

Moments of Understanding: Reflections on the Path to Becoming a Scientist

TO EXPLORE THE THEME of “Transformation to a Scientific Attitude,” members of the SACNAS News Editorial Advisory Board asked their current and former students to write a vignette that focused on a “Eureka!” moment—a single incident in their scientific research or studies when they first “got it”—and how this moment either allowed them to define themselves as scientists or helped them see that they were on the road to becoming scientists.





ADAN AMARILLAS

I first decided I wanted to pursue a science degree when I was in my senior year of high school. My physics teacher in high school taught in a way that showed me science was “cool.” Through her, I learned that science was something that can be a passion, there are constant discoveries, and that other people actually appreciated it and found it really interesting. Most importantly, my teacher said it was OK to admit that I had a passion for science because so did she! My freshman year of college, I was selected to attend the SACNAS National Conference. Meeting all those scientists was an unbelievable experience!

Adan Amarillas is a second-year mechanical and aerospace engineering undergraduate student at the University of California, Irvine.



NERY CHAPETON-LAMAS

My epiphany occurred in the fifth-grade auditorium, presenting my science fair project. It was a game involving circuits and electricity, and I received a ribbon for placing in the fair. Standing in front of my poster, I knew I was a scientist. Many years later, I would be in the same situation at the SACNAS conference presenting my summer research project. That same feeling overcomes me when I present, complete a project, or get a program to function correctly. I still know I am a scientist, but I know that I couldn't have figured it out without fifth-grade me.

Nery Chapeton-Lamas graduated with a degree in mechanical engineering from the University of California, Irvine. He was accepted to the computer science and engineering PhD program at the University of Nebraska.



WILBER VENTURA

My belief is that in life, we all have a given purpose. Therefore, it is impossible for me to think that I became a scientist; in fact, I know that I have always been a scientist. I have always had a passion for math and I have always been excited to take on the most difficult problems. I did not have one moment or epiphany that told me I was a scientist. Rather, I believe that every instant of my existence has been science. I believe that for a scientist every moment is an experiment, and every thought is scientific reasoning. We scientists have entered an endless search—because there will always be more questions than answers.

Science is the most amazing adventure because it makes us reach beyond our selves. I am proud to be a scientist and to belong to humans' quest for knowledge. Science is about questioning, discovery, curiosity, and creativity. Science forces me to think outside the box and see things in a different perspective. My natural curiosity and creativity were pushed further by interest in math and science. Through my scientific perspective, I find inspiration daily in my surroundings, life, and God's creation. My scientific perspective makes me have to reach beyond myself. I believe that nothing is impossible; I have to dream.

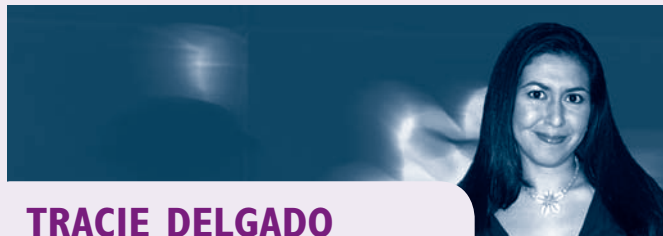
Wilber Ventura is an undergraduate mathematics student at the University of Texas at Arlington.

**ANDRES CARRILLO**

As a high school student, I recall being determined to study marine science in college. I loved learning about marine biology, which inspired me to do well in my studies and extracurricular activities. I had high hopes of getting into a good school. Upon graduating from high school, I was awarded the Science Pathways Award and the Marine Vocational Studies Award for my coursework and internship at Cabrillo Marine Aquarium. Despite my interests, studies, and achievements in high school, I had no clue what career options were available for someone with a degree in marine biology; all I knew is that I wanted to learn more.

I was a transfer student at California State University, Fullerton, where I was selected as a Southern California Ecosystem Research Program (SCERP) scholar. This NSF-funded program is designed to engage undergraduate students in environmental-biology research. In 2004, SCERP sponsored all scholars to attend the SACNAS annual conference and prepared us to present our summer research projects. At the conference, I attended talks, networked with professors, and discussed research with other students. I was submerged in the scientific community and for the first time I had my own research experiences and the knowledge that gave me the confidence to ask questions and contribute to discussions between professors and students. It was then that I identified myself as a scientist-in-training, but a scientist nonetheless. The experiences SCERP provided me were the driving forces that led me to develop an interest in scientific research. Research is now my passion and life.

Andres Carrillo is currently a MS candidate at California State University, Fullerton investigating larval fish development. As a laboratory assistant at Cabrillo Marine Aquarium, Andres is also a marine educator to schoolchildren and a research mentor to high school students.

**TRACIE DELGADO**

What defines a person as a scientist? For me, it was at a summer internship before my senior year of college. After carefully placing a cover slip on my immunofluorescence slide, I peered into the lenses of a confocal microscope and actually saw the beauty of a cell. I was investigating how herpes simplex virus (HSV) disrupts the nucleoarchitecture of its host cell. I viewed the cellular nucleoskeleton and it intrigued me. Its filamentous structure looked like spider webs spanning the nucleus. I then switched to my HSV-infected sample and saw the nucleoskeleton shattered apart into small punctuate dots throughout the nucleus. At the same time, I saw viral proteins now spanning an enlarged nucleus in its host cell. I thought, “How does that happen!?” I rushed on to do a western blot and found that both mock and HSV-infected cells had equal levels of nucleoskeletal protein, showing that HSV infection does not degrade, but rearranges the nucleoskeletal protein.

It was then that I started to meditate on the bigger picture of my project—not just how the virus does this, but why. Is it possible that HSV infection rearranges the nucleoskeleton so the nucleus can expand? Is this expansion necessary for viral replication? My summer program ended and it was time to go back home. That summer, I learned that being a scientist was not just finding answers, but learning to think like a scientist. It was then I knew I had become a scientist.

Tracie Delgado is a PhD candidate in microbiology at the University of Washington in Seattle.



ERNESTO GARCIA

Before the fall 2008 semester, I participated in my first undergraduate research program with the Mathematical Association of America. This was my first taste of mathematics outside the classroom and I witnessed its applications in science and use in problems being solved today. Through that program I started looking at mathematics differently and even started considering graduate school in mathematics. However, my confidence in my mathematical and scientific abilities was still low.

Then I took an analysis class that changed everything. The best professor I have ever had to date was teaching the course. Her energy and style were unmatched and she provided me the moment that changed my academic outlook forever. We were doing a problem in class that covered uniform convergence. I knew nothing about the subject and while she was teaching, understanding just came to me—like a light bulb turning on. I saw the logic behind the problem and was able to figure out the problem unlike any time before. It used to always take me a lot of time outside of class to be able to figure out a problem or concept and here I was following everything she was saying! From then on, I knew mathematics was the course of study for me.

Ernesto Garcia was born in Brooklyn, New York, and raised in North Richland Hills, Texas. He recently completed his bachelor's degree in mathematics and will soon begin graduate studies in mathematics at the University of Texas at Arlington.



MIGUEL AUGUSTO LOPEZ

Let me start out by saying that I consider myself to be a very blessed person. I am eternally grateful for my family and loved ones and all of the support they have given me.

Science does not serve just one role in society. Accordingly, although scientists may share some characteristics, there is no single quality that describes every scientist. The scientific community is comprised of unique individuals each offering distinct ideas and attributes. In turn, an individual's ideas and attributes are shaped by experiences—both positive and negative. In my opinion, the scientific perspective is acquired and formed through the experiences of individuals and, like science itself, is constantly evolving.

My interpretation of science as well as the characteristics of a scientist have changed drastically throughout my academic career—not as a consequence of one event, but rather as a result of several experiences. For instance, I have learned that bench work requires perseverance, patience, and optimism. Through collaborations, I have witnessed how the exchange of ideas between distinct scientific fields can resolve a question of general interest. Finally, through teaching, I have learned the value of relaying scientific information in an accessible and jargon-free manner (a responsibility of every scientist). Thus, every experience has changed my understanding of what a scientist is and has introduced me to various aspects of science. Every day brings new challenges and experiences as well as the opportunity to redefine my definition of a scientist.

*Miguel Augusto Lopez is a doctoral candidate in the Department of Microbiology, Immunology and Molecular Genetics at the University of California, Los Angeles. He is currently studying the social behavior of *Trypanosoma brucei* in the laboratory of Dr. Kent Hill.*



EDWIN PAZ

Reflecting on my training over the years, I have come to realize that there have been many significant moments during my scientific training that have shaped my current track as a graduate student. My first “Eureka!” moment occurred as an undergraduate when I completed an upper-division course in virology at the University of California, Los Angeles. I reflected upon the molecular mechanisms by which viruses infect cells and was able to appreciate the ability to design experiments that could address how a virus could induce cellular transformation. The revelation that cells and viruses have the ability to orchestrate the most beautiful biological feats imaginable, and that their processes are readily available for study, opened my eyes to the possibility of improved targeted therapies.

Eventually, my passion for the life sciences landed me in a laboratory, where I constructed molecular probes to profile activated receptor tyrosine kinases in epithelial tumor cells. The realization that I was able to independently manage the project, with the guidance of my mentor, was the moment I recognized that a career in the sciences was possible. The elegant concepts I learned during my undergraduate training instilled a confidence that I had never had. As a graduate student at the University of Arizona, the enactment of bill SB1070 has further strengthened my commitment to science and education. In the current political backdrop, I hope to convey a message of hope when mentoring younger students from backgrounds similar to mine who are just beginning to consider research and graduate school.

Edwin Paz is a fourth-year cancer biology graduate student at the University of Arizona. He is investigating the role of polyamines in posttranscriptional regulation under the mentorship of Dr. Eugene Gerner.



ANGELICA RIESTRA

During my 10th and 11th grade summers, I worked in the laboratory of Dr. Mark Lawson at the University of California, San Diego, as part of my internship through the Consortium of High Schools/Undergraduate and Medical Schools (CHUM) program. I was interested in learning more about lead poisoning, since lead is found in the paint of houses built before 1978, and many families in low-income areas are at a higher risk of exposure. For a science fair project, I had tested houses in my community for lead and found that some houses were indeed contaminated.

After learning about Dr. Lawson's area of research, I developed a project (with his help) to determine whether lead and two pesticides had an effect on the expression of the gonadotropin-releasing hormone (GnRH). I was also interested in testing whether two widely used pesticides had an effect on GnRH expression, since my father had shared stories with me of how pesticides would be sprayed on the fields while he and others were picking crops. This really concerned me, as I was sure that this was both illegal and harmful to the workers' health. Furthermore, I was in disbelief that testing the effect of pesticides on reproduction is not part of mandatory screening before their approval for use.

Years later, Dr. Lawson informed me that another group had addressed the same questions and had similar findings to mine. This was my “Eureka!” moment, when I realized that I, too, had started thinking like a scientist and started envisioning that I could actually become one. I also realized why it is so important to have diversity in the sciences, since people with different backgrounds and experiences will be interested in pursuing different scientific questions. Dr. Lawson and Dr. Park Trefets from the CHUM program helped transform me into a scientist by teaching me research skills and then allowing me to pursue my scientific curiosity. Now I want to help others undergo that transformation.

*Angelica Riestra is a second-year graduate student in the Department of Microbiology, Immunology, and Molecular Genetics at the University of California, Los Angeles. She works in Patricia Johnson's laboratory studying the mechanisms of pathogenesis in the sexually transmitted parasite *Trichomonas vaginalis*.*



DR. ROBERT CARRILLO

Why science? Serendipity. It may not be what you expected to hear, but that is how it happened to me (for the most part). A lot of people have the whole “Oh, I knew I wanted to be a scientist because I would collect bugs when I was young.” (Which I did, but only to scare my siblings!) Or “I was always asking questions about the world.” But for me, certain events just happened for some unknown reason—and now, bam, here I am.

During high school, I did pretty well in all subjects but I just happened to “stumble” into college. I don’t know if I ever would have even stepped into a lab if I hadn’t taken a job washing the glassware in Dr. Larry Simpson’s laboratory while at the University of California, Los Angeles. Dr. Simpson noticed that I was always bugging people in the lab about what they were doing, and so he asked if I would be interested in doing “research.” I hadn’t a clue what he was talking about, but it sounded important and a PROFESSOR had offered me the position. So, with a big grin on my face, I said, “Siii!”

Unbeknownst to me, Dr. Simpson had just given this Mexican kid a little nudge into the fascinating world of science. Yes, I said it: fascinating! There are plenty of other moments along the journey that have reinforced my decision to continue in science, but looking back, Dr. Simpson did one very simple, yet incredibly empowering thing—he gave me a chance.

Dr. Robert “Nufo” Carrillo is a postdoc in the lab of Dr. Kai Zinn at Caltech. He is investigating the mechanisms of axon guidance. Dr. Carrillo earned his BS in cybernetics from the University of California, Los Angeles, and completed his graduate work at Yale.



DR. CHARLA LAMBERT
(Haida/Tsimpsian)

When I entered graduate school at the University of Washington, I was very good at solving problems. My motto was “Give me enough time, I’ll figure it out.” I was trained in mathematics, and problem solving served me extremely well in that capacity. However, I went to graduate school in the University of Washington genome sciences department, which is a 21st century academic cross between experimental genetics, statistical analysis, and molecular biotechnology. To be an independent investigator in the field, one needs skills in both problem solving and scientific inquiry. But when I started graduate school, I couldn’t discriminate worthy scientific questions from merely interesting ones. Which questions were worth spending time and energy pursuing? I had no idea.

My scientific attitude was definitely cultivated through joint mentoring by my thesis advisors. My “Eureka!” moment came relatively late, well into my fifth year of graduate school. At the time, I was analyzing a public genomic data set to address a minor question in my thesis. The patterns of variation I observed for most human chromosomes matched what I expected to see, but the patterns of variation on the X chromosome differed wildly from my expectations. I showed the analysis to my advisors, who encouraged me to pursue that line of research. It was thrilling: I finally had ownership of a piece of research that I not only developed, but my advisors thought was worthwhile! The X chromosome project became a central focus of my thesis as well as my first publication, and it also marked a turning point in my confidence as an emerging scientist.

Dr. Charla Lambert is an IRACDA postdoctoral fellow at the University of Pennsylvania. She uses her training in mathematics to study population genetics and human evolution. Dr. Lambert is also an alumni of the 2009 SACNAS Leadership Institute.