

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 study human physiology and address questions in medicine. My work provides insight into the dynamics of complex physiological processes and their implications for human health. I am particularly interested in applying mechanistic modeling to advance biomedical research and drug development.

Education

Duke University

Defense March 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.
- [2025] **Allison Cruikshank**, Yuching Yang, Hao Zhu. Quantitative Systems Pharmacology for PNH: Capturing Biomarker Changes Under Multiple Therapies. In Prep.
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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 on key metabolites.
- 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

- Refined an established QSP model of the Alternative Complement Pathway in Paroxysmal Nocturnal Hemoglobinuria (PNH) to capture therapy effects on disease biology.
- Validated model predictions against Phase 3 complement inhibitor trials, ensuring accurate prediction of biomarkers and supporting mechanistic interpretation of therapy effects.

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 re-directors 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

ACoP Trainee Communication Challenge - 5 Minute Flash Talk

Fall 2025

ACoP - Contributed Poster

Fall 2025

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 <i>Nivolumab-mediated Liver Toxicity</i>	Summer 2025
Johnson & Johnson Internship Symposium - Contributed Poster <i>Mechanisms of Co-stimulation for T Cell Redirectors</i>	Summer 2023

Outreach and Service

Society for Industrial and Applied Mathematics (SIAM), <i>Chapter Officer</i>	2021 - Present
ASCPT Women in Science Identity Group, <i>Founding Member</i>	2024 - Present
Triangle Contest in Mathematical Modeling (TriCoMM), <i>Co-organizer</i>	2022 - Present
Triangle Area Graduate Mathematics Conference (TAGMaC), <i>Co-organizer</i>	2021-2025
Association for Women in Mathematics (AWM), <i>Chapter Officer</i>	2021-2025
Semester REU, <i>Graduate Student Support</i>	Spring 2024

Teaching

Laboratory Calculus II, <i>Instructor of Record, Duke University</i>	Fall 2024
Laboratory Calculus I, <i>Instructor of Record, Duke University</i>	Fall 2022
Laboratory Calculus I, <i>Teaching Assistant, Duke University</i>	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