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Yale junior swapped New Haven for Nashville this summer to study gene therapy treatment

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Yale junior Christopher "Kodi" Alvord spent the summer at Vanderbilt University Medical Center studying gene transfer processes. (Photo courtesy of Aspirnaut)

Yale junior Christopher "Kodi" Alvord spent the summer at Vanderbilt University Medical Center studying gene transfer processes through the Aspirnaut research program. The 10-week program seeks to give underrepresented students the opportunity to conduct intense hands-on research and make groundbreaking scientific discoveries.

"I look at these students as the forgotten students," said Dr. Billy Hudson, scientific director and co-founder of Aspirnaut. "Giving these students an opportunity is a critical component of our program. I feel strongly about it because when I was their age, I was one of these forgotten students. They represent an untapped talent pool. They have the opportunity to experience authentic research. During their internship, they are not only learning about scientific discovery, they are also learning how to work as a team, think critically, and live and work with others."

Alvord is a psychology major on the premedical track. He says be became interested in science as a child, and the Aspirnaut program helped him further refine his interests. He plans to pursue a M.D. degree to work with Native communities, either in psychiatry or surgery. He is also an active member of the Native American Cultural Center and Blue Feather Drum Group at Yale.

"I'm a quarter Navajo," Alvord explains. "Growing up, I didn't know what I wanted toado in life. Carrying that uncertainty into high school was scary, but I always enjoyedathe idea of entering medicine. My experience in

the Aspirnaut summer research program enabled me to have a research background in biology, and to learn how prescribed medicines and treatments are developed. While working in the Vanderbilt labs, I was able to grasp and appreciate the time and energy that goes into those developments. It was enlightening for me to see how science has its own pace, and I have gained a massive amount of respect for both the scientists and the scientific process."

Under the guidance of Dr. Matthew H. Wilson, Alvord analyzed the efficacy of a transposon-based gene delivery system called piggyBac. Transposons are mobile units of DNA, which can be removed from their original location and inserted elsewhere through the use of an enzyme called a transposase. The piggyBac transposon can be modified to carry a particular gene, which is then delivered on a circular DNA structure called a plasmid. While the piggyBac system efficiently transfers the gene from the carrier plasmid to the host genome, the remainder of the plasmid — the plasmid backbone — has been shown to also integrate into bacterial genomes *in vitro*.

Alvord's project was to examine the frequency of plasmid backbone integration into the host genome *in vivo*, using mice as model organisms. Backbone integration is an undesired phenomenon, and because it is not guided, it could have severe health consequences, including cancer, if applied to humans. Therefore, Alvord's research helped illuminate the viability of piggyBac usage as a gene therapy device.

"Specifically, my project was meant to understand how frequently the plasmid backbone of piggyBac integrates into target genomes: a phenomenon with potentially undesirable consequences due to the inability to guide the insertion of the backbone," says Alvord.

"Understanding the rate of backbone integration in a gene transfer system allows scientists to understand the magnitude of the obstacle, and future assessments on refined gene delivery systems will allow researchers to examine the viability of piggyBac as a clinical gene therapy device," he adds. "Should piggyBac be proven safe and efficient, it may one day be utilized as a mechanism for gene therapy to treat genetic diseases."

Alvord also appreciated the extra support provided by the program to him and other Native students, citing the importance of creating professional pipeline programs for Native students. "It has been a great honor and privilege to be a participant in the Aspirnaut program this summer. The tireless and selfless work of Drs. Billy and Julie Hudson in establishing a program that supports students from underrepresented backgrounds in STEM is truly admirable, and worthy of great reverence. I was deeply impressed by the thoughtfulness displayed with respect to the Native American students in the program," he says.

"As a Navajo student aspiring to work to reduce health disparities amongst minority populations, I found my conversations with Dr. Lauderdale, Mr. Carrol, and the Hudsons to be sincere, constructive, and motivating. I deeply appreciate the special attention paid to the Natives in this program, and I hope that future sessions will continue to explore Indian country for aspiring scientists and medical professionals."

Aspirnaut is a K20 STEM pipeline for diversity at Vanderbilt University. The program involves two main components: "beaming" of STEM labs to elementary and middle schools in rural America and summer internships for diverse high school and undergraduate students. Participants are supported by individual career development, mentorship by STEM professionals, college preparation, and a university partnership.

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