

Written by: Coop Jones
School: Crossroads Academy
Interviewee: Maike Morrison

From Teacher to Teacher

It all began in my ninth-grade geometry class. There my teacher taught me mathematics is more than memorization; it is a game full of puzzles and riddles.

Like so many students, Maike Morrison understands that the teacher makes all the difference. As an adolescent, Maike Morrison was unaware of the limitless opportunities in mathematical and scientific fields. In her freshman year of high school, however, her geometry teacher, Sharon Streger, opened her eyes to a world of possibility in these groundbreaking subjects. Since ninth grade, Maike Morrison has been striving to help and encourage others to understand and enjoy mathematics; as an adult, she has been using mathematics to understand complex variables, situations, and problems: microbiomes, genetic ancestry, and cancer mutations.

Presently, Maike Morrison is a postdoctoral researcher at the Sante Fe Institute. Last summer she graduated from Stanford with a PhD in Ecology and Evolutionary Biology. As an undergraduate, Morrison attended the University of Texas at Austin; she graduated with a BS degree in mathematics from the Dean's Scholars program in May of 2020. At the Sante Fe Institute, Maike Morrison continues to use her statistical analysis to understand stability, heterogeneity, and the structure of populations across different vectors, scales, and disciplines.

After a transformative geometry class freshman year, Maike was fully engaged in pursuing her new fascination with math. At the same time, Maike Morrison worked with Michelle Koehl, her adviser, studying the art of teaching by interviewing each math teacher at her school to understand how to best teach mathematics. She applied her studies by tutoring younger students. Undoubtedly, Maike's love of mathematics quickly merged with her love for helping others. By her senior year, Maike Morrison was a proud, confident mathematician and scientist, and she was a teaching assistant for an algebra class.

"While I did not realize it at the time, I was certainly a big fish in a small pond," Maike mentioned. "College was a lot different." The transition from a rural high school to the Dean's Scholars Program at the University of Texas proved to be daunting for Maike. During high school, Maike Morrison had grown accustomed to being at the top of her class; however, at the University of Texas, Maike vividly remembered feeling out of place. In fact, she was on the verge of changing her major to biology. Thankfully, due in part from the strong support of her close friends, especially Miriam Miyagi, an upperclassman, Dr. Morrison regained her confidence and fully engaged in her math and science studies. Not only did Maike regain her interest, but she also expanded on it; Maike Morrison began to do exceptional research with

Mark Kirkpatrick Lauren Ancel Meyers. Maike was so passionate about her research that by the end of her four years she decided to pursue a PhD.

Maike Morrison continued her studies at Stanford University where she began conducting original research as a mathematical population biologist. Over the next five years, Maike Morrison, advised and supported by Noah Rosenberg, extended the statistic F_{ST} and created FAVA. By using this statistic across data sets, Maike Morrison was able to uncover biological variation across vectors of compositional data. Understanding this variation, specifically diversity and compositional variability, is vitally essential to mapping ecology and

evolution. By applying the FAVA framework to different disciplines, from simple ancestry to cancer mutations, Maike Morrison has been able to investigate and discover original relationships in her data. Most interestingly, Maike Morrison traveled to the International Agency for Research on Cancer in Lyon, France to work with experts on understanding specific mutation signatures. Her most impactful and exciting work came from studying several mutations in esophageal squamous cell carcinoma tumors (ESCC). For simplicity, cancers are caused by various mutations. For ESCC, some geographic regions have “low diversity,” or few mutations, while other regions are caused by “high diversity,” or many mutations. To date, researchers had struggled to differentiate between high and low incidence countries’ mutation signatures with the standard research technique of graphing central tendency with dot plots. By taking the same data sets and using her own statistical techniques, she was the first to identify genetic differences between tumors from regions with low ESCC incidence and those from regions with high ESCC incidence. In a different type of example, Maike applied her same statistical method to an entirely different data set where she measured the ancestry variability of individuals in a population. These individuals were the Roman people, from the Neolithic age, through Imperial Rome and Late Antiquity, up to the present day. Her work identified a rise and fall of ancestry variability that amazingly matches the rise and fall of the Roman Empire. This work was the crux of her PhD at Stanford, and today she continues to expand and deepen her research at the Sante Fe Institute.

In a few years, after Maike Morrison finishes her postdoctoral work under the mentorship of Graham Coop, she hopes to become a professor. Because faculty positions are competitive, Dr. Morrison is uncertain where her career will begin. However, she is certain she wants to work at a research university. At a research university, Maike Morrison can both mentor and educate students while continuing to broaden her research. Her teachers and mentors have been so meaningful in her own life, she is committed to being that same positive force for others. In speaking with Maike, it is obvious that she loves math and science, and equally obvious that she loves human beings and the natural world. Wherever Dr. Maike Morrison’s career takes her, she will continue to love how math offers tools to see the world more clearly, share that passion with others, and do her best to make the world a better place.

About the Author:

I am Coop Jones, an eighth grader at Crossroads Academy. I was introduced to Maike through my cousin who became friends with Maike in graduate school. Along with English, my favorite subject is math. I play various sports including tennis, skiing, and running. Currently, I am participating in the Mathcounts team and taking geometry. During downtime, I enjoy playing guitar, as well as reading and discussing religion and philosophy.