The life-changing curiosity of Reg Penner

For retiring UCI Distinguished Professor and electrochemist Reginald Penner, his students are his legacy.

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Lucas Van Wyk Joel
UCI Physical Sciences Communications


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If you've ever admired the rose garden in front of Frederick Reines Hall at the UCI School of Physical Sciences, you've felt the impact Professor Reginald "Reg" Penner has had on campus life.

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Lucas Van Wyk Joel / UCI

In 2024, on a sunny morning in May, Distinguished Professor Reginald “Reg” Penner is walking down a hallway on the second floor of Natural Sciences II at UC Irvine. Penner sports a blazer with a UCI pin on its lapel, and he takes a turn and opens a door that leads to his lab. Inside, a long cavernous room hums with the sounds of pipes and machines. They’re the kinds of sounds that make the lab feel alive and ready for scientists to make new discoveries.

But today it’s just Penner, who’s looking for something to place under a microscope.

Penner started as a professor in the UCI Department of Chemistry in 1990. Back then, you could still spot his department’s founding chair and soon-to-be Nobel laureate Sherwood “Sherry” Rowland roaming the halls of the building that bears his name. Penner remembers how he, Rowland and others would eat lunch at a café called BC’s on the edge of Aldrich Park while they chatted about the latest op-eds in *The New York Times*.

Now, more than thirty years later, Penner is retiring. His lab is empty – but it’s spilling over with a rich history of scientific excellence and discovery that’s seen Penner and generations of his students and colleagues make field-defining breakthroughs in electrochemistry, which have made the cover of *Science* and propelled his students to careers in academia and industry.

And it all began, as at least one other legend does, with beans.

When Penner was in middle school, he convinced his parents to buy him a few bean plants from a nursery near their home in Minnesota. Itching with curiosity, Penner took the beans down to his basement where he proceeded to perform experiments on them.

“I was the kid who was growing bean plants in the basement and torturing them with chemicals to see what would happen,” said Penner with a grin. “I was a science nerd from a very early age. I also asked for a microscope for Christmas, and spent

years looking at everything I could find.”

Penner’s father, also named Reginald, was a United Methodist minister who took organic chemistry courses in college, and he encouraged his son’s budding interest in science. “He always carried with him this knowledge of organic chemistry, and he would tell me about things, about the naming of compounds, and he just really loved that material,” said Penner.

That love watered the soil of Penner’s curiosity, and once Penner reached UCI after a stint as a postdoc at Caltech, giant things grew from that soil.

What grew was a research program that developed new technologies, including sensors that can detect hydrogen gas with the help of the element palladium. Those sensors may one day help detect hydrogen gas leaks in industrial settings.

“Palladium has this unique property of absorbing hydrogen into its bulk, and very few metals can do that,” said Penner. “We did some experiments in the early 2000s with nanowires, and we discovered immediately that the size of the palladium sensing element had a profound influence on the properties of the sensor for detecting hydrogen.”

Figuring out how to make nanomaterials and understand their performance in devices like hydrogen sensors became a theme for the Penner lab that would define the next several decades of his research program.

“I wanted to start to make materials that could definitely influence the performance of devices of various types,” said Penner. “I wanted to look at the whole spectrum of how you make materials, how you control materials’ properties, all the way to how you control the performance of a device.”

Penner learned that taking the long view when it came to research projects was key to growing a culture in his lab that inspired his students to not only master the fundamentals of their science, but to imagine the ways that science might impact society through the development of devices like hydrogen sensors.

“You’ve got to capture the students’ imaginations,” said Penner, who explained that a large part of why students commit to doing a Ph.D. in his lab is the bigger story underpinning the work.

What grew from that culture were students like Chengxiang “CX” Xiang, who joined Penner’s lab back in 2004 as a UCI ChAMPS student, and who’s now a professor at Caltech. “The Penner group was exploring many translational science and engineering opportunities in nano-materials and their applications,” said Xiang, who described how he misses hearing Penner’s loud, joyous laughs from down the hallway, and drinking beers with Penner and his fellow students while discussing science. “Reg is also super kind and supportive of foreign students, often going out of his way to support us. He is a world-class electrochemist that has great passion for the people he mentors.”

That support helped something else grow: In his years after UCI, Xiang went on to found a company called Captura, which is a startup that aims to sequester planet-warming carbon dioxide from ocean water at a scale of around 10 gigatons per year. A few years ago, Captura received $1 million in starter funding from entrepreneur Elon Musk’s XPRIZE Carbon Removal competition, and just recently the company advanced to the list of top 20 XPRIZE finalists. If Xiang and his team win, they’ll receive $100 million in additional funding.

What also grew from Penner’s lab was a 2018 collaboration between Penner and UCI Chemistry professor Gregory Weiss. Both lost a parent to cancer, and both decided to see if they could train their respective skillsets on improving cancer detection capabilities. Together, the two labs crafted a design for a biosensor called the Virus BioResistor that can use virus particles as receptors that can detect certain cancer markers in human urine. The work published in *Nano Letters*, and led to Weiss and Penner founding a company called PhageTech to help usher the technology to market.

Lately, Penner has been seeing more and more lab alumni stop by for a visit as he prepares to switch off his lab’s lights for the final time. Xiang paid Penner a visit in recent months, as did David Li, another Ph.D. alumnus.

“Beyond his direct contributions to science, Professor Penner’s work has inspired many other researchers in fields like materials chemistry and nanotechnology,” said Li, who now works at Google in Irvine, and who’s seeking to improve upon the hydrogen sensing technology first developed by Penner. “His innovative approaches and rigorous methodologies serve as a model for other scientists. Inspired by Reg, I devised carbon nanotube ropes with nanoparticles for swift hydrogen sensing, aiming for revolutionary detection capabilities.”

If you ever walk in front of Frederick Reines Hall at the UCI School of Physical Sciences in the springtime, you may spot a rose garden. Penner, alongside UCI Chemistry professor A.J. Shaka, planted the garden about 17 years ago “because there was an ugly mix of bushes in that planter,” Penner said. “It was a mess, and we both recognized that it would be the perfect location for roses, with the full sunlight it gets.”

Maybe that’s the best way of putting his story: Penner’s touch makes great things grow, and the roses of his life are his contributions to his field and the students he helped mentor.

“My students are the most satisfying part of the job, ultimately,” said Penner about seeing his students’ lives and careers blossom. “That part has always been incredibly rewarding to me, to be able to provide their training.”

Back in his lab on that sunny May day, someone else enters the room, and Penner looks up from his microscope. It’s one of his last two graduate students, Nick Humphrey, who, like Li, is busy researching and developing Penner’s hydrogen sensor technology.

Humphrey leaves, and Penner watches him go.

“I’m just so proud,” said Penner.

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