

# Aspironaut: a rural high school pipeline to increase diversity in STEM

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A critical need exists for innovations in education that increase the recruitment of high school students from diverse backgrounds into the biomedical research workforce. Aspironaut is one model that addresses this challenge.

Fostering diversity in the biomedical research workforce is a critical strategy to reduce health-care disparities<sup>1</sup>. However, students from groups that are underrepresented in the science, technology, engineering and mathematics (STEM) workforce face considerable barriers to entering a career in STEM<sup>2</sup>. Less than 15% of US students from underrepresented groups who start college as STEM majors complete this degree, and persistence among these groups to a doctoral degree is just over 8%<sup>3</sup>. As progress in increasing the proportion of underrepresented groups in biomedical research has been underwhelming<sup>4</sup>, a critical need exists for innovative approaches to increase the recruitment of students from diverse backgrounds into STEM disciplines.

## Background of the programme

Our initiative — the [Aspironaut K-20 STEM Pipeline for Diversity](#) — was launched at Vanderbilt University Medical Center (VUMC) in 2009 and focuses on approaches to improve access of rural high school students to STEM higher education (Supplementary Fig. 1). The programme initially targeted elementary, middle and high school students from rural Arkansas by providing technology and educational tools on school buses. This online classroom with a focus on STEM subjects gained national recognition<sup>5</sup> and evolved with the development of live, STEM activity-based videoconferences for students in rural elementary and middle schools and visits to VUMC laboratories. Following the receipt of a 2-year National Institute of Diabetes and Digestive and Kidney Diseases grant in 2009, it was a natural progression for the Aspironaut programme to offer high school summer research internships at VUMC.

Ten years on, Aspironaut identifies as a pipeline to promote the progression of education that is populated with talented, motivated students from rural USA who are not on the usual recruitment radars for STEM programmes<sup>6</sup>. These students are afforded an opportunity to develop their STEM talent and are known as Aspironauts — aspiring voyagers.

## Rationale and recruitment

Engaging high school students in research is one of the best strategies to recruit these individuals in STEM studies and promote their subsequent entry into the research workforce. Exposure to discovery science during high school leads to increased interest in STEM and provides mentors for career development<sup>7</sup>. The economic benefit of pursuing a STEM career is not to be underestimated. As STEM jobs pay well above the national average, acquiring a job in a STEM field helps to address income inequality and lack of socioeconomic mobility.

Although we acknowledge the dearth of quality research experiences for urban youth, an even greater ‘research desert’ exists in rural USA. Rural America is comprised of diverse underrepresented groups that include those from economically disadvantaged backgrounds, certain racial and ethnic minority groups and American Indians, and families with low educational attainment. Tracking of diversity indices shows that 84% of Aspironauts are from rural locations, 68% identify as being from families of low socioeconomic status, 46% are from racially or ethnically diverse backgrounds and 46% would be first-generation college graduates. In addition, 25% of Aspironauts have an Adverse Childhood Experience score of  $\geq 4$  out of 10, which is associated with lifelong increased risk of heart disease, cancer and mental illness according to the US Centers for Disease Control and Prevention.

## Programme description

Selection criteria for the Aspironaut programme include student interest in STEM studies, a pattern of challenging oneself maximally, and letters of recommendation. The Aspironauts work full time in the laboratory on a discovery science project for six weeks in the summer with the goal of learning enough to generate original data. Every discovery scientist knows that discovering something new is a life-changing experience. Multiple years of participation are encouraged.

The programme uses a holistic approach to address the comprehensive set of skills needed to succeed in competitive STEM careers. Guided development of

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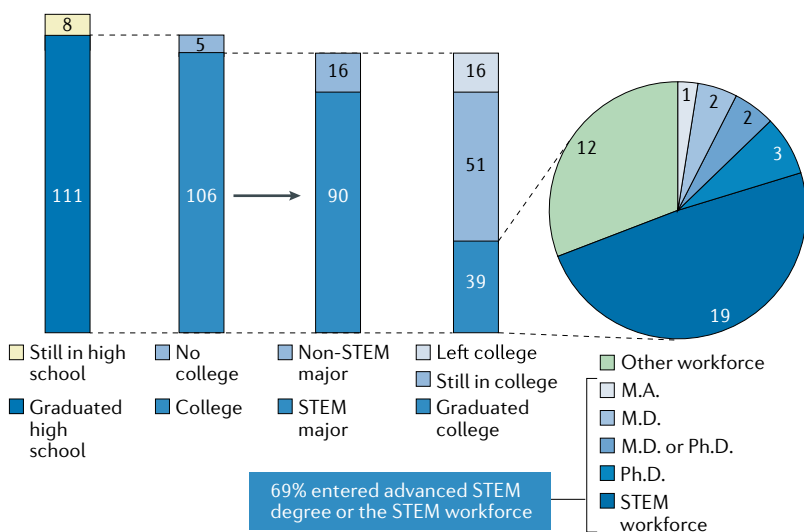
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professional skills includes weekly sessions on scientific communication, a distinguished speaker luncheon series, training on responsible conduct of research and long-term mentorship. Participants practice skills that will facilitate their engagement in a professional environment such as formulating and asking questions. Knowing how to approach a mentor for a letter of recommendation and staying in touch with mentors will serve participants well in any professional environment.

Guided self-discovery includes group sessions on psychological thriving skills led by a clinical psychologist, individualized career planning sessions, an unconscious bias session, post-internship mentoring, social activities, and college and financial aid planning. Wellness for Life training comprises a classroom session on topics such as mindfulness and resilience, and two fitness sessions per week. Self-management, accountability and engagement are highlighted through this training. Seminal to the experience is creating a sense of community among like-minded individuals and a white coat ceremony bestows tangible professional identity. Individuals join a scientific family who are pursuing similar goals, and the residential experience creates a supportive community. Another key factor is ascribing worth to each participant in the programme, which helps individuals to see their own value. With mentorship, participants achieve milestones they did not think possible and can recall these memories along their journey to reinforce their perception of self-worth.

### Outcomes

Ten years of data suggest that the programme is achieving its goal of increasing the diversity of the STEM workforce (FIG. 1). All 119 participants to date have graduated from high school. College attendance is high (95%) among participants. Persistence in college is the norm (85%) and persistence in STEM studies (88%) far



**Fig. 1 | Outcomes of the Aspirnaut programme.** To date, 119 students from 17 US states have participated in the programme, the majority of whom were from diverse backgrounds. All of these participants have graduated from or still attend high school. Many participants have also attended college, completed science, technology, engineering and mathematics (STEM) college degrees and pursued advanced STEM degrees.

exceeds available national rural norms. Most participants who graduate college achieve an advanced degree, enter the STEM workforce, or take 1–2 gap years to prepare for admission to an advanced degree programme (69%) (Supplementary Fig. 2). About one-quarter of high school participants continue in the programme as undergraduate interns. Aspirnauts have co-authored over 24 scientific publications of relevance to kidney disease and diabetes, including one publication spanning three summers and co-authored by over 80 Aspirnauts<sup>3</sup>.

### Call to action

Every US state has a rural population with highly talented students and Aspirnaut was built as a model to be replicated at other research universities. In 2018, the University of Michigan Life Sciences Institute became the first university to replicate this model. We challenge other universities to join us in acquiring the resources needed to sustain and replicate the Aspirnaut pipeline. Many talented individuals are waiting to be matched to an incomparable opportunity that will change their lives and the lives of generations to come, as well as increasing the diversity of the STEM workforce with all the associated benefits.

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### Competing interests

The authors declare no competing interests.

### Supplementary information

Supplementary information is available for this paper at <https://doi.org/10.1038/s41581-019-0190-z>.

### RELATED LINKS

Aspirnaut K-20 STEM Pipeline for Diversity: <https://www.aspirnaut.org/>