CAMB STUDENT NEWSLETTER

Volume 10 // Issue 2 // May 2025

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LETTER FROM THE EDITORS:

Dear CAMB Students, Faculty, and Alumni,

We are thrilled to share with you the May 2025 installment of the CAMB Student Newsletter!

In this exciting issue, we polled current CAMB students about their thoughts on **the current state of science and funding** and how Penn, BGS, and CAMB have responded to recent events, and we also highlight some non-federal funding opportunities available for grad students in the life sciences. We then speak with **CAMB Chair Dr. Dan Kessler** about his career journey and his time as Chair of CAMB as he prepares to step down after 16 years. Next, we chat with **CAMB-MVP alumnus Dr. Marisa Egan and CHOP postdoc Dr. Ifrah Shahi** about their pursuit of more teaching-focused career paths to professorship at primarily undergraduate institutions (PUIs). We also spotlight **CAMB-CPM alumnus Dr. Charlie Bond's fascinating thesis research** on using the super-resolution light microscopy technique DNA-PAINT to characterize late endosome/lysosome heterogeneity.

For additional articles, past publications, and to learn more about the CAMB Student Newsletter team, visit our blog at https://cambnewsletter.wixsite.com/blog or follow us on Instagram **@cambnewsletter.** The CAMB Student Newsletter is always looking for new writers and editors to join our team! Current students interested in contributing to the CAMB Student Newsletter can fill out this form or reach out to us via email at **cambstudentnewsletter@gmail.com** to learn more! You can also check us out in person — our next meeting will be Tuesday, June 10th at 3pm, location TBD. Join us to brainstorm ideas for the August issue. Snacks will be provided!

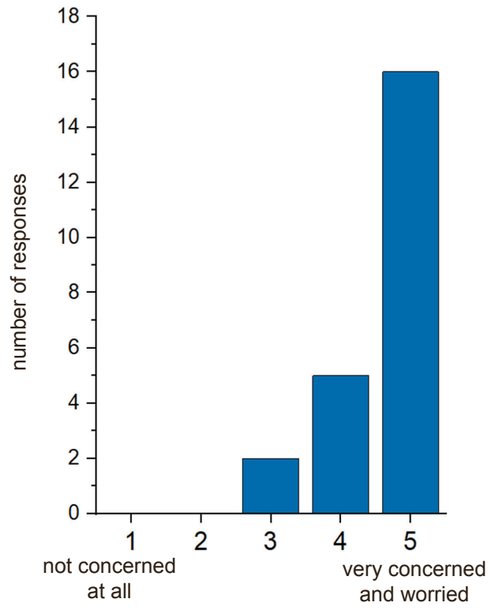
Sincerely,
Ariana Majer and Kay Labella
Editors-in-Chief

CAMB Students' Thoughts on the State of Science and the NIH

by Katey Stone
Peer Edited by Caroline Bickerton

Given the events in the headlines lately regarding the current administration and changes to the NIH, we asked CAMB students to share how they are feeling about research, funding, and science in general. Here is a selection of their responses. An unabridged list of responses is available on our blog.

How are you feeling about recent events around the state of science and funding?



TL;DR: *CAMB students are generally worried about maintaining their graduation timeline and are considering changing their career plans for after graduation. Many believe that the effects of these actions will last decades.*

"I am very concerned that I may have issues completing my thesis work as originally planned, either leading to compromising the quality of my research and/or extending the length of my degree."

"Terrified. Ready to master out and find a job overseas where science is respected."

"I am anxious, angry, and appalled that things have gone this far fairly quickly and that it doesn't seem like it will come to an end any time soon. How anyone can justify so many blatant attacks on not only science, but also our basic rights is beyond me."

"The uncertainty about funding will have long lasting negative impacts for the foreseeable future regardless of whether these cuts even go into effect."

"I feel very nervous about the future of science as well as the state of my career if these funding cuts continue."

"A little numb. It's clear there's nothing I can really do so I have to just roll with the punches and adapt, and also look for jobs outside of academia and possibly all bench science jobs for when I graduate."

"I think it is concerning that the federal government is claiming that funding that goes into scientific research is being squandered and implying that the necessity for these funds is fraudulent. It places both the government and the general public in opposition to the important work that we do to improve the lives of as many people as possible."

"It makes pursuing a career in academia seem precarious and less certain. It's affected the jobs I'm looking for as I finish up my PhD."

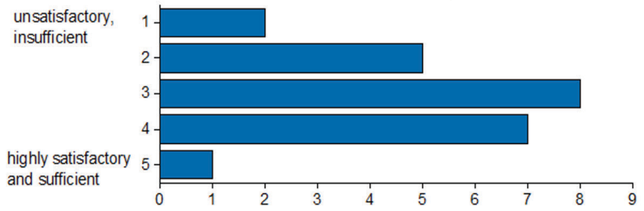
If your PI HAS addressed recent events, did you find this conversation sufficiently addressed your concerns? Why or why not?

TL;DR: *Overall, CAMB students were comforted and appreciative when their PIs addressed recent events, but often found the conversation insufficient. However, they recognized that their PIs aren't going to have all of the answers. In contrast, some students found their PIs' responses to be dismissive or tone deaf. In cases where PIs have not addressed recent events at all, CAMB students report feeling abandoned and disheartened.*

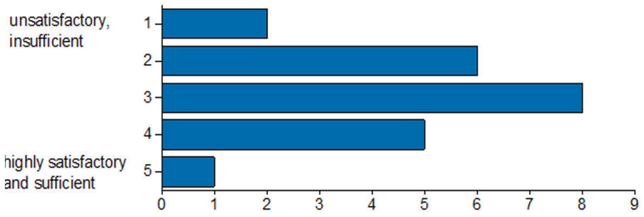
"It was good for our PI to candidly talk to us all and build solidarity because we don't know what will happen next."

How would you rate the response and communication regarding recent news about the NIH from...

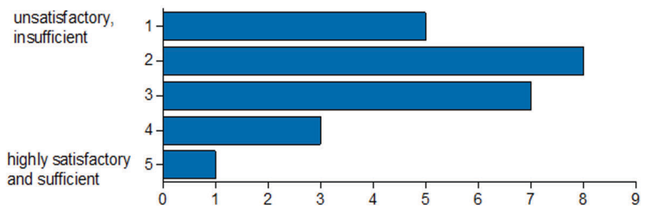
CAMB?



BGS?



Penn?



"No – addressing it was limited to an email saying that we shouldn't worry about our positions much and that we should just continue doing the work we are doing – it reads slightly tone deaf and I wish there was more compassion about not only the things happening to science, but also other recent executive orders that have a large impact on the community."

"Yes, they focused on how it affects our lab in particular in the short and long term. I think no one really knows what employment or opportunities are going to look like with these changes so it's hard to ask them to address unknowns. They know as little as we do."

"Not really – my PI said that the department and the university has not provided any concrete information, so my PI was just speculating also. They said that they couldn't make any commitments or promises until they heard back from BGS, but also said that BGS hadn't communicated anything with them. My PI has remarked about being more careful about the resources we use because of funding issues and has encouraged us to pursue additional funding opportunities for our projects. However, my PI has not directly addressed the NIH budget cuts. However, this has not sufficiently addressed my concerns because I am more concerned about how Penn will respond to massive budget cuts for indirect costs that support much of the research-related infrastructure that seem impossible to make up."

"Yes she did a great job summarizing the situation, what she knows, and how it affects us."

"No, I didn't feel like it was sufficient. However, I know that my PI doesn't necessarily also have all the insights onto what is happening at higher levels at Penn."

"It addressed my concerns in that I know she was telling us as much as she knows, and I know that she's in our corner, but did it make me less worried? No."

What do you wish you were hearing from Penn/BGS/CAMB administration?

TL;DR: *Overall, CAMB students want transparency about decision making and policy changes that are being considered and implemented. Students feel frustrated by the lack of culpability that has been taken by administration thus far, in both lack of support offered to at risk identity groups and in funding cut excuses. They want to hear about contingency plans, possible legal action and what will be guaranteed moving forward.*

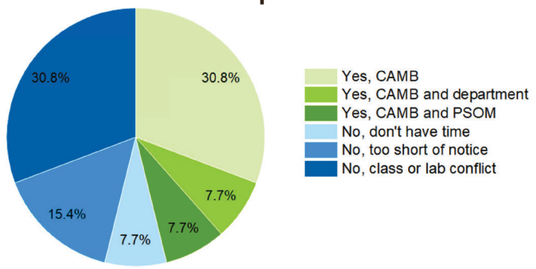
"More explicitly assuring women and people of color that they are still valid members of the scientific community and that their identities will not be erased."

"I wish there were more transparency with things going on behind closed doors. I also wish Penn as a top university would stand up for DEI and against the current administration's attacks on science."

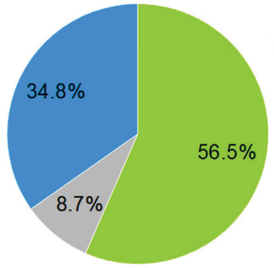
"Reassurances that our research and time is valued. That you will fight to protect your students, especially international and LGBTQIA+ students."

"I wish Penn would stop pushing off culpability by saying they're unable to use endowment funds to support research, when their 2025 operating budget document shows Penn was estimated to net 685 million dollars in their assets in 2024 and continue to pay their top executives millions of dollars of additional salary."

Have you attended any townhalls that Penn has put on?



Would you attend another townhall if one was held?



Some students noted that they would attend if an evening or virtual option was offered.

"Resources for finding funding and job opportunities that are outside of the NIH and Federal Government control."

"I would like to hear more about what the Penn administration plans to do about the concerns that students have that they cannot finish their PhDs. There are some things Penn could do to free up funds such as not requiring PIs to pay student tuition, but as of now I do not have faith that the university admin will not sacrifice students and faculty."

"I would like to see a concrete plan that shows exactly how the measures being taken will enable the university's research program to survive these budget cuts, but I understand that while we don't know exactly what will happen, that is simply not possible."

"I think administration should be as transparent as possible about how funding changes may influence things other than our class sizes for upcoming cohorts. I would like to know more concrete plans on how admin is going to protect students (especially those most vulnerable to these changes like URM, international students, disabled students, LGBTQ+ students, etc.)."

Any additional thoughts?

"We as a university have one of the top business schools in the world. While people, intelligence, logic, and general good-decision making seems anathema to this administration, I believe that they do answer (to some extent) to dollars – that is, they follow the money. I think if we are going to win this in any capacity, it is vital that somehow we leverage our contacts from Wharton and perhaps biotech to lobby the government from a capitalistic standpoint for why this funding must be maintained (as I think it is the only argument they will accept). All in all, I appreciate the CAMB and BGS offices' endeavors to help calm tensions we are all experiencing. I really appreciate the directness and willingness to pass on information as it comes. I just wish the University would stand up and fight back (though I'm not even sure what this would look like)."

"The administration's excuse that funding was pulled due to one transgender swimmer who doesn't even go here any more is an obvious farse, and for the university to entertain or capitulate to that farse would be cowardly and embarrassing. Recent funding cuts are nothing short of an attack on all academia that follows a recent rise in anti-intellectualism. Any ground ceded to these bullies will just embolden them further, and if Penn wants to be seen as an academic leader, it needs to act like one."

"I would like to have guidance on how to talk about the current situation with non-academics (such as family & friends) so that I can better communicate what is happening."

If you need specific support in relation to recent changes and how they are affecting you, your lab, or your work, please contact CAMB administration or take advantage of other resources as needed.

SPECIAL INTEREST

Non-Federal Funding Opportunities

by Avani Modak
Peer Edited by Kay Labella

The majority of funding to support life sciences research in the United States comes from federal resources distributed by organizations like the National Institutes of Health, the National Science Foundation, the Department of Defense, and more. However, recent administration changes have brought about unprecedented instability in the federal grant funding stream. Given current circumstances, we wanted to share a link to Penn Pivot-RP, a searchable database of fellowship and award opportunities, including those from non-federal organizations, that provide alternative funding sources to graduate students and postdoctoral scientists. Access this database here.

Sponsor	Program	Description	Eligibility/Requirements	Amount	Deadline
Tobacco-Related Disease Research Program of California (TRDRP)	Predoctoral Award	This opportunity supports predoctoral students in hypothesis-driven research on tobacco-related diseases, including cancer, cardiovascular disease, and smoking behavior. Emphasis is on innovative projects with potential impact, fostering development into independent researchers or alternative careers in the field.	Must study tobacco-related disease.	180,000	Aug 22, 2025
American Heart Association (AHA)	Predoctoral Fellowship	This fellowship supports predoctoral students in developing research and clinical skills for careers in cardiovascular, cerebrovascular, and brain health. It emphasizes collaborative proposals with mentors, encouraging innovative research to advance global health in these areas.	Must be AHA professional members enrolled in a graduate degree program.	69,548	Sept 4, 2025
Howard Hughes Medical Institute	Gilliam Fellowships for Advanced Study	The Gilliam Fellows Program promotes equity and inclusion in science by supporting graduate students and their advisers. It offers leadership training, professional development, and mentorship enhancement across diverse fields, including life sciences, engineering, and social sciences, to foster inclusive scientific environments.	Must be a second or third year PhD student and a US citizen, permanent resident, or undocumented individual.	159,000	Dec 6, 2025
Ford Foundation	Predoctoral Fellowship	This fellowship supports Ph.D. or Sc.D. candidates in diverse fields, including sciences, humanities, social sciences, and interdisciplinary studies. It emphasizes academic excellence, teaching commitment, and leveraging diversity to enrich U.S. higher education.	Must be a US citizen, national, permanent resident, or undocumented individual.	81,000	Jan 31, 2026
Friedreich's Ataxia Research Alliance (FARA)	Graduate Research Fellowship	This fellowship supports Ph.D. research focusing on neuroscience, cardiac disease, and the molecular basis of Friedreich's Ataxia (FA). It emphasizes drug discovery, development, and translational research to advance clinical understanding and treatment of FA.	Must be a second or third year PhD student.	150,000	Mar 15, 2026

FACULTY INTERVIEW

Dr. Dan Kessler

by Kay Labella
Peer Edited by Eva Agostino

Chair of the Cell and Molecular Biology Graduate Group for the last sixteen years, Dr. Dan Kessler has been a beacon of leadership and mentorship for students at every step of their graduate career. The CAMB Newsletter team was thrilled to sit down with Dan and learn more about the road that led him to Penn, his time as a PI, and his advice to current students in these unprecedented times.

Tell us a little bit about your scientific journey. What was your path like?

My parents were teachers. Growing up in Binghamton, NY, my mother was an elementary school teacher and my father a professor of English and a poet at the State University of New York at Binghamton. My role models were teachers, not scientists, and teaching and mentoring have been a central focus of my faculty career. In sixth grade, I had a formative experience during my father's sabbatical semester in Honolulu, HI. The school I attended had an innovative experiential science curriculum involving day trips to the reefs and tidal pools of the island. This hands-on experience with marine life sparked a lifelong passion for biology.

As a freshman at Cornell University, I had my first laboratory experience as a work study student washing glassware and weighing samples in an animal nutrition laboratory. I then joined a bacterial genetics lab for my undergraduate research experience, working with *Bacillus subtilis* to identify mutants in the branched-chain amino acid biosynthetic pathway. There, I learned to love the unstructured freedom of the lab and the excitement of doing experiments. From Cornell I went directly to graduate school at Rockefeller University, doing thesis research with Dr. Jim Darnell. I studied the signaling pathways and transcriptional response to interferon signals, identifying the founding members of the STAT family. I've always felt like I peaked in graduate school with regard to impact and productivity, which was a direct result of the talented and supportive people I worked with. At Rockefeller, I had my first exposure to developmental biology and the models used, including the work of Dr. Steve DiNardo, a newly arrived assistant professor. I was fascinated by the three-dimensional transformation of the embryo and the tools for visualizing gene expression.

Motivated to explore this field, I pursued a postdoctoral fellowship with Dr. Doug Melton at Harvard University, studying the inductive signals and transcriptional regulators that controlled germ layer formation in the frog embryo. This work established the direction of my independent research career at Penn. At Harvard, I also had my first teaching experience in an undergraduate embryology course. During the period of my training (1986-1994), I don't recall mentorship being widely discussed, but I was drawn to faculty mentors who were kind and seemed to be genuinely invested in the success and well-being of their trainees. This set a positive example that I have strived to fulfill in my faculty roles. I arrived at Penn in 1995 to join the recently established Department of Cell and Developmental Biology, which has consistently been a wonderfully supportive and scientifically creative community.

What factors influenced your decision to become a PI? When did you know it was the right path for you?

Although not a scientist, my father's work exposed me to the creative independence and intellectual freedom of an academic career, as well as the joys of teaching and mentoring. Through my research experiences, I came to appreciate how anyone in the lab could be the source of an important new idea, hypothesis, or experimental approach. In thinking about a career in science, I couldn't imagine working in a setting that didn't allow that freedom. All of my scientific role models were academics and I didn't have much awareness of other career paths in science. Choosing graduate school was an easy decision for me, but I had no meaningful understanding of the career beyond the work at the bench; no concept of what it was to publish a paper or write a successful grant. So at an early stage, the choice of an academic career path was a relatively uninformed leap of faith, and my understanding of what was required to be a successful PI was learned on the job. Fortunately, I started my career at Penn during a period that seems far more forgiving with regard to grants and publications, and I was able to navigate the early years of my career with less pressure than current assistant professors experience. I've never really questioned whether this career path was right for me, even during the most stressful moments. I was very lucky to start at Penn together with exceptionally talented colleagues and friends, including Dr. Peter Klein, Dr. Mary Mullins, Dr. Michael Granato, and others, and within weeks of arriving I was certain I had made the right decision, both in career path and institution. That belief persists to this day.

What was your favorite part about being a PI?

From the very start I loved working with students in the lab, sharing those rare moments of discovery, and seeing them develop independence and succeed in their career goals. I also really enjoyed the process of drafting manuscripts together with students. Once the initial draft was completed by the student we would sit together at the computer and make revisions, working through the language to find clarity in communicating the critical ideas and results. I found that students appreciated this approach as a method for providing guidance on effective writing, leading to a better understanding than simply scribbling comments on the paper. And then of course was just the fun of being in the lab as everybody did their experiments. Like many faculty, I had a habit of passing through the lab every hour or so to check in. And most of all, I enjoyed the conversations, whether about science, sports, politics, family life, and which bar or restaurant got a good review from the weekend. When things were going well, the lab had a family feel to it, which I was grateful for.

What led to you becoming the chair of CAMB?

Early on, becoming chair of CAMB was certainly not a goal of mine. To be honest, CAMB always appeared so large and complex that the job seemed impossible. And now that I've been doing it for 15 years, the job still seems impossible at times. The path to becoming CAMB chair was more organic than strategic. Following the example of my parents, I arrived at Penn with a strong desire to get involved in teaching, mentoring, and advising. I had minimal experience, but felt getting involved right away was important. I joined the Developmental Biology (DB) program within CAMB as soon as I arrived on campus. Dr. Jonathan Raper was DB chair at the time, and also a faculty mentor to me. Eager to get involved, I soon became academic advisor for DB. Much of what I initially learned about supporting and advising students came from Jonathan in advising sessions we held together. Several years later, Jonathan became CAMB chair, and it was a natural move for me to become DB chair. After five years as DB chair, during which the program became Developmental, Stem Cell and Regenerative Biology (DSRB), Jonathan stepped down as CAMB chair and I moved into that role. I'm not sure if this reflected my qualifications or the fact that no one else wanted to do it, but either way, I was definitely in over my head for the first few years. I made many mistakes, but was grateful for the support and patience of the program chairs as I figured it out.

I can say that one of the main incentives for taking on leadership roles in DSRB and CAMB has been the exceptional CAMB administrative team: Meagan, Anna, Kathy, and more recently Christina and Ryan. Their commitment to the students and the quality of the CAMB experience is amazing, and is perhaps

the most important contributor to the strength of CAMB today. Even after 15 years, I rely on Meagan to ensure I'm getting it right in all aspects of the job. Universities claim certain humanistic values that should be reflected in the academic programs. However, it is individual faculty who express those values in their support and guidance of students. The underlying motivation for my service in CAMB has always been a desire to fulfill those values in advocating for the needs, success, and wellbeing of students.

What advice would you give for current students who might one day be interested in such a position?

All of us, students and faculty alike, arrive at Penn with a focus on doing the science. But we bring a breadth of other interests with us and this environment offers a wonderful opportunity to pursue those as well, whether that's teaching, policy, mentorship, program design, advocacy, etc. My advice is get involved in the things that matter to you. Take a chance and put yourself out there. Engage with your faculty mentors and program leaders in discussing the quality of your experience and propose ideas for how to make things better. Support your peers and pursue issues of value to you on and off campus. All aspects of engagement build a foundation of experience and knowledge that will serve you well in your future careers, especially should you desire a leadership role in graduate education.

Between your time as a PI and as CAMB chair, you've helped many students navigate the challenges of a PhD. Based on this experience, what would you say are important traits for a good mentor?

It's critical for a mentor to meet a student where they are. To be open to the changing needs and circumstances the student experiences during their journey in graduate school. To be willing to receive constructive feedback, and even to seek it out, in continually trying to improve as a mentor. To be kind, patient, and to listen intentionally. To understand that what worked well before may not be the best approach right now. To guide a student towards independence, creating space for them to determine the direction of their research and even fail productively. To always value a student as an individual and colleague, especially when the experiments aren't working.

What are your favorite moments to look back on from your time as CAMB chair?

There are many favorite moments, including recruitment events, the annual symposium and, of course, student-faculty basketball and softball. Each year, graduation is a true celebration for me. Having the privilege of acknowledging the accomplishments of our exceptional students makes tangible the success of our program and the value of the work we do collectively, students, faculty, and staff. I attend as many thesis defenses as I'm able, and while each is a hugely satisfying experience, there are those that really stand out and offer a personal feeling of accomplishment. Some students face difficult challenges, whether personal or scientific, during their thesis work, and consider leaving without the degree. Having the opportunity to support such students, help them navigate the challenges to get back on track, and see them succeed in completing the PhD is an especially sweet experience for me. The hug or handshake for these students is particularly meaningful knowing the challenges overcome.

What was one of the most challenging parts of being the chair?

The most personally challenging part of the job is dealing with faculty who are behaving badly. And most often that bad behavior is at the expense of students in classes, prelim exams, thesis committees, or in the thesis lab. Thankfully, it's a minority of faculty who do so, but when it happens, it can be highly demanding both in emotion and effort for me. For the student, the situation creates a compounded problem with the behavior itself causing harm, as well as the fear that reporting it will create additional difficulties or retaliation. Over the years I've worked hard to cultivate the trust of the students so that when they are facing such situations they can come to me confident that I won't make things worse. In the more extreme cases I will intervene directly with a faculty member, but only with the permission of the student. As you might imagine, faculty who behave badly do not have good self-awareness and do not take constructive feedback well, so providing direct and honest feedback can be an unpleasant experience. In isolated cases, faculty have been dismissed from the graduate group, yet it felt like a failure on my part that a student had such a negative experience. I'm grateful that such circumstances are less common in recent years, and I believe this reflects an increased focus on good mentorship, especially among the junior faculty.

What's next for you now that you're stepping down?

I am not retiring or leaving Penn. I will stay close to CAMB and will continue to advocate for, support, and advise students. Whether this will be in an informal or formal capacity will be determined with Dr. Craig Bassing, once he becomes chair in July 2026. I will work closely with Craig to ensure a successful transition into his new role. I may even continue to hold office hours. Beyond CAMB, it's my intention to remain engaged in graduate education at PSOM, and possibly at the university level, focusing on program development and policy, student resources and advocacy, as well as possibly taking on a course director role. As CAMB chair, I have worked very closely with BGS leadership for many years, and I'd be eager to contribute to the broad mission of BGS. I have also served on the Faculty Advisory Council for Access and Academic Support, chaired by the Vice Provost for Education, and I'm excited to explore the possibility of contributing to the graduate education mission at the university level. And I will continue as co-director of PennPREP, the impactful post-bac pathway program in PennMed. There are many avenues for me to stay engaged in this meaningful work, and to continue supporting the success and wellbeing of graduate students.

What do you enjoy doing outside of work?

At 61 years old I try to stay active, including basketball, softball, yoga, and the gym, as well as hikes with the dogs. The past year has been a challenge as 50 years of basketball got the better of my arthritic knee. I spent most of 2024 trying to get the knee back into shape but ultimately had a knee replacement in December. I'm doing well now and although not back to basketball, I have started playing softball again. I'm a Philly sports fan, but my enthusiasm doesn't reach the extremes of those who grew up in Philly. I definitely try to get to a few Phillies and Sixers games each year. A favorite cultural activity is BalletX, a local modern ballet group that partners with young choreographers in creating new works. I recommend BalletX to anyone with an interest or curiosity for modern dance.

What is one thing you hope every CAMB student will take away from their time at Penn?

What I hope for every CAMB student is that they leave their graduate school experience with strong confidence in their abilities and ideas, built on a foundation of research accomplishments. That they build a broad supportive network of peers and faculty to take with them into the next stages of their career. And that they retain, and even expand, the joy of doing science, which is what brought them to CAMB in the first place.

Any closing words of advice for the current cohort of CAMB PhD students?

Recent months have been the most challenging, stressful, and chaotic period of my career as a faculty member. It's essential to acknowledge the attacks facing our community and institution, and the resulting fear, uncertainty, and harm related to identity, immigrant status, family, research support, and career. Despite these overwhelming circumstances, I urge you to stay away from hopelessness, to engage in causes of importance to you, to raise your voice, and to take care of each other. This country will always need science and scientists, and your persistence in pursuing your research and education, especially now, gives me hope. I believe there are better days ahead, and although the path is uncertain, your intellect, creativity, persistence, and energy are essential for us to get there.

SPECIAL INTEREST

Insight on Professorship at Primarily-Undergraduate Institutions

by Eva Agostino
Peer Edited by Avani Modak

As graduate students at a large research institution, we are most familiar with the requirements, expectations, and workload typical of an R01 faculty position. As such, many CAMB students may be unaware that an alternative career path to professorship exists. Here, we've talked with two newly-appointed faculty members at primarily-undergraduate institutions (PUIs) whose job description and goals differ greatly from that of our own R01-funded principal investigators (PI). With more emphasis on teaching and largely undergraduate-driven research, students interested in academia with more focus on teaching and undergraduate mentorship may want to consider a career as a professor at a PUI.

Dr. Ifrah Shahi is a postdoc at the Children's Hospital of Philadelphia (CHOP) who will be starting her own lab as an Assistant Professor of Microbiology at Bates College in August of 2025. Once there, Dr. Shahi will be expanding on her postdoctoral research concerning the pili of pediatric bacterial pathogen Kingella kingae. Dr. Shahi earned her PhD from New York University (NYU) prior to coming to CHOP.

Dr. Marisa Egan is a CAMB-MVP alumnus who started her own lab as an Assistant Professor of Biology at Swarthmore College in August of 2024. Dr. Egan's lab studies how non-pathogenic and pathogenic Escherichia coli (E. coli) sense and respond to their environments using regulatory molecules, like non-coding small RNAs.

Both Dr. Egan and Dr. Shahi completed their postdoctoral fellowships at CHOP through the Penn-PORT IRACDA Program. Part of the NIH-funded IRACDA program, PennPORT aims to provide postdoctoral fellows with pedagogy training and experience alongside the traditional research experience. Fellows get "protected" time during their post-doc to teach undergraduate classes at local colleges/universities partnered with IRACDA-affiliated institutions.

Tell us a little bit about your scientific journey. What was your path like, from graduate student to postdoc to PI?

Dr. Shahi: I started graduate school not really knowing what I wanted to do with my PhD. I toyed with the idea of becoming a PI at an R01 institution, but became less interested the more I learned about what an R01 PI job entails. I did however, love benchwork and wanted to continue with research. I realized somewhere around my third year of graduate school at NYU that I would love a career similar to my own undergraduate PI at Mount Holyoke College (a small liberal arts school) that combined both undergraduate teaching and research in a much more integrated way than an R01 position. I like the idea of being able to get the instant gratification I get from teaching while waiting for the more "delayed" gratification of research results. Of course, I had never really taught a full undergraduate class when I reached this decision and was basing my love for teaching on small scale tutoring positions. Since teaching is so important to PUI positions, I applied to IRACDA postdoctoral positions to get formal pedagogy training and undergraduate teaching experience alongside postdoctoral research. The things I learned as a PennPORT IRACDA scholar and a postdoc made me, I believe, a highly competitive candidate and really helped me approach interviews for the Bates College faculty position with the confidence and preparedness I did not have even a year ago!

Dr. Egan: Ever since I was an undergraduate student, I knew that I wanted to be a professor who could use her research to inform her teaching and even her teaching to inform her research. With my mom being a clinical professor and family physician, I grew up witnessing the impact that teaching has on people, especially in medicine. I was fortunate to have an inspiring and formative undergraduate experience at Saint Joseph's University (a PUI), where I received an incredible liberal arts education and

discovered my passion for scientific research and teaching. I learned fundamental microbiology skills working as an undergraduate researcher which launched my interest in microbiology and motivated me to pursue a PhD at Penn. During my PhD, my PI (Dr. Sunny Shin) helped me pursue opportunities to teach and mentor students, which ultimately solidified my passion for science education. I'm grateful to have amazing teaching mentors, like Dr. Mecky Pohlschroder, Dr. Kurt Engleka, and Dr. Ian Petrie at Penn's Center for Excellence in Teaching, Learning, and Innovation (CETLI). They all helped me gain invaluable teaching and mentoring experience, which set me up for my faculty position today. After my PhD, I was grateful to be part of the Penn-PORT IRACDA Program for my postdoc with Dr. Joe Zackular at CHOP. Joe was very supportive of my career goals, helping me prepare for my transition to a PI from my first day in his lab! Truly the mentors and role models in my life starting with my mom and continuing at Saint Joseph's University, Penn, and CHOP are the reason why I am where I am today; they made my scientific journey enjoyable!

Why did you decide to pursue undergraduate-driven research over the more traditional graduate- and postdoc-driven research?

Dr. Shahi: I remember the feeling of being an undergraduate student and having newly discovered my love for biology research. While research as a graduate student and a postdoc feels (to me) to be more results-driven, my time as an undergraduate researcher seemed to be more interest-driven where I was just as fascinated by every new simple technique or research factoid I learned as I was by my experimental results. I would like to recreate that experience for more students, to really absorb the excitement and passion of science before they become more jaded older researchers! I think this ties in to my love of teaching – the gratification of seeing a student learn something new and be captured by it. Because science is so amazing, and I think the older and more experienced we get with it, the more we forget to marvel at it.

Dr. Egan: My undergraduate research experience at Saint Joseph's University was transformative. It helped me to solidify my career goals, identify my academic passions, and explore what excited me most about science. Because of this experience, I knew I wanted to dedicate my career to giving students a similar experience during their undergraduate career. Also, I truly enjoy working with undergraduate students! They are refreshingly curious, dedicated, and enthusiastic about science. It has always been such a pleasure and a privilege to work with them… and to learn from them!

What are you most looking forward to / have enjoyed the most in your new position?

Dr. Shahi: I am really excited to start setting up my new lab, and to start teaching several new (for me) undergraduate classes! It also all feels slightly terrifying - but in a good way.

Dr. Egan: I have truly enjoyed working with the incredible faculty, staff, and students, especially in the Biology Department at Swarthmore! During this past year, I have met such supportive colleagues and inspiring students - they have made me absolutely love my transition into my faculty position. I am blown away by the department's commitment to enhancing student learning and supporting student success in creative ways. Moreover, the students are genuinely passionate about their courses and come to every class excited to learn! They are a joy to mentor and teach.

What excites you about your research? How heavily did knowing this work would be primarily conducted by undergraduate students impact your research plan?

Dr. Shahi: I have worked on bacterial virulence factors for many years now - first in the form of toxins during my PhD, and now as bacterial pili contributing to pathogenesis. I love working with bacteria and made an effort to find a postdoc lab that would help me learn new skills while staying within the bacterial pathogenesis field.

That being said, I did always keep in mind that I wanted to start an undergraduate lab down the road, and therefore stuck to research questions that could be investigated easily in at least some (if not most) PUIs. It is tricky to do that because all PUIs offer different resources – some only have BSL-1 spaces, while others have elaborate animal facilities. Not knowing what kind of PUI I might end up at, I constantly adjusted research questions in my head for how I might pursue them after my postdoctoral stint. For example, I knew I did not want to compromise on doing BSL-2 research, but I was okay not doing animal work in my undergraduate lab. When looking for faculty job openings, I researched what resources each institution had and whether that would fit my research. I also had an open and honest conversation with my PI (Dr. Joe St. Geme) when I started at my PennPORT postdoctoral lab, so that we were both aware of the future I envisioned for my research. Joe's support in helping me tailor research towards a future undergraduate-focused lab was therefore also instrumental.

Differences between Professorship at a PUI versus an R01 Institution

Summary	PUIs pay lower salaries and a PUI lab would produce less/smaller publications than at an R01 institution; however, PUI salaries are more fixed, the position/research much less dependent on grants, and the day-to-day job more teaching-focused and undergraduate-driven than an R01 institution.	
	Primarily Undergraduate Instituion (PUI)	**R01 Institution**
Mentees	Mainly if not entirely undergraduate students in both laboratory and classroom settings.	Mostly graduate students and postdocs in the laboratory.
Teaching Expectations	Depending on the PUI, teaching undergraduate classes can consist of 50-90% of job expectations or even 100% with no research expectations.	Minimal. Tenure expectations are more driven by research output and grants.
Grant Expectations	Reduced or negligible grant expectations from the faculty. Therefore, salary and research output are much less or even completely independent of earning grants. Often offer a separate fixed salary and sometimes limited research funds.	The number and value of grants earned are pivotal considerations for tenure.
Research Output and Impact	Lower output and less high-impact since mostly or entirely conducted by less-experienced undergraduate students who work part-time at a slower pace than graduate students or post docs.	Higher output and increased ability to conduct high-impact research given a more experienced, full-time workforce and access to more and better resources.
Resources	Fewer resources (both financial and physical) available for research. This impacts how and what research can be conducted. **Important considerations:** • Limited startup funds • Availability of BSL facilities • Access to "core" facilities like microscopy or flow cytometry • Collaborations with R01 labs • Applying for PUI-specific grants (less money than R01s)	More financial and physical resources at the institutional level.
Salary	Significantly smaller compared to R01 faculty salaries. Starting salaries are rarely above $90,000/year, at even the wealthiest and most highly-ranked PUIs and are lower at many other PUIs.	Significantly higher with a much higher ceiling. However, salary level is influenced by the amount of grant funding the PI is able to bring to the institution and the amount/impact of research conducted in the lab in addition to other factors.

Dr. Egan: I'm really excited that my research program integrates aspects of research that I became interested in during my undergraduate, graduate, and postdoc journeys. It really feels like a full circle moment for me. I would say I focused a lot of my research program on ensuring undergraduate engagement. My top priority is offering undergraduate students a meaningful hypothesis-driven research experience. So, I have tried to really consider how

to involve undergraduate students at every level of my research program, from how to safely work with bacteria to giving them the experience of designing their own experiments.

What advice would you give to current CAMB students interested in pursuing more undergraduate-focused teaching at a PUI?

Dr. Shahi: I have heard that more and more that PUI positions are becoming competitive and PUIs are really looking for relevant experiences nowadays. So I would suggest trying to get any sort of teaching and science outreach experience you can. It doesn't have to be teaching a full class of undergraduates or even high school students – I spent a lot of time with programs that went to elementary school classrooms to do simple science experiments or paired graduate students with local high school students for one-on-one mentoring through a full school year. Mentoring rotation students or summer students in your lab is also great.

The IRACDA program is fantastic, and really makes postdocs competitive for PUI job positions. Many institutions around the country are part of the IRACDA program, so it's worth applying to those places for postdoc positions. If you don't join an IRACDA program, it's also worthwhile to try to find part-time adjunct teaching positions (even for just one semester) at local community colleges or other institutions during your graduate or postdoctoral period.

Dr. Egan: My first piece of advice would be to reach out to faculty members at PUIs to get a sense of what their daily lives are like! I think networking is invaluable. Every PUI is different, and every faculty member's experience is unique. So, it's important to hear about those differences when considering if this type of career is the best one for you!
My other big piece of advice is to get teaching and mentoring experience! To me, the most important part of the career path is teaching and mentoring undergraduate students in the lab and in the classroom. So, it is important to have some level of familiarity with teaching and mentoring to develop your own teaching philosophy (which of course will change with each experience) and understand your mentoring style (this, too, will change as you learn and grow as a mentor). It is also important to see if you truly enjoy these experiences. The best way to do that is to practice teaching and mentoring in any way possible - mentoring an undergraduate student in the lab, being a teaching assistant for an undergraduate course, or even giving a guest lecture!

Any interested students can reach out to Dr. Shahi at ifrahshahi1@gmail.com or Dr. Egan at megan1@swarthmore.edu. For more first-hand accounts of experience as a PUI professor, please refer to this recent article published in Cell Reports Physical Science.

Article addendum:
We are very sad to report that funding for the NIH-IRACDA programs has been terminated as of early April 2025. The future of IRACDA-affiliated programs such as PennPORT are in flux as programs respond to the tumultuous funding landscape. While PennPORT is still recruiting new postdocs as of April 2025, these postdocs can no longer be supported by IRACDA funds, and will need to secure funding from their postdoctoral PI or another independent source to participate in the program.

Given the uncertain future of IRACDA-affiliated programs, CAMB students interested in pursuing teaching careers in academia can turn to other resources for training.

- Many of the pedagogy workshops offered through CHOP and Penn that are part of the PennPORT curriculum have always been open to postdocs outside of the PennPORT program. Both Dr. Shahi and Dr. Egan found these workshops to be invaluable resources for securing a faculty position and preparing for a career as a professor.
- For additional teaching experience, CAMB students can explore opportunities to be a teaching assistant in undergraduate courses or complete the CETLI Teaching Certificate during their PhD.
- Part-time adjunct teaching positions at or nearby your postdoc institution can informally recreate the IRACDA-based teaching-focused postdoctoral experience. Institutions that had IRACDA-funded programs like PennPORT may maintain their partnerships with neighboring PUIs and be able to advocate for their postdocs to fill those adjunct positions.

Any CAMB students with questions concerning the future of the PennPORT program, teaching resources, and general advice on alternative ways to pursue a career in teaching independent of IRACDA can reach out to PennPORT leadership and/or CETLI.

RESEARCH SPOTLIGHT

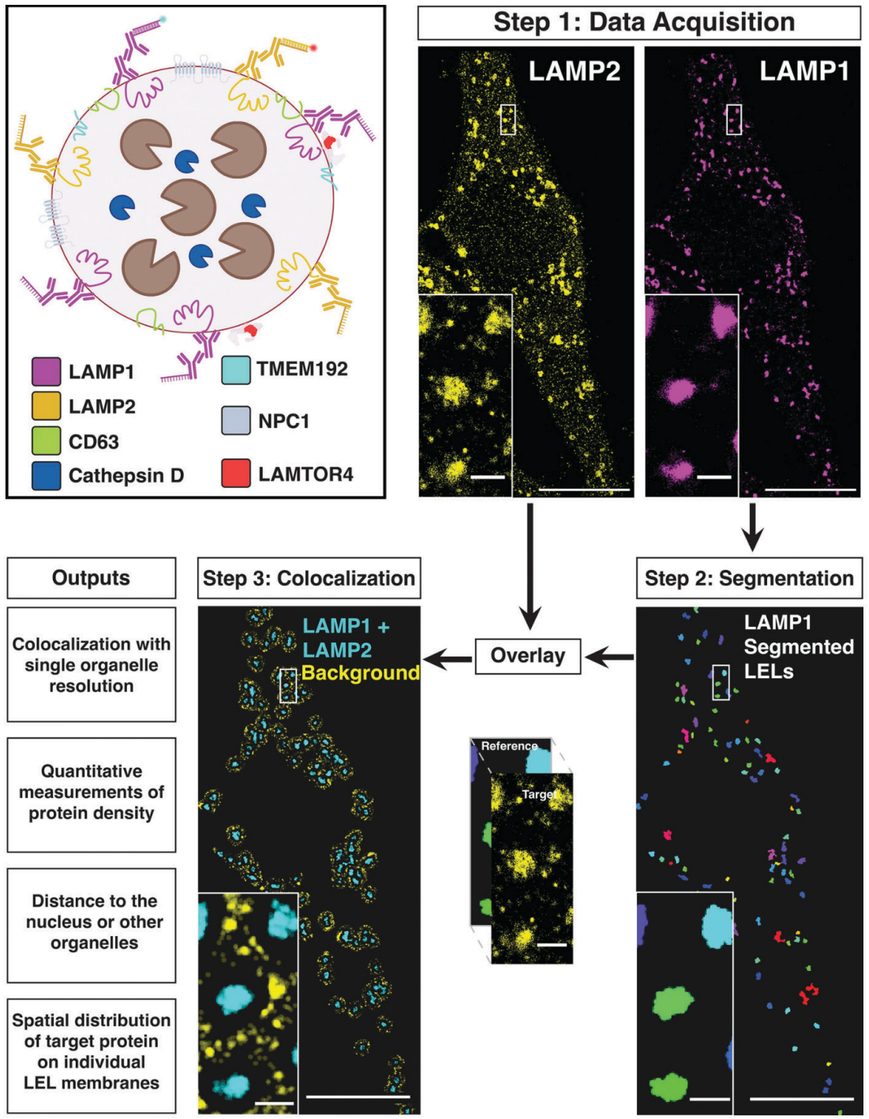
Charlie Bond

by Ariana Majer
Peer Edited by Maya English

The endosomal-lysosomal system consists of a series of dynamic membrane-bound compartments that regulate sorting, trafficking, and degradation of cellular materials to maintain cellular homeostasis. Dysfunction in the endosomal-lysosomal system is linked to aging and multiple diseases, including Alzheimer's disease, cardiovascular disease, and various cancers[1,2]. Late endosomes and lysosomes (LELs) are increasingly recognized as playing a diverse array of roles within the cell, from autophagy to scaffolding mTOR signaling[1]. While over 100 lysosomal membrane proteins have been identified, it remains unclear whether each protein is present at similar levels in every LEL or if there are distinct LEL subtypes with unique combinations of surface proteins. Previous studies investigating the molecular composition of endosomes and lysosomes have been limited by their use of techniques like traditional light microscopy that lack the spatial resolution and sensitivity necessary to effectively characterize differences between individual organelles, and by the low throughput and high cost of higher-resolution methods like electron microscopy. A better means of understanding LEL heterogeneity is therefore needed. Unlike electron microscopy and traditional light microscopy, super-resolution light microscopy allows for the visualization of the inner architecture of cells with both nanoscale spatial resolution and relatively high throughput[3], allowing for resolution of individual proteins on individual organelles.

DNA Point Accumulation in Nanoscale Topography (DNA-PAINT) is one example of super-resolution light microscopy. DNA-PAINT uses antibodies barcoded with short DNA oligonucleotides to detect, image, and quantify target proteins with single-molecule detection efficiency[4]. In DNA-PAINT, fluorescent signal above background levels occurs when fluorescently-tagged imager oligos bind to their complementary oligo on the target antibody. The imager oligos float freely in solution, and randomly and stochastically bind to their complementary oligos. This transient binding creates a blinking effect, whereby only a few spatially distinct imager oligos are bound and in focus at any given time, thus allowing for clear visualization of individual fluorophores. Localization data obtained over the course of multiple rounds of imaging can then be reconstructed to create a higher-resolution image of protein localization, which allows for resolution below the diffraction limit[3]. Given the quantitative nature of DNA-PAINT and its single molecule detection efficiency, recent CAMB-CPM graduate Dr. Charlie Bond from the Lakadamyali lab therefore sought to develop a quantitative, multiplexed DNA-PAINT super-resolution imaging pipeline that could be used to assess protein abundance and localization at the single LEL level and examine LEL heterogeneity under native conditions.

Dr. Bond validated the suitability of the quantitative DNA-PAINT imaging analysis pipeline to identify protein abundance on individual LELs using the highly abundant and commonly studied LEL membrane proteins LAMP1 and LAMP2. He confirmed that both LAMP1 and LAMP2 predominately localized to vesicular compartments resembling LELs. He then developed a novel object-based colocalization analysis pipeline to determine the extent of colocalization between different proteins (i.e., LAMP1 and LAMP2) within a single object (i.e., a single LEL), as most existing colocalization methods are unable to provide information about colocalization with respect to a specific individual object. Briefly, he segmented individual LELs into a reference channel using either LAMP1 or LAMP2 positive signal in combination with a minimum size filter of 250 nm (representing a small LEL) to denote individual LELs. The segmented compartments identified as LELs were then used to denote the regions of interest for assessing the localization of the other LEL target proteins, with signal inside the region of interest above that of the signal outside the region of interest being deemed positive colocalization. Using this method, Dr. Bond observed over 90% of LAMP1-positive LELs overlapped with LAMP2-positive LELs in two different



cell types regardless of whether LAMP1 or LAMP2 was used as the reference channel for the colocalization analysis. As LAMP1 and LAMP2 are known to be highly abundant on LELs, these findings suggest DNA-PAINT and the novel object-based colocalization analysis pipeline are capable of localizing proteins to the correct subcellular compartment. Importantly, there were no significant differences in LAMP1 abundance across five distinct biological replicates, further suggesting that the quantitative analysis pipeline is robust. There was also minimal colocalization between LAMP1 and early endosome marker EEA1, verifying that this method is capable of distinguishing lysosomes from early endosomes.

Dr. Bond then employed the quantitative DNA-PAINT pipeline to examine the abundance and localization of five additional lysosomal proteins (Cathepsin D, CD63, LAMTOR4, TMEM192, and NPC1) using either LAMP1 or LAMP2 as a marker of LELs. He found that the degradative enzyme and lysosomal marker Cathepsin D or its precursor localized to over 80% of LAMP2-positive LELs in two different cell types, suggesting that LAMP1, LAMP2, and Cathepsin D mark the same population of organelles. Unlike Cathepsin D, the highly abundant lysosomal membrane protein CD63 was present on 87 ± 6.8% of LAMP1-positive LELs in one cell type but varied between individual cells from 40% to nearly 100% in a different line. These data suggest that different cell types may contain different LEL subtypes, which could reflect cell-type-specific differences in the maturity or function of LELs.

Unlike the highly abundant Cathepsin D and CD63, LAMTOR4, transmembrane protein 192 (TMEM192), and Niemann Pick Disease Type C1 protein (NPC1) were lowly abundant on the surface of LELs. LAMTOR4, which plays a critical role as a scaffold for Rag GTPases crucial for the recruitment and activation of mTORC1 on LEL membranes, was found on over 75% of LAMP1-positive LELs in two different cell lines despite its low abundance, suggesting LAMTOR4 is present at low levels in multiple LEL subpopulations. Interestingly, LAMTOR4 was found to form 83 nm nanoclusters on the LEL membrane. As LAMTOR4 plays a role in the recruitment of mTORC1 to the LEL membrane, these nanoclusters may facilitate efficient mTORC1 recruitment. Unlike LAMTOR4, both TMEM192 and NPC1 localized to only around 45% of LAMP1-positive LELs in both cell lines. The low colocalization of TMEM192 and NPC1 with LAMP1-positive LELs suggest that not all lysosomal proteins are found on every LEL and that these markers may be subpopulation-specific. Notably, NPC1 also localized in nanoscale domains on the LEL membrane, though the nanoscale domains formed by NPC1 were more tightly packed (median diameter 55 nm) than those formed by LAMTOR4. As NPC1 is known to be involved in cholesterol export from LELs, these nanoclusters may be important for facilitating cholesterol export. Further validations using alternative antibodies, higher antibody concentrations, and an alternative colocalization method for TMEM192 and NPC1 similarly revealed that these proteins were only present in a subset of LELs, suggesting these findings are biologically significant and not an artifact of the study's methodology.

Dr. Bond then determined whether various lysosomal perturbations altered protein abundance and localization on LELs. He found that either overexpressing LAMP1 or treating cells with drugs that alter lysosomal pH altered protein abundance, colocalization, and/or nanocluster formation. These data indicate that the protein composition of LELs is sensitive to perturbation and that loss of homeostatic conditions, such as those occurring in disease states, may result in loss or gain of LEL subpopulations. As overexpression of LAMP1 is a common technique used to study lysosomes, these data also suggest that the results of prior studies using overexpression should be interpreted with caution. Moreover, these data highlight the utility of DNA-PAINT for studying lysosomes under native conditions.

In addition to being sensitive to changing conditions, lysosomal function is influenced by the lysosome's spatial positioning within the cell. Dr. Bond therefore examined the localization of different LEL subpopulations relative to other organelles. There did not appear to be a significant clustering of any subpopulations relative to the nucleus. However, there was a significant overlap between NPC1-positive LELs and mitochondria compared to NPC1-negative LELs in HeLa cells, but not in ARPE-19 cells. This suggests that subcellular positioning of distinct LEL subpopulations with respect to other organelles may also be cell-type specific. The positioning of NPC1-positive LELs near mitochondria in HeLa cells may also indicate that NPC1-positive LELs play a role in the delivery of cholesterol to the mitochondria in HeLa cells.

A key feature of DNA-PAINT is its capacity to image a large number of distinct targets. Dr. Bond therefore adapted a recently developed workflow for high-order multiplexing (5) to visualize multiple LEL protein targets together. While DNA-PAINT has the capacity for multiplexing, the number of protein targets able to be imaged at one time has historically been limited by the low availability of high-quality antibodies from unique species and a limited number of spectrally distinct fluorophores. To overcome these barriers, Dr. Bond used primary antibodies preincubated with DNA-PAINT-labeled secondary nanobodies and developed a strategy for precise alignment of targets over multiple rounds of target imaging. With this method, they were able to multiplex imaging for four different markers and found that the predominant LEL subpopulation in HeLa cells definitively contained LAMP1, NPC1, and LAMTOR4, and likely also contained LAMP2 and CD63. They also identified a significant subpopulation of LELs that were LAMP1-positive but lacked NPC1 and LAMTOR4, demonstrating that not all LELs contain the same membrane proteins. Further highlighting the LEL heterogeneity, up to eight different LEL subpopulations were identified in ARPE-19 cells based on differential protein abundance. Notably, there was also variability in LEL protein composition within the same cell line, with some subpopulations being present in some cells but absent in others. This variability may suggest that not all LEL subtypes are functionally significant.

Through his thesis work, Dr. Bond developed a novel colocalization-based imaging analysis pipeline compatible with quantitative and multiplexed DNA-PAINT super-resolution imaging.With this technique, he identified previously unknown diversity in the protein composition of LELs and demonstrated the ability of the image analysis pipeline to characterize protein abundance and localization at the level of individual organelles. This methodology has broad implications for the field of cell biology, as it can be used to assess protein composition and localization within and between different types of organelles beyond just LELs. Future work extending this pipeline to 3D imaging and the incorporation of emerging advancements in the quality of labeling reagents, such as the development of synthetic nanobodies, will

allow for a more complete characterization of protein abundance and localization across a variety of organelles in the future, which will better inform our understanding organelle structure and function.

References

1. Bond, C., Hugelier, S., Xing, J. et al. Heterogeneity of late endosome/lysosomes shown by multiplexed DNA-PAINT imaging. Journal of Cell Biology, 224, 1 (2024). https://doi.org/10.1083/jcb.202403116
2. Cao, M., Luo, X., Wu, K. et al. Targeting lysosomes in human disease: from basic research to clinical applications. Sig Transduct Target Ther 6, 379 (2021). https://doi.org/10.1038/s41392-021-00778-y
3. Bond, C., Santiago-Ruiz, A. N., Tang, Q., & Lakadamyali, M. Technological advances in super-resolution microscopy to study cellular processes. Molecular Cell, 82, 2, 315–332 (2022). https://doi.org/10.1016/j.molcel.2021.12.022
4. Jungmann, R., Avendaño, M., Woehrstein, J. et al. Multiplexed 3D cellular super-resolution imaging with DNA-PAINT and Exchange-PAINT. Nat Methods 11, 313–318 (2014). https://doi.org/10.1038/nmeth.2835
5. Sograte-Idrissi, S., Schlichthaerle, T., Duque-Afonso, C. J. et al. Circumvention of common labelling artefacts using secondary nanobodies. Nanoscale, 12, 18, 10226-10239 (2020).

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