Allison Cruikshank

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Overview

I am a fifth-year PhD candidate in Mathematics at Duke University, where I develop mechanistic mathematical models to represent human physiological processes and address questions in medicine. I plan to pursue a career in the pharmaceutical/biotech industry after completing my PhD in May 2026, with a particular interest in applying modeling approaches to support drug development.

Education

Duke University Expected May 2026
PhD in Mathematics, Advisor: *Professor Michael C. Reed*
Thesis: *Mechanistic Mathematical Models of Sex Differences and Oxidative Stress in Health and Disease*

University of Nebraska-Lincoln May 2021
BS in Mathematics and Biochemistry with Highest Distinction
Thesis: *A Mathematical Model of Pancreatic Cancer Growth and Response to Treatment*

Publications

[2025] Mizuki Suzuki, Hwi Young Kim, Michael C Reed, Frederik Nijhout, **Allison Cruikshank**, et al. Elevated Homocysteine is Associated with Liver Fibrosis in MASLD in a Sex- and Menopause-Specific Manner. *Gastro Hep Advances*. https://doi.org/10.1016/j.gastha.2025.100800.

[2024] Sergio Mena, **Allison Cruikshank**, Janet Best, H. Frederick Nijhout, Michael C. Reed, Parastoo Hashemi. Modulation of Serotonin Transporter Expression by Escitalopram under Inflammation. *Communications Biology*. https://doi.org/10.1038/s42003-024-06240-3.

[2024] **Allison Cruikshank**, Michael C. Reed, H. Frederick Nijhout. Sex differences in glutathione metabolism and acetaminophen toxicity. *Metabolism and Target Organ Damage*. https://doi.org/10.20517/mtod.2023.44.

[2024] Anna Marie Buchanan, Sergio Mena, Iman Choukari, Aditya Vasa, Jesseca N. Crawford, Jim Fadel, Nick Maxwell, Lawrence Reagan, **Allison Cruikshank**, Janet Best, H. Frederick Nijhout, Michael Reed, Parastoo Hashemi. Serotonin as a Biomarker of Toxin-Induced Parkinsonian. *Molecular Medicine.* https://doi.org/10.1186/s10020-023-00773-9.

[2023] **Allison Cruikshank**, Janet Best, H. Frederick Nijhout, Michael C. Reed. Dynamical Questions in Volume Transmission. *Journal of Biological Dynamics*. https://doi.org/10.1080/17513758.2023.2269986.

[2023] Archer Harrold, **Allison Cruikshank**, Bryan Penas, Rebecca Roston. Introducing High School Biology Students to Biochemistry with a Short, Content-Oriented Intervention. *Biochemistry and Molecular Biology Education*. https://doi.org/10.1002/bmb.21782.

Preprints

[2025] Michael C. Reed, Ayako Suzuki, **Allison Cruikshank**, Mizuki Suzuki, H. Frederick Nijhout. Differential effects of synthetic estrogen on serum homocysteine levels before and after menopause. Under Review at PLOS One.

[2025] **Allison Cruikshank**, Michael C. Reed, H. Frederick Nijhout. A Mathematical Model of Oxidative Stress: Sex Differences and Cystathionine β-Synthase Deficiency. In Prep.

Professional and Research Experience

PhD Researcher, Duke University 2021 - Present

- Created mechanistic models of hepatic oxidative stress management to study sex differences and the differential effects of estradiol supplementation in pre- and post-menopausal women.
- Uncovered glutathione-mediated mechanisms of sex differences in acetaminophen toxicity.
- Investigated the interaction of serotonin and dopamine in Parkinson's Disease, revealing serotonin as a biomarker.

Mathematical Modeling Consultant, Zyphore Therapeutics 2025 - Present

- Designed and calibrated mechanistic models of metabolic processes to support drug discovery strategy.
- Delivered modeling insights in regular reports to align computational and experimental objectives.

FDA QSP Research Fellow 2024- Present

- Developed a QSP model of the Alternative Complement Pathway in Paroxysomal Nocturnal Hemoglobinuria (PNH) to predict and interpret how therapies modulate disease biology.
- Predicted biomarker responses in Phase 3 clinical trials of multiple complement pathway inhibitors, enabling mechanistic interpretation of clinical outcomes and supporting development decisions.

Simulations Plus QSP Modeling Intern Summer 2024

- Integrated the downstream effects of Nivolumab on the adaptive immune system and its impact on liver toxicity within BIOLOGXsym, a QST software designed for large molecule liver safety.
- Generated and analyzed virtual patient populations to evaluate how T cell variability influences different mechanisms of Nivolumab-related liver toxicity.
- Parameterized drug-induced liver toxicity mechanisms using LAMPs organ-on-a-chip experimental data to support translational safety modeling.

Johnson & Johnson Clinical Pharmacology and Pharmacometrics Intern Summer 2023

- Incorporated novel mechanisms of immunological synapse formation into a mechanistic model of T cell redirectors for lymphoma treatment.
- Implemented and tested co-stimulation hypotheses to evaluate potential combination strategies.

Awards

FDA ORISE Fellowship — November 2024 - Present

Best Collaborative Project at ISoP QSP SIG Student Symposium — Summer 2025

Top 5 Data Science Project in Erdős Data Science Bootcamp — Fall 2024
Project: Thrive or Survive: Predicting the Health of Trees following Forest Fires

AWM Poster Award at SIAM Annual Meeting (Honorable Mention) — Summer 2024 (Summer 2025)

SIAM Student Chapter Certificate of Recognition — 2024

NSF RTG Research Assistantship *Duke Applied Math RTG* ($42,000) — Spring 2023, 2024, 2025

Presentations

Sex Differences in Glutathione and Oxidative Stress

SIAM Annual Meeting - Contributed Poster and Invited Talk — Summer 2025

ISoP QSP Special Interest Group Student Symposium - Contributed Talk — Summer 2025

SIAM Dynamical Systems - Invited Talk — Summer 2025

ICERM Workshop on Uncertainty Quantification - Contributed Poster — Summer 2025

University of Pittsburgh AWM Student Seminar Series - Invited Talk — Spring 2025

Virginia Commonwealth University BioMath Seminar - Invited Talk — Spring 2025

Duke Mathematical Biology Seminar - Invited Talk — Spring 2025

Oregon State Math Bio Seminar - Invited Talk — Spring 2025

Joint Mathematics Meeting - Invited Talk — Spring 2025

AMS Fall Sectional Central Meeting - Invited Talk — Fall 2024

AWM Workshop at SIAM Annual Meeting - Contributed Poster — Summer 2024

SIAM Life Sciences Meeting - Invited Talk — Summer 2024

Triangle Area Graduate Mathematics Conference - Contributed Talk — Spring 2024

Triangle Area Computational and Applied Math Research Symposium - Contributed Poster — Fall 2023

Association for Women in Mathematics Research Symposium - Contributed Poster — Fall 2023

Co-modulation of Neurotransmitters in the Brain

Society of Mathematical Biology Annual Meeting - Contributed Talk — Summer 2023

Dynamical Systems in the Life Sciences - Invited Talk — Summer 2023

Internship Presentations

ISoP QSP Special Interest Group Student Symposium - Contributed Talk — Summer 2025
Nivolumab-mediated Liver Toxicity

Johnson & Johnson Internship Symposium - Contributed Poster — Summer 2023
Mechanisms of Co-stimulation for T Cell Redirectors

Outreach and Service

Society for Industrial and Applied Mathematics (SIAM), *Chapter Officer* — 2021 - Present

ASCPT Women in Science Identity Group, *Founding Member* — 2024 - Present

Triangle Contest in Mathematical Modeling (TriCoMM), *Co-organizer* — 2022 - Present

Triangle Area Graduate Mathematics Conference (TAGMaC), *Co-organizer* — 2021-2025

Association for Women in Mathematics (AWM), *Chapter Officer* — 2021-2025

Semester REU, *Graduate Student Support* — Spring 2024

Teaching

Laboratory Calculus II, *Instructor of Record, Duke University* — Fall 2024

Laboratory Calculus I, *Instructor of Record, Duke University* — Fall 2022

Laboratory Calculus I, *Teaching Assistant, Duke University* — Fall 2021

Professional Memberships

International Society of Pharmacometrics (ISoP)

American Society for Clinical Pharmacology & Therapeutics (ASCPT)

Society of Mathematical Biology (SMB)

Society of Industrial and Applied Mathematics (SIAM)

Relevant Skills

Programming Languages: Matlab, Python, R, SAS

Data Science: Regression, Classification, Ensemble Learning, Inference, neural networks