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Benita Albert brings us insight into the career of an amazing Oak Ridge High School graduate scientist and her research. Katherine has written another excellent article "Co-existing with the Coronavirus" that was published in *The New Yorker* magazine on July 20, 2021. Here is the link: <u>https://www.newyorker.com/science/annals-of-medicine/coexisting-with-the-coronavirus</u>

Katherine Xue, a 2009 Oak Ridge High School (ORHS) graduate, wrote a compelling article, "The Awful Uncertainty of the Coronavirus Death Toll," that was published in *The New Yorker* magazine on February 21, 2021. (Here is the link: https://www.newyorker.com/science/elements/the-awful-uncertainty-of-the-coronavirus-death-toll)

My former student, Pat Brent (ORHS 2006), forwarded the story via her mother, Rebecca, who knew I would be interested in not only the subject but also the connection to another of my former students. Both Pat and Katherine were students whom I had the pleasure to teach for two years of Calculus as well as Math/Science Thesis, an ORHS research course. Pat and Katherine were gifted young scientists and writers, and Pat's referral was key to my making contact and writing this alumni story.

Katherine Xue has spent the past twelve years since ORHS pursuing her passion for evolutionary biology, an interest incubated in her high school studies. She recalled her Math/Science Thesis project, with ORHS peer Alborz Bejnood, entitled "From Sequence to Structure: Linking Genomic and Biochemical Information to Identify and Optimize Cellulolytic Bacteria."

This research, mentored by Professor Igor Zhulin and postdoctoral fellow Brian Cantwell at the University of Tennessee Knoxville (UTK), is described by Katherine: "Our project aimed to understand a tiny piece of the puzzle of how microbial communities could be engineered to produce ethanol from leftover plant material to provide a renewable source of energy. We worked to identify features in the DNA sequences that could help us predict what sugars the genes were involved in breaking down, so that it would be easier for engineers to design microbial communities that could fulfill these important biological functions."

Reflecting on this early work, Katherine said, "Looking back, this project has themes that are uncannily similar to my current work. Like Dr. Zhulin, I work in computational genomics—that is, I analyze DNA sequences to understand an organism's biology. I also study microbial communities, though the ones I study usually live in humans instead of in the environment. The basic methods of comparing and analyzing DNA sequences that I learned in my ORHS thesis project have their roots in evolutionary biology, which is my field of study today, and I have used these methods many times since then. In many ways my ORHS project planted the seed for my current research interests."

Katherine's parents are scientists who met as undergraduates at Nanjing University in China and who moved to the United States for graduate studies. Both parents received PhDs in chemistry from UCLA and completed postdoctoral studies at Indiana University before settling in Tennessee in 1992. Katherine's father, Ziling (Ben) Xue, is a professor of chemistry at UTK, and her mother, Yihui (Yvette) Yang is a lecturer in the UTK Chemistry Department.

Katherine, born in 1991, attended Knoxville schools before enrolling as a four-year, tuition student at ORHS. She wrote, "I was always interested in math and science growing up, and my parents decided to enroll me in Oak Ridge High School after seeing the expanded course offerings and opportunities in STEM—in particular classes like Calculus 2 and Math/Science Thesis." Her younger brother, Albert, would also transfer to ORHS, graduating in 2016. He is currently enrolled in the Bioinformatics PhD program at UCLA.

Katherine credits her family for her academic penchants. She wrote, "I come from a multigenerational family of scientists—my parents, grandparents, aunts, and uncles are all involved in scientific research and teaching—and I grew up steeped in math and science.

As a kid, I remember my dad teaching me the triangle inequality as we cut across the lawn on the way to school, and I remember playing with my mom (and losing!) in the arithmetic card game "24." (In this game, you draw four cards from a

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deck and race to use each card once, and exactly once, in basic arithmetic operations to make the number 24.) My parents taught me to love math and science, as well as to value knowledge, learning and hard work."

She also pursued interesting outside-of-school activities: "I always loved art! When I was in middle school, I took drawing lessons from a local artist for a few years which helped me refine my skills. These days my artistic leanings sometimes overlap with my scientific work when I put together cartoons and figures to illustrate my scientific work. I'm a big believer in using visual language to illustrate scientific concepts."

As her teacher, I fondly remember our Calculus homeroom class benefitting from Katherine's artistic talents via her creative homecoming door design. Our door pictured a Wildcat holding a paw full of daisies with petals dropping. Although I no longer remember the slogan, it was symbolically predicting a Wildcat victory over homecoming rival Soddy Daisy High School. The entire homeroom enjoyed the reward for our prize-winning door, a huge tray of chicken and biscuits from Chick-fil-a.

Other special learning moments included weekend classes of which Katherine wrote: "My family was involved in the East Tennessee Chinese Association, and growing up, I went to Chinese school on the weekends and learned Chinese martial arts. Many of my Chinese-American friends became my classmates when I started attending ORHS, and we're still good friends today."

Katherine's special ORHS memories include: "Favorite courses: Math/Science Thesis and AP Biology were some of my favorite courses, and they built the foundation for everything I do now. One fun connection: In AP biology, my teacher, Theresa Holtzclaw, asked us to read a popular-science book about biology, chosen from her extensive personal library, and to do a book report. I chose *The Discoverers*, by Daniel Boorstin, which helped spark my own interest in science writing. Later at Harvard, I won the Bowdoin Prize for Undergraduate Essay in the Natural Sciences. I found out afterward that Boorstin had also won an earlier version of that essay contest when he was in college!"

Katherine spoke graciously of special ORHS teachers, Theresa Holtzclaw, and myself (Benita Albert), and she added many others to her list: "Nita Ganguly taught my first biology course and spearheaded Science Olympiad and Science Bowl; she was a force of nature and an incredibly kind, generous neighbor (often providing transportation from their close by Knoxville homes to and from ORHS). I also loved spending time with teacher sponsors Vidal Moreno, Matthew Perkins, and Peggy Bertrand through Science Olympiad and other extra-curricular activities. Teachers Aaron Pickering, Michael Feuer, and Naida Finane all encouraged and nurtured my more humanistic interests in literature and philosophy. And our absurd French skits in Madame (Elizabeth) Barry's French classes were a highlight of my time at ORHS."

ORHS activities of special note to Katherine were the interscholastic science competitions, Science Olympiad and Science Bowl. She wrote that it was: "Tons of fun. I spent a lot of time with friends studying and practicing for those activities, and we developed many nerdy inside jokes."

Though Katherine did not know it at the time, it was at national science contests where she would meet her future husband, Seungsoo Kim, a student from Mountain View High School in Camas, Washington. She reported "faring worse" in those competitive science events, but they would soon thereafter become fellow classmates and special friends at Harvard University.

Katherine was a co-founder of the ORHS Philosophy Club, and this group helped cultivate some of her current interests in Science, Technology, and Social Studies (STSS). She later received a certificate in STSS during her graduate studies at the University of Washington (UW). She says she pursued this path to further understand the social nature of science and the implications of science for society at large.

Katherine wrote, "My STSS coursework inspired me to co-found the UW Genomics Salon, a student-led group that organizes town-hall-style discussions on the interactions of genomics and society. We've discussed topics ranging from CRISPR engineering of the human germline to the use of metaphors in science communication.

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The Genomics Salon was, in many ways, a more scientifically oriented version of the Philosophy Club at ORHS, and I drew on some of the same methods for facilitating open-ended discussions about key issues. I've found that many scientists are concerned and thoughtful about the social implications of our work, and I hope that more coursework and programs will start to bridge the traditional gaps between the sciences, social sciences, and humanities."

The Genomics Salon exemplifies Katherine's continued quest to communicate and to openly share her passion for science. *The New Yorker* article mentioned at the first of this story is just one example of her current publications. When I asked Katherine to comment on her writings, she answered: "I write semi-regularly for *The New Yorker* about the science of the COVID-19 pandemic. I've long admired researchers like Stephen Jay Gould and Siddhartha Mukherjee who move between the worlds of science and writing, and I think scientists have a responsibility to communicate the results of their research to empower public decision-making. I think my scientific background puts me in a unique position to communicate some of the nuances and complexities of science."

The COVID-19 death toll of which she writes in the aforementioned *New Yorker* story is a particularly vexing problem to document. Citing the still-debated numbers from the 1918-19 influenza pandemic death toll as an example, Katherine lists a litany of causes for the inaccuracies. Yet, similar imprecision looms in documenting COVID-19 victims.

In this article, Katherine opines: "I sometimes ask myself why I care about these numbers. I think it is because the significant figures of this pandemic are blurred for the same reason that the virus has eluded our control. Testing remains inadequate. Hospitals and supply chains are periodically overwhelmed. A jumble of contradictory state and local regulations has taken the place of a coordinated national response.

These are not problems of science alone. The numbers from this pandemic lay bare our biggest uncertainty: the problem of collective will." (*The New Yorker*, February 21, 2021) Check out the following link to the complete article at: https://www.newyorker.com/science/elements/the-awful-uncertainty-of-the-coronavirus-death-toll

I asked Katherine to briefly describe her current research. A part of her explanation begins here with more specifics to follow in a second part of her story: "Theodore Dobzhansky wrote that "Nothing in biology makes sense except in the light of evolution," and evolution is the lens I use to understand the living world. We usually think of evolution as something that takes place extremely slowly, over millions of years, but I study evolution in the microbial world, where it can happen in a matter of days or weeks."

More of Katherine's amazing journey in science follows in a later, Part Two, installment. I am awestruck by the relevance of her work to public health issues of today and also by the promise her research offers to better understand viral evolution and therapeutics.

I am honored to have had Katherine in my classroom. She is a testament to what I felt I saw each day in my students... I saw the future, and it looked bright! I have rested easier during the COVID-19 crisis knowing that so many former ORHS students have been on the forefront as medical providers and researchers, and I honor all their heroic efforts.

Thank you Benita! Katherine Xue is certainly bringing to light extraordinary details of the COVID-19 crisis which seems to linger longer than any of us imagined. We are looking at lasting change and she has documented some of the most important reasons for this prolonged and dreaded virus. Even more variations seems to be on the way. Stay safe and protect yourself!

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Katherine Xue when she was a senior at Oak Ridge High School



As an Oak Ridge High School Junior, Katherine Xue won a second place trophy in this Science Bowl