditional computational machinery and moving toward artificial neural networks.

Neural networks are mathematical constructs modeled on the input and output functions of neurons. Just this year, Hendrix published a paper explaining their novel approach using a recurrent neural network to discover the complex biological rules behind RNA protein-coding potential.

“Unlike traditional machinery that relies on known biology, neural networks can define their own rules for protein coding,” Hendrix explains. “And not only that — they outperform any other program out there.”

The network that Hendrix developed is the most hands-off approach to RNA sequence analysis that exists today. His lab is at the leading edge of a widespread shift that is happening throughout science as artificial intelligence continues to develop. Even though neural networks can outperform human scientists in some ways, Hendrix does not see them as a threat to the future of the scientific community.

“What drives me to be a scientist is a passion for discovery.”

“It is a complex mathematical tool that we can use to extract information. But you still need the expert knowledge to interpret what’s going on,” says Hendrix.

Computational technology lends itself to a wide range of biological venues including a completely different project in the Hendrix Lab, sequencing

the hops genome. Cascade hops, developed at OSU in collaboration with the U.S. Department of Agriculture, is the most popular variety used in craft brewing, and makes up 14% of all hops grown in the U.S.

Sequencing the genome of the hops plant helps uncover evolutionary trends that previously weren't understood. In addition, studying the hops plant has also deepened the Lab's interest in transposable elements — endogenous retroviruses naturally occurring in both plants and animals — that may also be important in anti-aging research.



“I like having a lot of interesting projects going on, because in some cases you can find surprising connections between them,” Hendrix explains. “The common thread in all these projects is the analysis of biological sequences: finding patterns and meaningful information to help understand how genes are regulated and molecules function.”

Protein dynamics and disease: Barbar Lab

Elisar Barbar's lab maps the interactions of intrinsically disordered proteins (IDPs) in highly dynamic complexes, using an innovative integration of multiple techniques — Nuclear Magnetic Resonance, single particle electron microscopy, fluorescence quenching, crystallography and more. What is a disordered protein? Proteins are large, complex molecules made up of chains of amino acids that fold into a specific three-dimensional (3D) structure. The shape of each protein is critical to its purpose, such as an enzyme or an invader-destroying antibody. Unlike regular proteins, which have a unique, fixed shape, IDPs have regions that do not fold but remain more elongated and often highly flexible, able to take on different shapes under different circumstances. This volatility makes them “notoriously difficult to study,” says Barbar.

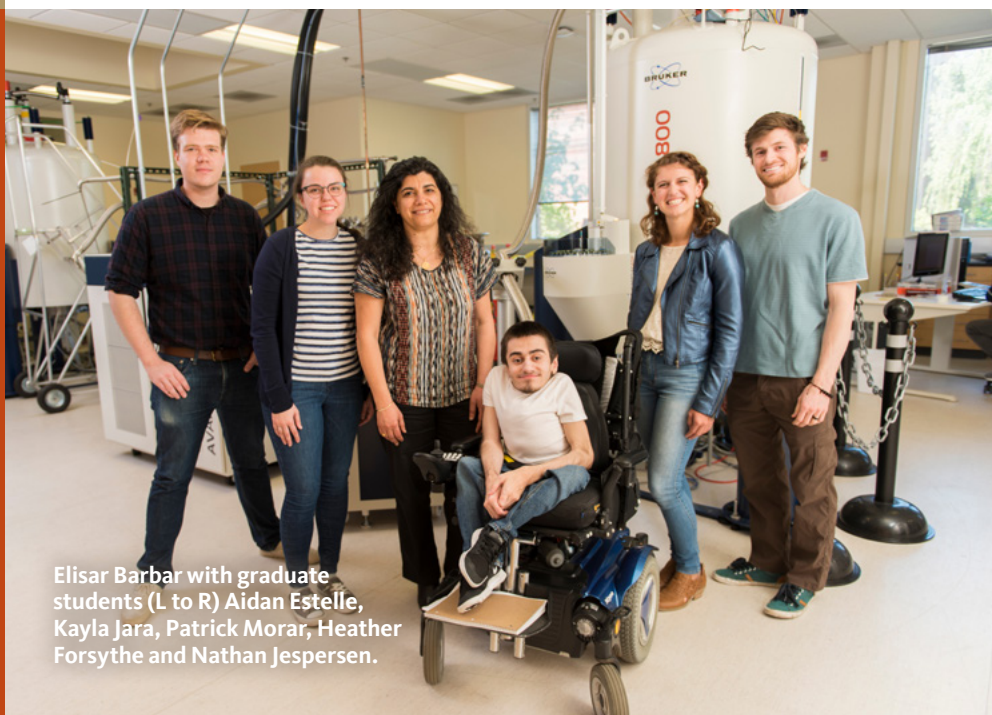
IDPs are essential for many biological purposes – for example, the Barbar Lab has revealed how the IDP ASCIZ plays a key role in regulating production of the hub protein LC8 in order to maintain organisms' homeostasis under rapidly changing environments. The Lab also studies an IDP in the rabies virus, and how manipulating its interaction with host proteins can be used to treat rabies infection.

More recently, in collaboration with OHSU, the importance of dynamic proteins has extended to cataracts, which involve partly disordered crystallin proteins in the eye lens. With age, these flexible regions are modified and cause impaired vision.

IDPs are also implicated in several other age-associated diseases such as cancer and Alzheimer's, applications which the lab is just beginning to address.



Elisar Barbar (L) with graduate student Heather Forsythe.



Elisar Barbar with graduate students (L to R) Aidan Estelle, Kayla Jara, Patrick Morar, Heather Forsythe and Nathan Jespersen.

Twenty-year mystery solved in Karplus Lab

Andy Karplus closed his research lab this year to focus more on leadership, teaching, mentoring and collaborative research. His final Ph.D. student, **Kelsey Kean**, published the last of her nine papers on the structure of the enzyme lactate monooxygenase, a protein that had confounded the lab for 20 years. Kean revealed that the enzyme's unique mechanism was not due to the active site chemistry but resulted from a more stable 'flap' that covered the active site and slowed product dissociation. In other news, Karplus' work on peroxiredoxins continues collaboratively with **Elisar Barbar**'s group. The group is doing nuclear magnetic resonance studies to define the roles of dynamics in the mechanism by directly measuring the dynamic properties of each catalytic intermediate. Karplus also continues in-depth exploration of the fundamentals of protein structure

with undergraduate **Jenna Beyer**, expanding a description of protein turns from 8 to 33.

Breakthroughs build in Beckman Lab

Joe Beckman's 25-year pursuit of a cure for Lou Gehrig's disease (ALS) may be on the verge of a big payoff in helping to establish copper-ATSM (CuATSM) as a promising treatment. Last January, the completion of successful Phase 1 clinical trials revealed that patients with sporadic and familial ALS showed a "slowing in disease progression." Randomized, placebo-controlled phase II trials are next. The lab continues basic research to understand the still-unknown mechanism of action of CuATSM, which may involve the delivery of copper to cells containing damaged mitochondria. The horizon for Beckman's work is also expanding. CuATSM may be effective not only for ALS, but also for Parkinson's disease and is now being tested for Alzheimer's disease. In other news, Beckman and OSU collaborators founded the company e-MSion to commercialize a transformative new mass spectrometry

technology, invented at OSU, that uses electron-capture based fragmentation to sequence intact proteins in seconds, even those that are a few hundred residues long.

New diffractometer opens door to discovery

Head **Andy Karplus** and chemist **May Nyman** led a campus-wide effort to purchase a new state-of-the-art single crystal diffractometer at OSU, which within its first week of use produced enough data about new structures to support eight articles in peer-reviewed science journals. It is not only fast — what used to take two hours now takes eight minutes — but it can analyze smaller crystals, has fewer runtime errors, and has two types of X-rays to optimize imaging for different crystals.

"There is nothing like being able to see what a protein or DNA or RNA molecule looks like to help understand how it works. In fact, such work is at the root of many Nobel Prizes," says Karplus. **Rick Cooley** and **May Nyman** will direct the new facility, which is expected to open new avenues of research on campus and across Oregon.

NEWS

Fond farewells

Indira Rajagopal and **Kevin Ahern** were celebrated for three decades of service at a retirement reception last November in the Memorial Union Lounge. Numerous colleagues and administrators saluted the pair with short speeches, and department head **Andy Karplus** presented a walnut box engraved with the words “Champions of Undergrads” in honor of their tireless work to improve the educational experience and success of undergrads at OSU and around the world (see p. 2). The box, handcrafted in Oregon, was filled with hundreds of notes wishing them well in the future. Karplus then announced the establishment of the Kevin and Indira Champions of Undergrads Fund, an endowed fund with an initial allocation of \$50,000, which is currently accepting donations in their honor (see p. 15).

Known for his Metabolic Melodies, Ahern composed a limerick for the occasion:

**We're finding it hard to believe
That our last day was
Last New Year's Eve
30 years since we're hired
And now we're retired
Enjoying maturity leave.**

Gary Merrill, who retired after a 34-year career in the department (see p. 2) was fêted outdoors on a fine June evening last summer at **Ryan Mehl's** house. **Andy Karplus** emceed a short presentation that included well wishes from former students and colleagues

and presented Gary with a farewell gift, a photo series of him whitewater rafting with colleagues and students entitled “Thanks for the Adventures!” The retirement reception included dinner, desserts, dancing and a live band. Merrill’s retirement plans include travel adventures with his wife Chris and continued research at OSU and beyond.

Matt Andrews is taking on a new position as the director of the National Science Foundation’s EPSCoR (Established Program to Stimulate Competitive Research) and the National Institute of Health’s IDeA (Institutional Development Award) for the state of Nebraska. Andrews joined OSU in August 2016 as associate dean for strategic initiatives and administration in the College of Science and professor of biochemistry and biophysics. Since August 2017, he has been the executive associate dean for the college.

Although his role at OSU has been primarily administrative, Andrews remains active in research. Along with bioengineer **Adam Higgins**, he applies hibernation-based methods to prolong the storage time of organs used for transplantation. He also mentors five undergraduates including three biochemistry and molecular biology students, **Maja Engler**, **Rosalee Land** and **Taylor Kuntz**.

What will Andrews miss the most? “The absolutely wonderful people I have worked with in the department and at the College of Science. After nearly three

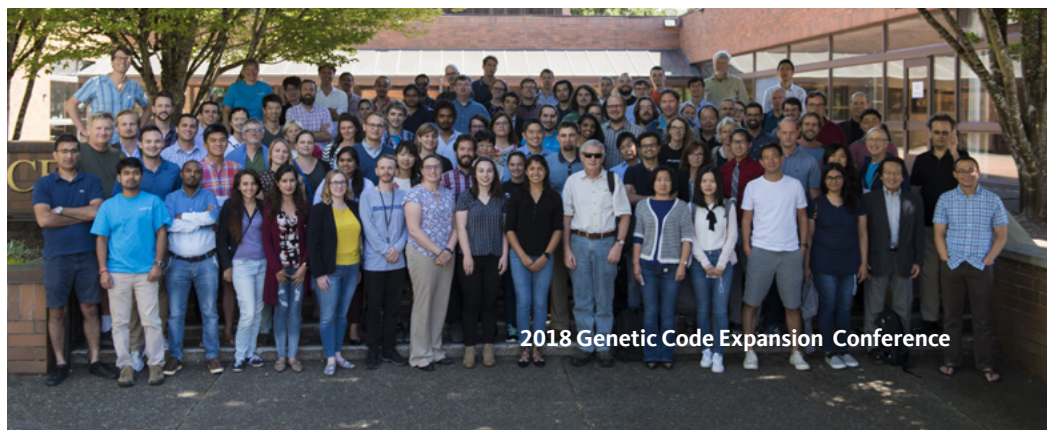
years, I got to know the majority of our faculty, and I have really enjoyed that.”

Attracting a crowd

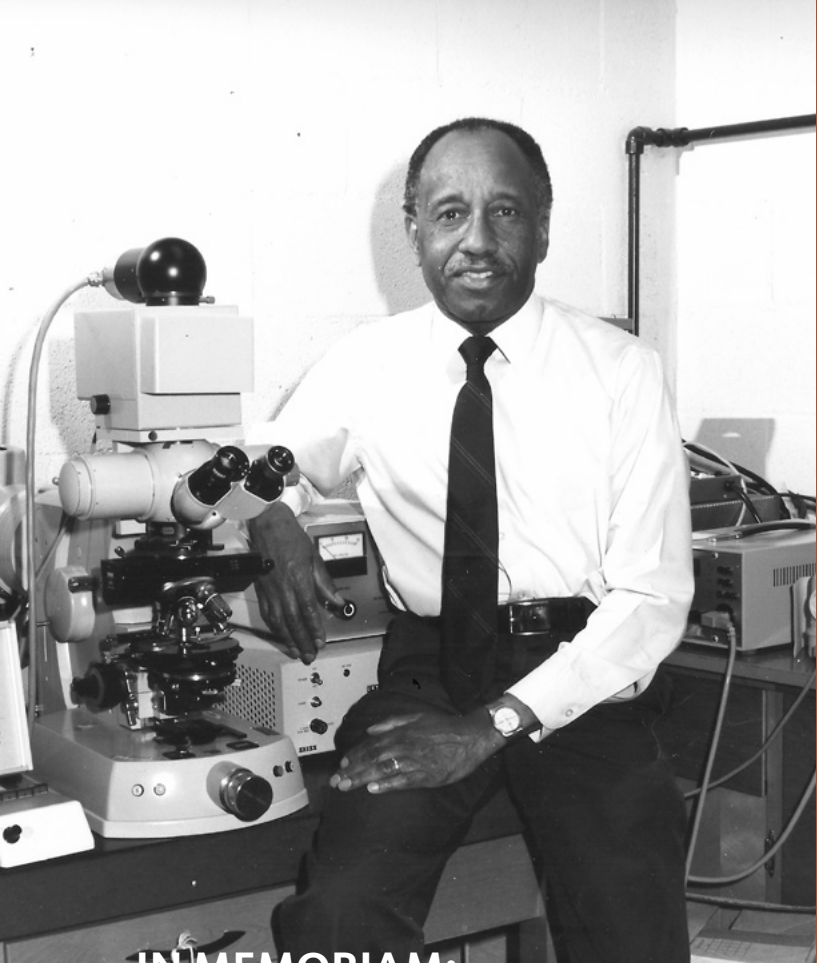
The second Genetic Code Expansion (GCE) Conference, hosted by the department on August 9-11, 2018, attracted 112 participants in academia and industry from 11 countries around the world to campus. Their research encompassed both fundamental research into the biology of life as well as drug discovery and material science with the aim of enhancing life forms and curing disease. Participants voted to hold the third biennial GCE conference at Peking University in Beijing, China in 2020 and then return to Oregon State in 2022.

Tsoo King Lecture

Dr. Michael Eisen from the Department of Molecular and Cell Biology at University of California Berkeley and the Howard Hughes Medical Institute presented this year’s Tsoo King Lecture, “Paywalls and Peer Review: Scientists Squandered the Potential of Internet to Communicate with the Public and How to Fix it” on February 27. A co-founder of Public Library of Science (PLOS) and a vocal proponent of open access scientific publishing, Eisen also presented the seminar “Live imaging of transcription and transcription factors in Drosophila development.” Despite a sudden snow, both events were well-attended and followed by lively discussion.



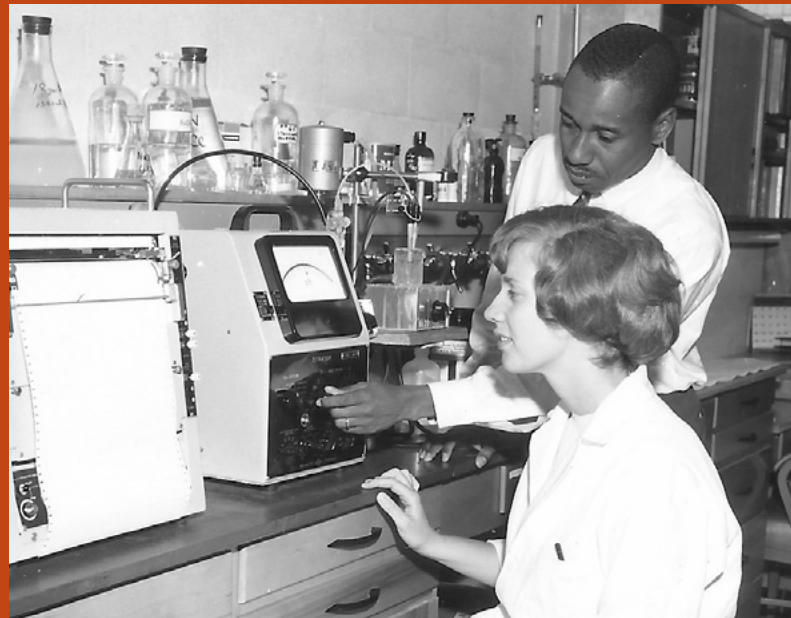
2018 Genetic Code Expansion Conference



IN MEMORIAM:

Wilbert Gamble, 1932-2019

By Chris Mathews



The department lost one of its most beloved faculty with the recent death of **Wilbert Gamble**. Wil joined OSU in 1962 — as the earliest identified African American faculty member at OSU — following his Ph.D. at Wayne State and a postdoctoral fellowship at Cornell University. He maintained an active research program in lipid metabolism and atherosclerosis well past his formal retirement in 1997.

The winner of several teaching and advising awards, Wil is perhaps best remembered for his many years of teaching BB 450, our largest course.

Students recalled him as occasionally “gruff” with clear affection. As Wil’s department chair for about 20 years, I met with many former students who shared the warmest memories. During his years as faculty representative to Intercollegiate Athletics, it was rare not to see several tall, broad-shouldered students waiting outside his office.

Wil also had a big impact at OSU beyond the department. A passionate activist, he was a member of the NAACP, Oregon Assembly of Black Affairs, Kiwanis, and served as an

Advisor to the Black Student Union, assisting students, staff and community members in establishing the Lonnie B. Harris Black Cultural Center in 1975.

Wil picked up new research after retirement. He somehow discovered that bears rarely develop atherosclerosis and enthusiastically pursued this clue to an overriding human health challenge. He summarized his ideas in a 2006 paper in the *Journal of Theoretical Biology*. Truly, Wil embodied all that is best in a professor.



ALUMNI & FRIENDS

Making us proud

Biochemist blazes trail for women in STEM

When **Karen Nickel** (Chemistry, '61) returned to campus after a long and illustrious career in clinical chemistry, the trip “brought back lots of good memories” and made her feel “young again” even as the undergraduates she met made her wonder, “was I ever that young?”

On her visit, Nickel enjoyed a chat with head **Andy Karplus**, who impressed her with the department’s growth and future potential. Indeed, Nickel, who had previously made generous gifts to the College of Science, was so inspired that she created the Karen Nickel

Biochemistry/Biophysics Scholarship for undergraduate students.

Nickel would likely have been a biochemistry and biophysics major if it had existed at the time (it wasn’t created until 1967). Her undergraduate research with Professor Tsou King on heart enzymes sparked a lifelong interest in clinical endocrinology. After graduation, she went on to earn a Ph.D. in biochemistry and analytical chemistry with special emphasis on endocrinology from Kansas State University in 1968.

What was life like as one of only a few women in chemistry back in the late 50s and early 60s? “It was quite

hard,” Nickel remembers, and not only because of her gender. “Without a scholarship, I had to work throughout the school year and summers to pay my way. Courses were tough, and I was competing ‘with the guys’ in my classes. It would have been a little easier without that added pressure!”

Nickel also recalls “lots of cold and rain and long lab classes in smelly labs” but “very pleasant and helpful professors” who encouraged her to persevere and to work hard. Both the challenges Nickel overcame and the support she received at OSU put her in good stead for a long and fruitful career: “I have been so blessed with career opportunities and that all started here.”

“I have been so blessed with career opportunities and that all started here.”

After earning her Ph.D., Nickel taught at the university level in Southern

California while her children, Mark and Jamie, were small. Then she pursued postdoctoral training to qualify for licensure in California as a Clinical Chemist.

After several clinical positions in the newly emerging field of radioimmunosassays, Nickel found herself “thrust into leadership,” a fact which she attributes simply to “being interested in people and seeing what needs to be done.” She was elected president of the American Association of Clinical Chemistry in 1991 and, in 1993 was the first woman to become Chief of Laboratory Field Services for the California Department of Health Services, a position she held for 17 years, overseeing 17,500 clinical laboratories in California and 27,000 licensed clinical laboratory personnel.

What is Nickel’s advice for students today? “Get the best education you can, the more STEM the better! Then, work hard and don’t expect everything to be easy.” Any advice for women in STEM? “Women rule!” she cries. Nickel hopes that her scholarship will “encourage young women to major in biochemistry/biophysics and continue on to graduate work” in the field.

Honored alumni

Marian Waterman ('81) and **Jeremy Cutsforth-Gregory** ('05) were honored with the 2018 Alumni Fellows Award at the OSU Alumni Association’s awards ceremony in October. The

award recognizes eminent alumni who have distinguished themselves in their professions and communities.

While still a postdoctoral scholar, Waterman discovered a regulatory protein that is highly expressed in the fetus and implicated in the growth of a wide variety of cancers, a discovery with profound consequences for cancer research.

Author of more than 100 research articles, Waterman is a professor at the University of California, Irvine and director of the Cancer Research Institute. Recently, she and her colleagues received a \$10 million grant to establish a Center for Cancer Systems Biology focused on understanding the complexity of cancers in order to develop better treatments.

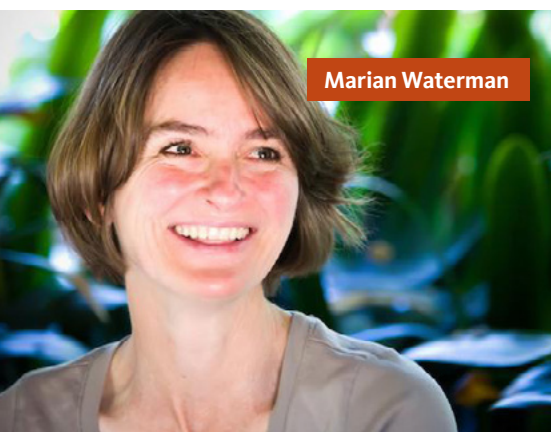
Cutsforth-Gregory, an Honors College alumnus who graduated summa cum laude in two majors, biochemistry and biophysics and Spanish and international studies, is a practicing physician in the neurology department at the Mayo Clinic and an assistant professor of neurology at the Mayo Clinic College of Medicine and Science. In 2014, he received the Chief Resident Award as well as the Henry W. Woltman Award for clinical excellence. He has also received the Golden Apple Teacher of the Year (2015), the A.B. Baker Teacher Recognition Award (2017) and the Golden Stethoscope Teacher of the Year Award (2017).

Mike Riscoe (Ph.D. '84) won our 2018 Distinguished Alumni Award, which recognizes biochemistry and biophysics alumni who have achieved distinction and brought honor to the University through exemplary contributions to society and the world. Mike is currently a professor of molecular microbiology and immunology at Oregon Health Sciences University and he has done outstanding work toward developing a potentially world-changing affordable cure for malaria. His current potent pre-clinical drug candidate “ELQ-300” is active against liver, blood and transmission stages of the main malaria parasite, *Plasmodium falciparum*.

NEW!

Kevin & Indira Champions of Undergrads Fund

In honor of beloved biochemistry married duo **Kevin Ahern** and **Indira Rajagopal** on the occasion of their retirement (see p. 12) and their three decades of enthusiastic and innovative teaching and advising (see p. 2), the department has established a Kevin and Indira Champions of Undergrads Fund. Ahern and Rajagopal share many honors, among them the 2008 OSU President’s Beaver Champion Award. What this fund seeks to honor and perpetuate is their unflinching caring and supportive, one-on-one mentoring relationships with students before, during and after their time at Oregon State. They are both at the heart of the warm family-like culture



Marian Waterman



Jeremy Cutsforth-Gregory



Mike Riscoe

that characterizes our undergraduate programs. This fund honors their legacy by providing tangible support for our students into the future and all alumni who are inspired to contribute can contact Marlys Amundson at the OSU Foundation, Marlys.Amundson@osufoundation.org, 541-737-0055.

Notes from the field

Rebecca Pankow (Honors Biochemistry and Biophysics '11), a doctoral student in computer science at Brown University, was featured in the October 2017 issue of the New Yorker for her ongoing research to build a new generation of robots that can work cooperatively with humans.

Andres Cardenas (Biochemistry and Biophysics '10) accepted a faculty position at the University of California, Berkeley in Environmental Health Sciences.

Borries Demeler (Ph.D. '92) retired this year from the University of Texas Health Science Center's Department of Biochemistry and Structural Biology, and moved to the University of Lethbridge, Alberta, where he is an endowed Canada 150 Research Chair in Biophysics in the Department of Chemistry and Biochemistry. He enjoys his new life north of the border.



Kelsey Kean

Newly Minted

Congratulations to our outstanding group of 2018 Ph.D.s!



Bharath Sunchu

Bharath Sunchu (Perez Lab) elucidated the mechanism by which skin cells from long-lived species are more resistant to proteotoxicity than short-lived species. He discovered that long-lived species have a robust protein quality control mechanism that protects against the toxic effects of protein aggregation. Currently, Bharath is a postdoctoral fellow at University of Washington in Seattle, studying asymmetric cell division and its role in cellular diversity.

Kelsey Kean (Karplus Lab) explored advanced structure-function studies of sugar-phosphate cyclases that make bioactive cyclitol natural products, including gadusol, a natural vertebrate sunscreen. With numerous exciting side projects, including a chemical biology "course-based undergraduate research experience," Kelsey published nine papers, helped organize our new graduate student association and developed a weeklong biochemistry camp for middle school students that is now an annual event. Targeting a career as both a researcher and educator, Kelsey entered the National Institutes of Health-funded SPIRE (Seeding

Postdoctoral Innovators in Research & Education) program at the University of North Carolina, where she combines research with **Marcey Waters** and pedagogical training and teaching at partner minority-serving institutions.



Sarah Clark

Sarah Clark (Barbar Lab) completed her dissertation on intrinsically disordered proteins and their role in regulating cellular processes. A stellar student and gifted experimentalist, she published four first-author papers and one as a coauthor. She received competitive travel awards from Sigma-Aldrich and Bruker, and presented her work at several international meetings as well as the inaugural students' symposium at the Experimental Nuclear Magnetic Resonance Conference. She won a university-wide fellowship to pursue collaborative research. Sarah continues her success in the lab of Howard Hughes Medical Institute investigator **Eric Gouaux** at Oregon Health and Science University, where she has already received postdoctoral fellowships from the National Institutes of Health and from the Cold Spring Harbor Laboratory.

Andrew Popchock (Qiu Lab) studied the mechanism and regulation of kinesin-14 motor proteins. For his thesis, Andrew made several significant

Andrew Popchock

contributions to the kinesin field, including the discovery of the first context-dependent bidirectional kinesin-14 motor and the development of a novel chemical biology-based method for engineering artificial heterodimeric kinesin motors. Currently, Andrew is a postdoc with **Sue Biggins** in the Basic Sciences Division at the Fred Hutchinson Cancer Research Center in Seattle, Washington. He is researching the fundamental mechanisms underlying DNA segregation during cell division.

Joey Porter (Mehl Lab) produced the first detailed exploration of how oxidative stress regulates protein function through tyrosine nitration in his thesis, "Defining the Role of Tyrosine Nitration in Biology with Genetic Code Expansion." Porter is currently a postdoc at the University of Rochester, working with **John Lueck** on the therapeutic applications of tRNAs.



Joey Porter



Robby Blizzard

Robby Blizzard (Mehl Lab) explored the limits of the fastest bioorthogonal conjugation reactions inside cells in his thesis, "In Vivo Reactions of Tetrazines Incorporated through Genetic Code Expansion." He is now a postdoc at Boston College, working with **Abhishek Chatterjee** on optimizing genetic code expansion in eukaryotic cells.



John Gamble

John Gamble (Greenwood Lab and Kolluri Lab) used zebrafish as an in vivo model to study cancer cell biology. In the Greenwood Lab, he studied the role of the laminin alpha 5 protein on glioblastoma invasion and developed methodology for imaging and tracking individual glioblastoma cell movements inside living zebrafish larva. In the Kolluri Lab, he established human cancer cell xenograft tumors and tested target selective effectiveness of newly discovered anti-cancer compounds on cancer growth and progression. He accepted an Oak Ridge Institute for Science and Education postdoctoral position with the National Center for Computational Toxicology at the U.S. Environmental Protection Agency in Hillsborough, North Carolina.

Honor Roll

We are proud to recognize the department's annual supporters who have made outright gifts or pledge payments totaling \$500 or more between January 1, 2018, and December 31, 2018.

Indira Rajagopal and Kevin G. Ahern '86
 Wanda H. & Daniel J. Arp
 Tanya & Joseph S. Beckman
 Katherine Brempelis
 Collins Medical Trust
 Toni L. '01 and Erick T. Doolen
 Philip R. Gafken '01
 Ward E. Harris '62
 Karen E. and Andrew Karplus
 Andrea Knutsen
 Grace Knutsen
 Lijing You '98 and Kechuan Liu '94
 Margaret R. MacDonald '79
 Catherine Z. and Christopher K. Mathews
 Medical Research Foundation of Oregon
 Karen Sahlstrom Nickel-Creusere '61
 Sumie Suzuki Nishikawa '68 and Hiro Nishikawa '65
 Edward J. Ray
 Alice Burk Stormshak '81 and Fredrick Stormshak
 Vasiliki D. '79 and Zachary H. Stoumbos
 Grace Y. Sun '66
 Thomas T. Tibbitts '83
 Carol Kohlheim Woodstock '81 and Tim Willis

Thank you!

Every attempt has been made to ensure the accuracy of these lists. However, if you notice an error, please contact Pam Powell, Associate Director of Stewardship, OSU Foundation, Pam.Powell@osufoundation.org or 541-737-5820



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