Research Statement

Indiana University School of Medicine June 2024 – May 2025

NIH Post-Baccalaureate Research Education Program (iPREP) Research Fellow

- As an NIH iPREP Fellow, I am leading a project that epitomizes my dedication to immunoinformatics and systems immunology: the identification of immunogenic CD8+ T cell epitopes in Coxsackievirus B3 (CVB3), a major cause of viral myocarditis. Driven by a desire to bridge computational and experimental immunology, I independently developed a bioinformatics pipeline utilizing tools such as PSSMHCpan, NetMHCpan, and the Immune Epitope Database (IEDB). This pipeline synthesizes multiple computational algorithms to predict peptide-MHC class I binding affinities, generating ranked lists of candidate epitopes for subsequent in vitro validation. Beyond refining my technical expertise, this project exemplifies the creative problem-solving central to immunoinformatics—melding theoretical frameworks with actionable insights to address real-world challenges in immune research.
- Presenting my findings at the 2024 Annual Biomedical Research Conference for Minoritized Scientists (ABRCMS) was a transformative experience, allowing me to share my work with a community of interdisciplinary scientists. This research has deepened my understanding of T cell-mediated immunity and its translational potential for vaccine development, while solidifying my commitment to immunoinformatics as a field where computation and biology converge to solve immunological puzzles.

Indiana University Indianapolis January 2024 – June 2024

Undergraduate Research Assistant

- In Dr. Randall Roper's lab, I conducted RNA sequencing (RNA-seq) analysis to investigate gene expression dysregulation in the femurs of Ts65Dn mouse models of Down syndrome. My work revealed dysregulation in key pathways, including JAK/STAT and PI3K/AKT, which govern bone metabolism and structural development. Employing tools for differential expression analysis, pathway enrichment, and protein-protein interaction mapping, I identified the molecular signatures underlying skeletal deficits in this model. This experience advanced my ability to analyze large datasets, integrate multi-omic data, and draw meaningful conclusions about complex biological systems. It also reinforced the power of systems biology approaches in understanding how genetic and signaling networks contribute to disease phenotypes—a perspective I am eager to explore further within systems immunology.

- This project not only enhanced my computational and experimental skills but also gave me a profound appreciation for how tools like RNA-seq and network analysis can unravel intricate biological processes. It laid a critical foundation for my passion for leveraging systems-level approaches to decode the immune system's complexities.

Indiana University Indianapolis June 2021 – August 2021

NSF Louis Stokes Alliance for Minority Participation Program (LSAMP) Scholar

- My earliest exposure to translational research began with the NSF LSAMP program, where I investigated the role of Dyrk1a in axonal growth within dorsal root ganglia (DRGs) of Ts65Dn mouse models of Down syndrome. DRGs, which are integral to peripheral innervation, provided a model to examine how neurodevelopmental abnormalities contribute to skeletal deficits. Through immunohistochemical staining, tissue culture, and quantification of axonal responses to nerve growth factor (NGF), I demonstrated that trisomic DRG neurons exhibited significantly impaired growth. These findings illuminated the intricate interplay between genetic anomalies, neural development, and skeletal structure, while fostering my technical proficiency in imaging and cellular assays.
- This experience planted the seeds for my interest in systems biology, as I began to see how localized molecular dysfunctions ripple across entire biological systems to drive complex phenotypes. It also strengthened my drive to address these challenges through innovative research approaches that integrate computational and experimental strategies.

My research experiences have instilled in me a deep appreciation for immunoinformatics and systems immunology as the tools to bridge the gaps between complex biological questions and actionable insights. From identifying viral epitopes in CVB3 to exploring gene regulation in Down syndrome, I have witnessed firsthand how computational approaches can illuminate patterns in seemingly disjointed data, offering clarity on intricate biological phenomena. However, pursuing this passion has often felt like navigating uncharted territory without a mentor or a robust academic environment that prioritizes immunoinformatics. This has only strengthened my resolve to immerse myself in a program where systems immunology thrives and where I can collaborate with like-minded peers and mentors. I am eager to contribute to and learn from a community that values the interdisciplinary spirit of systems biology and immunology. My goal is to not only deepen my expertise in computational immunology but also to create meaningful collaborations that advance our understanding of immune dysfunctions and translate those insights into therapeutic breakthroughs. These experiences have shaped my identity as both a computational scientist and a systems thinker, ready to tackle the immune system's most pressing challenges alongside a network of innovative researchers at Colorado Anschutz.

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