Jessica Kelz receives UC Presidential Postdoctoral Scholar award

The award honors a blossoming career in chemistry defined by expert mentoring and creative research.

Wednesday, May 10, 2023

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UCI Physical Sciences Communications



Kelz’s rise as a chemist saw her learn from a slew of mentors who helped her find her path. One of those mentors was Dr. Robert "Skip" Pomeroy at UC San Diego. “I took his course at the end of my naval service in 2014, and he allowed me to do volunteer work in his lab on the weekends developing analytical methods to detect trace pathogen contaminants in an algal biofuel pond,” recalled Kelz. “He helped me to feel prepared to become a student and researcher again after a long hiatus while serving as an officer in the Navy."

Picture Credit:
Jessica Kelz

What do carnivorous plants and cataract disease have in common?

This isn't the set-up for a bad pun. There *is* a connection between carnivorous plants and cataract, one that may, with a lot of luck, help treat the millions of people around the world who suffer from the blinding disease.

But more on that later.

First, meet Jessica Kelz. She's a graduate student in the UC Irvine Department of Chemistry in the lab of Professor Rachel Martin. For her doctoral research, Kelz builds instruments that can help determine the structures of proteins.

Kelz just applied for and won the University of California's Presidential Postdoctoral Fellowship award. It's a prestigious award that goes to only a handful of postdocs across the UC system each year, and it gives women and minority Ph.D. recipients the financial support they need to do their research.

And yes, Kelz's postdoctoral research, which she'll do with UCI Chemistry's Professor Douglas Tobias, will focus on the potential connection between cataract disease and carnivorous plants.

But we're not to the plants yet.

Next, you need to learn about a UC San Diego scientist named Mark Hildebrand. Hildebrand passed away in 2018, but during his life he was a researcher at UCSD's Scripps Institute of Oceanography where he studied the biofuel creation potential of algae.

Kelz grew up in San Diego, and she discovered she had a proclivity for chemistry in an AP Chemistry course taught by Dr. Lee Price at Coronado High School. Meanwhile her mom, Irene, regularly volunteered at the school, and she advocated for Kelz to join a new internship program in which Hildebrand was a research mentor.

Hildebrand showed Kelz how to cultivate marine microorganisms called diatoms so the two of them could perform experiments studying gene expression in diatoms as a result of changes in composition of the artificial seawater environment.

Kelz recalled how it was during this mentoring process that Hildebrand showed her that chemistry and doing chemistry isn't merely a process of memorizing

innumerable facts and figures – it's a creative endeavor that's as active and dynamic as the chemical reactions that define it.

"Mark was a really special person," said Kelz. "There aren't many adults that a teenager would willingly wake up early on a Saturday morning to spend more than half the day working with. Mark was the first to show me what both a scientist and mentor looked like in terms of how to creatively approach problems and how important it is to treat each team member – no matter how novice – with respect."

Hildebrand was the first in a long line of mentors that now includes Professor Martin who helped show Kelz that what's possible in chemistry, both as a researcher and as a mentor, is infinite.

"I will forever be grateful for the impact Mark – and now Rachel – have had on my life. They both have inspired me to lead a lab in the future with the same passion, curiosity and dedication as them," Kelz said.

Kelz was a first-generation college student, something she said contributed to some initial academic struggles when she enrolled as an undergraduate at the U.S. Naval Academy in Annapolis, Maryland.

But then she took Professor Clare Gutteridge's organic chemistry class during her second year. Gutteridge excelled at creating an inclusive learning environment, one defined by a compassionate awareness of her students.

This helped Kelz restore her confidence at a key point. "I clearly remember the office hour where she reassured me that I was capable of being a successful chemistry major – something I was doubting at the time. She supported me by not only offering tips on different, more effective study strategies, but also through emotional support in the wake of immediate family being treated for life-threatening health conditions. Both were critical when it came to feeling valued and understood," Kelz said.

Things started turning around, and Kelz points to Gutteridge's guidance as yet another time in her life when a mentor helped her navigate challenges and overcome obstacles so she could flourish.

Kelz continued growing as a chemist, and as a Ph.D. student and now as a soon-to-be postdoc at UCI, she has sought to become a mentoring light for others in the chemistry community around her.

“I think between Clare and Mark, that really set the foundation for chemistry being something that I can do that I’m interested in,” said Kelz.

At UCI, Kelz was a participant in and then a Pedagogical Fellow for the university’s Teaching Assistant Professional Development Program (TAPDP). As part of her teacher training, Kelz designed discipline-specific curricula for teaching assistants aimed at helping them support the significant first-generation student population at UCI. Kelz also earned her Center for the Integration of Research, Teaching and Learning (CIRTL) certification, which aims to support research-based teaching practices and which included coursework offered by the Division of Teaching Excellence and Innovation (DTEI).

“UCI has been a very good environment for my teaching growth, and there are a lot of awesome things happening on our campus toward that end. I think this is a special place in that sense,” said Kelz. “The opportunity to help other students see that they can grow, see that they can do challenging things, that their potential isn’t limited to whatever skills they came in with. That there’s a lot of room for improvement regardless of what your end-goal is or what your degree is going to be, and that learning shouldn’t be a static or stagnant thing. That it’s a constant process.”

Now, at last, back to Kelz’s caractact-carnivorous plant research question – one that grew in soils rich with the memories of impactful mentors like Hildebrand and Gutteridge.

Cataract disease causes blindness in those it afflicts via the formation of clouds of light-obscuring protein molecules in the lens of the eye. This happens because some of the building blocks in proteins that help focus the light passing through the lens of the eye become attracted to the same building block on other, similar proteins. This attraction causes the proteins to aggregate and to form the protein clouds that cause blindness.

So far, researchers have been unable to pinpoint exactly why protein building blocks form clouds, but Kelz, in collaboration with Professor Douglas Tobias, will be running computer simulations with the aim of uncovering what leads proteins to cloud.

“Jessica’s research will seek to understand cataract formation on the molecular level using atomically-detailed computer simulations that will be validated by experiments carried out in the Martin lab,” said Tobias. “Jessica’s simulations will elucidate how

minor changes to the chemical structure of the crystallin proteins – such as the mutations that are associated with congenital, early onset cataract – give rise to altered interprotein interactions that lead to protein aggregation and, ultimately, cataract formation."

And that's where carnivorous plants come in. When carnivorous plants like Cape sundew digest something like a fly that was unlucky enough to land within the plant's reach, it uses specialized proteins called enzymes to help it digest its prey.

According to Kelz, it's possible that these same enzymes may one day help inform the development of treatments for cataract disease that can help de-aggregate the protein clouds that form in eye lenses.

"Things that seem very disconnected have the potential to be more connected than we might think," said Kelz.

It's a confluence of ideas that Kelz said is the brainchild of her advisor, Professor Martin. "She's incredibly creative," said Kelz. "Her idea is 'well, we have these proteins that are forming these aggregations or clumps in the eye lens, and we may not be able to totally prevent that, so what would a treatment option that doesn't involve surgery look like? One option may potentially be that we can break up these clumps.'"

Testing the idea is still a distant prospect, but it's an idea that may have implications for our understanding of other diseases beyond just cataract. Alzheimers, Kelz explained, is another disease driven in part by the formation of similar protein aggregates in the brain.

"In her graduate work, Jessica has pioneered a system for 3D printing templates to make optimized parts for instruments used to study protein structures. Traditionally, this process has been very difficult and labor-intensive, and only a few research groups have the expertise to do it," said Martin. "Jessica's innovations will allow researchers with less extensive probe-building experience to use very sophisticated parts, and will enable much faster construction and testing of new part designs to the benefit of the broader community. This is emblematic of Jessica's entire approach to science: she is not content with a solution that will work once in a special case – she is always thinking about how to generalize and scale up her approaches. I look forward to seeing what she does as a fellow and beyond."

It’s trailblazing research made possible by the people Kelz met and the opportunities she took advantage of along her path.

“It’s hard to believe and incredibly humbling that a dream that was conceived almost two decades ago may soon become a reality,” said Kelz as she reflected on her presidential scholar win and her dream of becoming a professor herself. “I’m incredibly grateful to the mentors, friends and family who encouraged me despite the uncertainty and challenges to help me get where I am without compromising who I am. I sincerely intend to help those I mentor do the same.”

Image



Jessica Kelz stands alongside her former mentor at UC San Diego, Mark Hildebrand. *Jessica Kelz*

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